FARM HORTICULTURE

PREPARED ESPECIALLY FOR

THOSE INTERESTED IN EITHER HOME OR COMMERCIAL HORTICULTURE

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PREFACE.

It has been the aim of the author in preparing this work to bring together a few facts dealing with some of the general principles underlying horticulture. The book has been written primarily as an elementary text, so arranged and developed as to meet the needs of the undergraduate collegiate student, as well as those who are studying agriculture in the secondary agricultural schools.

The object of the book is to give a brief discussion and to supply information on some of the important subjects in horticulture. It is hoped it will be a guide to every farmer and every city man who practises any horticulture about the home.

It is thought that teachers of agriculture and elementary horticulture will find it suitable as a text to cover the general field, and to give some information about those practices which many people desire and which cannot be found in any single text.

Since the work treats the subject from the standpoint of production of horticultural products as well as improvements for the home, it should prove of value to anyone interested in this subject.

The author is indebted to the following, and takes this form in expressing his appreciation to Professors Melville T. Cook, New Jersey Agricultural Experiment Station; A. L. Quaintance, U. S. Department of Agriculture; Donald

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FARM HORTICULTURE.

CHAPTER I.

PLANNING THE HOME GARDEN.

THERE are two distinct kinds of horticulture, amateur and commercial. In amateur horticulture the primary object is to supply the home table with vegetables and fruits and to furnish ornamental flowers for the decoration and the beautification of the home and the grounds surrounding the home. An ample supply in all divisions is essential. The object, however, in commercial horticulture is much different. For this field the grower selects one phase of horticulture, and specializes in it, growing the specialty on a large scale to supply the community in which he lives. In the commercial field the assortment might be either large or small and consist of only one vegetable, fruit, or ornamental.

Horticulture for the home is exceedingly important, and by its adoption one makes a good start for a successful and happy life.

Laying Out the Garden.—In order to succeed well with any undertaking, one must first have a definite and a well-formulated plan to follow. A plan is essential in the home garden as well as in any other line of work, and a well-designed plan that will be readily understood is indispensable. To draw a garden plan the grower should first secure a piece of paper, which must of necessity vary in size and in shape, according to the size of the garden, and the unit of measure which is adopted. The plan should be drawn to a definite scale.

This scale is called the unit of measure. The unit of measure furnishes the proper proportions, and represents the exact number of feet of ground the garden is to occupy and the distance between the rows of plants. For example, the drawing of the garden plan on the paper must necessarily be smaller than the garden, and therefore we must have what is known as the reducing unit, or scale. If the scale in which one-fourth of an inch equals one foot is used, then one-fourth of an inch on the paper will represent one foot on the ground. If the garden is twenty by thirty feet, then to reduce it to the scale in which one-fourth of an inch equals one foot, the size of the paper would have to be six by eight inches. If the garden is one hundred by one hundred and fifty feet, the paper must be twenty-five by thirty-eight inches. The sizes indicated are the exact sizes the paper must be to draw the garden, but in all plans, a larger size should always be secured to allow for an inch or two of margin. If the garden space is large, one-eighth-inch scale can be used, which means that for every one-eighth of an inch on the paper there must be one foot on the ground. By making use of the unit of measure, the rows of vegetables and fruits can be located in their proper places. In using the reducing scale the grower must always remember that for each linear foot in the garden, he must use one unit of measure, say one-fourth inch or one-eighth inch on the paper.

Location of the Garden.—In selecting the site for the garden, several important points should be considered: (1) The garden should be located conveniently close to the kitchen, and since it is considered as a part of the kitchen equipment, it should necessarily be in close proximity to the objective point. (2) The soil, when possible, should be a sandy loam, but where this is out of the question and it is a heavy clay, it should be improved by adding well-rotted manure, sand, sifted cinders, etc. (3) A gentle slope to the south or southeast should be selected where this is possible. A sunny slope dries off and warms up earlier in the spring and makes planting possible earlier than if the ground sloped to the north. It is also more pleasant to work on a southern exposure. A slope also gives the garden good air drainage, because cold air is heavier than warm air and it settles to the lower levels, therefore less danger is experienced from frost. Avoid too steep a slope, one with a fall of about four or five feet to the hundred is good. A gentle slope provides good soil drainage, which is important, because neither fruit nor vegetables can thrive with wet feet. Horticultural crops which are grown slowly on poorly drained land often become very irregular and gnarled in shape and poor in quality. Fruit trees are more liable to split under the strain of wind and other agencies on a poor soil than on a well-drained piece of land, and many gardens are a disappointment to the owner, chiefly because they are not well-drained. (4) A good supply of water should be available for irrigation when it is needed. An immense quantity of water is required at certain seasons of the year and the value of irrigation should not be overlooked. (5) Exposed locations should be protected by windbreaks. Every experienced fruit and vegetable grower is familiar with the advantages of a windbreak. They are especially valuable in the protection of the cucurbits, such as the cucumber, the squash, etc., and the small fruits, such as raspberries, strawberries and blackberries. Windbreaks are of two kinds, natural and artificial. A common practice is to construct an artificial windbreak such as a fence, which serves the purpose fairly well, although natural windbreaks, such as hedges of conifers are more attractive and more economical when once they are established.

Size of the Garden.—The space a garden occupies is largely determined by the number of individuals in the family. The garden should be the minimum size that will produce a sufficient supply of vegetables and fruits for home consumption. The dimensions of the garden will also depend upon the individual preference for the different kinds of vegetables and fruits, the season of the year, the fertility of the soil, the amount of land available, as well as the intensiveness of the methods which are followed. The size will necessarily vary with each family, and it should be determined in each case by trial. Always plan to use the most intensive methods of cultivation because this practice will make the garden occupy the smallest possible space, as well as to reduce the factor of labor.

Arrangement of the Plants.—In determining the position of the vegetables and the fruits in the garden it is advisable to have the small fruits such as grapes, raspberries, blackberries, dewberries, currants, gooseberries, and strawberries, placed along one side of the garden, usually in the order named, with the grapes forming one border. The perennial vegetables such as the rhubarb and the asparagus can usually find a place between the gooseberries and the strawberries, because the land they occupy is not plowed up each season. It is an advantage to place the rows the same distance apart when it is possible. The small, short-season crops, such as lettuce, radishes, and onions, should be grouped together, thus enabling the gardener to soon clear that land, so that a second crop can be planted. The long-season crops such as the tomatoes, cucurbits, corn, etc., which occupy the ground for a longer time, should be grouped in one place, thus avoiding the mixing up of the early and the late crops. Suggestive plans offered on the following pages will aid in simplifying the arrangement and the location of the vegetables and the fruits.

In recommending the amount of seed to plant in the garden as well as the distance apart the plants should stand, only suggestive amounts of seeds and arbitrary distances can be given, since local factors, and different conditions, alter cases. It is assumed that a large share of the cultivation which is given to the farm garden will be done with horse implements. This of course necessitates a less intensive plan. In the suburban garden the cultivation will be performed with hand implements, such as the hand cultivators, etc., and the plants can be grown closer together and a more intensive system of planting followed. The city garden should be the most intensive of the three gardens. In the city garden practically all of the work is done by hand, with such tools as the hand hoe, rake, trowel, etc. The plants are all given more individual attention. Such plants as the tomatoes are pruned and staked, thus allowing a greater number of plants to a given space.

TABLE I.—DISTANCE TO PLANT VEGETABLES.

	Farm garden.		Suburban garden.		City garden.	
	Distance between rows, inches.	Distance between plants in row, inches.	Distance between rows, inches.	Distance between plants in row, inches.	Distance between rows, inches.	Distance between plants in row, inches.
Beans (string) .	24	4–6	18	4–6	15	4–6
Beans (Lima) .	30	6–8	24	6–8		
Beets	24	3	18	3	15	3
Cabbage (early) .	24	16	24	16	24	16
Cabbage (medium)	24	24	24	24		
Cabbage (late) .	30	24	30	24	24	24
Carrots . . .	24	3	24	3	15	3
Cauliflower . .	30	24	30	24		
Celery	48	6	48	6		
Chard	24	6	18	6	15	6
Sweet corn (early)	30	24	30	24		
Sweet corn (medium) . . .	30	30				
Sweet corn (late) .	36	30	30	30		
Cucumber . .	60	12	60	12		
Egg plant . . .	30	24	24	24		
Lettuce . . .	24	12	18	10	8	6
Melon (musk) .	60	15	60	15		
Melon (water) .	60	24				
Onion seed . .	18	5	18	5	12	4
Onion sets . .	18	3	18	3	12	3
Parsley . . .	24	6	24	6	18	6
Peas	30	6	30	6		
Peppers . . .	30	24	30	24	24	24
Potatoes . . .	30	12	30	12		
Radishes . . .	18	5	18	3	12	3
Squash . . .	60	24	60	24		
Tomatoes . . .	48	48	36	24	24	24

TABLE II.—DISTANCE TO SET PERENNIAL PLANTS AND SMALL FRUITS.

	Farm garden.		Suburban garden.		City garden.	
	Distance between rows, inches.	Distance between plants in row, inches.	Distance between rows, inches.	Distance between plants in row, inches.	Distance between rows, inches.	Distance between plants in row, inches.
Asparagus . .	36	12	36	12	36	12
Blackberries . .	72	48				
Currants . . .	60	48	48	48	48	36
Gooseberries . .	60	48	48	48	48	36
Grapes . . .	120	96	96	96		
Horseradish . .	24	12	24	12		
Raspberries . .	72	36	60	36		
Rhubarb . . .	36	24	24	24	24	24
Strawberries . .	36	12	36	12	24	12

TABLE III.—THE AMOUNT OF SEEDS TO PLANT IN THE GARDEN.

	Farm garden.	Suburban garden.	City garden.
Beans (string)	1 quart	1 pint	½ pint
Beans (Lima)	1 pint	½ pint	None
Beets	2 ounces	1 ounce	1 ounce
Cabbage (early)	1 packet	1 packet	12 plants
Cabbage (medium)	1 packet	1 packet	None
Cabbage (late)	1 packet	1 packet	12 plants
Carrots	1 ounce	1 packet	1 packet
Cauliflower	1 packet	1 packet	None
Celery	1 ounce	1 packet	None
Chard	1 packet	1 packet	1 packet
Sweet corn (early)	1 pint	½ pint	None
Sweet corn (medium)	1 pint	None	None
Sweet corn (late)	1 pint	½ pint	None
Cucumber	1 ounce	1 ounce	1 packet
Egg plant	1 packet	12 plants	12 plants
Lettuce	1 ounce	1 packet	1 packet
Mustard	1 packet	1 packet	1 packet
Muskmelon	1 ounce	1 packet	None
Watermelon	1 ounce	None	None
Onion seed	2 ounces	1 ounce	1 packet
Onion sets	2 quarts	1 quart	1 pint
Parsley	1 packet	1 packet	12 plants
Peas (early)	1 quart	1 pint	None
Peas (medium)	1 quart	1 pint	None
Peas (late)	1 quart	1 pint	None
Peppers	1 packet	24 plants	6 plants
Potatoes	1 bushel	½ bushel	None
Radish	3 ounces	1 ounce	1 ounce
Rhubarb	36 plants	24 plants	6 plants
Spinach	1 ounce	1 ounce	1 packet
Squash (summer)	1 ounce	1 packet	None
Squash (winter)	1 ounce	1 packet	None
Sweet potatoes	250 plants	None	None
Tomatoes	200 plants	50 plants	12 plants

TABLE IV.—THE NUMBER OF PERENNIAL PLANTS AND SMALL FRUITS TO SET.

	Farm garden.	Suburban garden.	City garden.
Asparagus	100 plants	50 plants	25 plants
Blackberries	50 "	25 "	
Currants	25 "	15 "	6 "
Grapes	15 "	5 "	
Gooseberries	20 "	10 "	6 "
Horseradish	12 "	12 "	
Raspberries	50 "	25 "	
Rhubarb	25 "	12 "	6 "
Strawberries	400 "	200 "	100 "

REVIEW QUESTIONS.

1. Name three kinds of home vegetable gardens.
2. What is the basis for this division?
3. Why is it necessary to first draw a plan of your garden?
4. What is meant by the unit of measure?
5. What is meant by a scale?
6. What determines the scale which should be selected?
7. Describe the method of laying out a garden on paper.
8. Discuss the location of a garden.
9. What important points must be considered in the selection of the garden site?
10. Why is a gentle southern slope preferable?
11. What is the proper degree of the slope? Why?
12. What is the value of a windbreak? How many kinds do we have?
13. What determines the size of a garden?
14. Draw a plan of a home garden for the city lot, the suburban lot and the farm.

NUMBER OF ROW	DISTANCE BETWEEN ROWS	PLAN OF GARDEN 25′ by 30′ Scale 1″ = 10′	
1	1½′	RADISHES	
2	1½′	LETTUCE FOLLOWED BY LATE CABBAGE	
3	1½	ONIONS	
4	1½′	SPRING TURNIPS FOLLOWED BY LATE CAULIFLOWER	
5	1½′	BEETS	
6	1½′	GREEN BEANS FOLLOWED BY LATE CABBAGE	
7	1½′	WAX BEANS	
8	2′	CABBAGE FOLLOWED BY ENDIVE	
9	2′	EARLY PEAS FOLLOWED BY LATE BUSH BEANS	
10	2′	EARLY PEAS FOLLOWED BY LATE BUSH BEANS	
11	2′	BUSH LIMA BEANS	
12	2′	BUSH LIMA BEANS	
13	2′	TOMATOES	
14	2′	SWEET PEPPERS	EGG PLANT

30′ 25′

FIG. 1.—A city vegetable garden, 25 by 30 feet.

Fig. 1 gives a suggestive plan for the arrangement of a home garden 25 by 30 feet. This garden is designed for the back end of a city lot, in which only one-half of the yard is available for the growing of fresh vegetables. It is primarily for a small family. This arrangement will permit the use of a hand cultivator, which can be operated to good advantage. In case the grower does not own an implement of this type, the ordinary hand hoe will answer the purpose.

This plan only includes a few vegetables, but they will meet with approval on anyone's table, and at the same time will give a sufficient variety so as not to become monotonous. The rows should run the long way of the garden, and where it is possible the garden should be arranged so that the rows will run north and south, although if this is impossible, no serious drawbacks will be experienced, if the rows run in the opposite directions.

In certain sections of the country, where the rainfall will permit, or where water for irrigation or sprinkling can be supplied, lettuce and green beans can be followed by late cabbage, the early peas can be followed by late bush beans, turnips by cauliflower, and cabbage by endive. This arrangement makes a more intensive form of horticulture and keeps the ground occupied all of the growing season.

Heavy applications of stable manure should be applied every fall, if the highest yields are to be expected.

Fig. 2 gives a tentative arrangement for a city vegetable garden 25 by 40 feet. This garden is designed to be somewhat more permanent in nature, and to occupy the 25 feet on the lower end of a city lot that is 40 feet in width. The first two rows include asparagus, the third, two plants of the gooseberry and two plants of the currant, and the fourth rhubarb which can be protected in the winter and forced in the spring by banking with manure or with straw. The garden should be arranged so that the rows will run north and south when possible, but this will be determined largely by the way in which the lot faces.

In regions where the rainfall is sufficient, or where irrigation is possible, lettuce, onions, and radishes can be followed by bush beans; early beans and beets can be followed by late radishes and lettuce; and early peas by late endive. Where the tomatoes are staked the plants can be set two feet apart each way, where they are not staked or pruned they must be planted four feet apart each way.

PLAN OF GARDEN

25′ by 40′

Scale 1″=10′

NUMBER OF ROW	DISTANCE BETWEEN ROWS	
1	1′	LEAF LETTUCE FOLLOWED BY BEANS
2	1′	HEAD LETTUCE
3	1′	ONION SETS FOLLOWED BY BEANS
4	1′	ONION SEED
5	1′	ONION SEED
6	1′	RADISHES FOLLOWED BY BEANS
7	1½′	EARLY BEETS FOLLOWED BY RADISHES
8	1½′	CARROTS
9	1½′	PARSNIPS
10	1½′	WAX BEANS FOLLOWED BY FALL RADISHES
11	1½′	GREEN BEANS FOLLOWED BY LEAF LETTUCE
12	1½′	EARLY PEAS FOLLOWED BY ENDIVE
13	1½′	EARLY PEAS FOLLOWED BY ENDIVE
14	2′	EARLY TOMATOES
15	2′	LATE TOMATOES
16	2′	LATE TOMATOES
17	2′	LATE CABBAGE
18	2′	LATE CABBAGE
19	2′	LATE CABBAGE
20	3′	RHUBARB
21	3′	CURRANTS GOOSEBERRIES
22	3′	ASPARAGUS
23	3′	ASPARAGUS

40′

25′

Fig. 2.—A city vegetable garden, 25 by 40 feet.

Fig. 3 illustrates a city vegetable garden 30 by 60 feet. This garden is planned for the back end of a city lot or for one side of a lot that can be devoted to the growing of economic plants. This plan is rather intensive and the selection of the vegetables differs from that of Fig. 2. Owing to

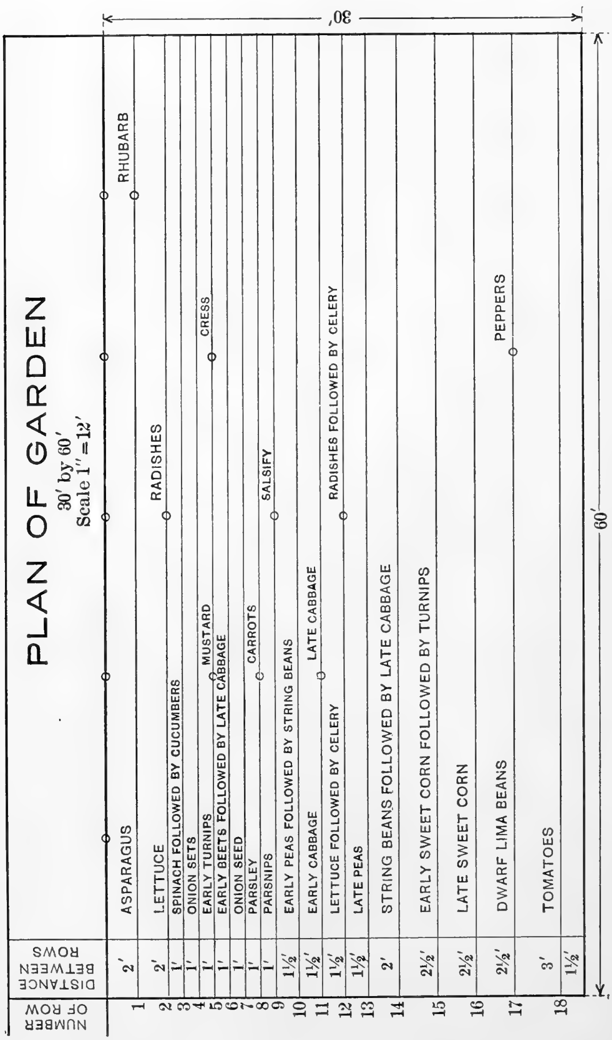


Fig. 3.—A city vegetable garden, 30 by 60 feet.

the spacing of the rows, all of the cultivation must be done by hand tools, such as hand cultivators, hoes, rakes, etc. This plan provides a greater variety of vegetables, but less in quantity and it would serve only a small family.

The asparagus and rhubarb which border one side can either be placed along the boundary of the lot or the border of the walk. If the latter location is chosen it will serve to screen the remainder of the garden from public view. Where one row gives too large a quantity of one vegetable, the row can be divided and two vegetables of a similar growing season can be planted. The spinach can be followed by cucumbers, which will occupy the ground vacated by the lettuce, onions, turnips, etc. The early beets can be followed by late cabbage, the early lettuce, and radishes by late celery, the beans by late cabbage, and the early sweet corn by turnips. The tomatoes should be staked and pruned, for the best results, where such an intensive plan is followed.

Heavy application of stable manure and liberal watering will be found to pay well.

Fig. 4 illustrates a home garden 45 by 50 feet. The selection of the different crops in this plan is designed to be somewhat more permanent. The first three rows are devoted to herbaceous perennials and woody plants that will occupy the ground for more than one year. In selecting this plan it will be wise to so place the garden that the asparagus, gooseberries and currants will occupy a position nearest the border, so that they will not be disturbed for several years. This plan provides for one portion of the garden to be somewhat intensive and the other portion to be somewhat extensive. It also includes many cucurbits, so arranged as to almost completely cover the ground during the latter part of the growing season. It is advisable to use the hand hoe and rake for cultivating this garden. The winter squash, melons, pumpkins and the summer squash can either be planted in hills 5 feet apart or in rows with the individual plants standing about one foot apart in the rows. The tomatoes can be either staked or allowed to grow without staking. Liberal application of stable manure and plenty of water is advisable.

Fig. 5 illustrates a suburban home garden 50 by 75 feet.

This plan is designed to be cultivated by both horse and hand implements. However, a certain amount of hoeing will be found to be valuable. This plan introduces the cold frame in addition to the hotbed. It is advisable to construct a four-sash hotbed and a four-sash cold frame. However,

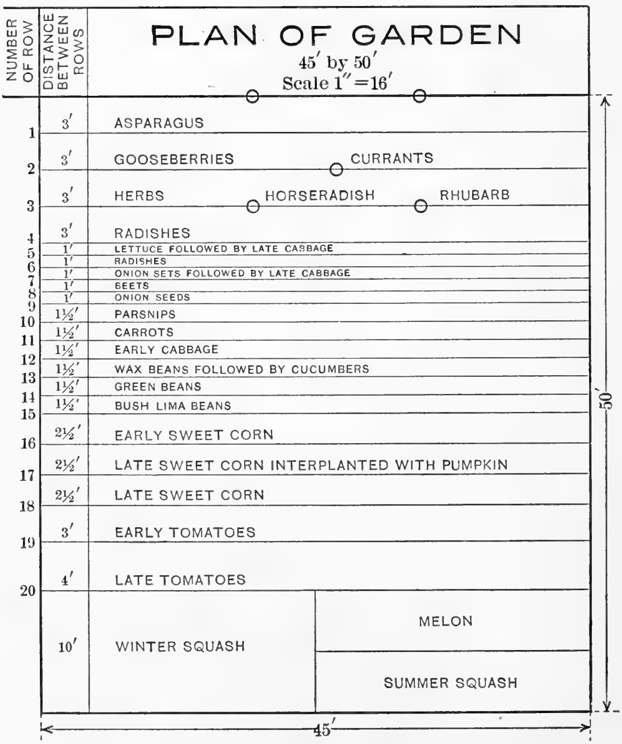


FIG. 4.—A city vegetable garden, 45 by 50 feet.

the hotbed space can be made either larger or smaller according to the conditions. In such an event the space devoted to the asparagus can either be reduced or extended. In case the cold frames are not desired the space can be devoted to an outdoor seed bed, which is of great value.

The celery must be bleached with either boards, tile or paper placed around the plants, because the space is hardly sufficient to bank the plants with earth. The late endive

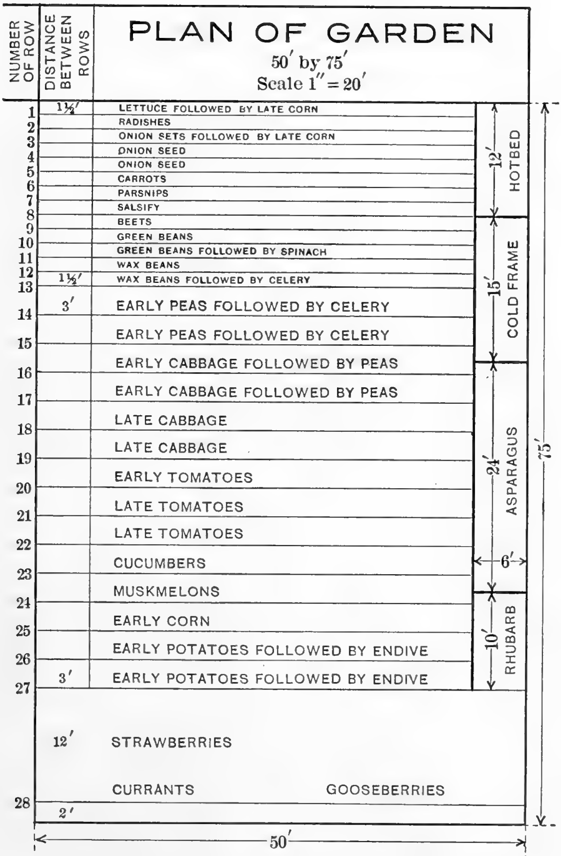


FIG. 5.—A suburban home garden, 50 by 75 feet.

can follow the potatoes where the growing season is sufficiently long to permit it to mature.

The border row should include the currants and gooseberries. The strawberries should be planted in rows 2 feet apart and the plants 12 inches in the rows. The asparagus

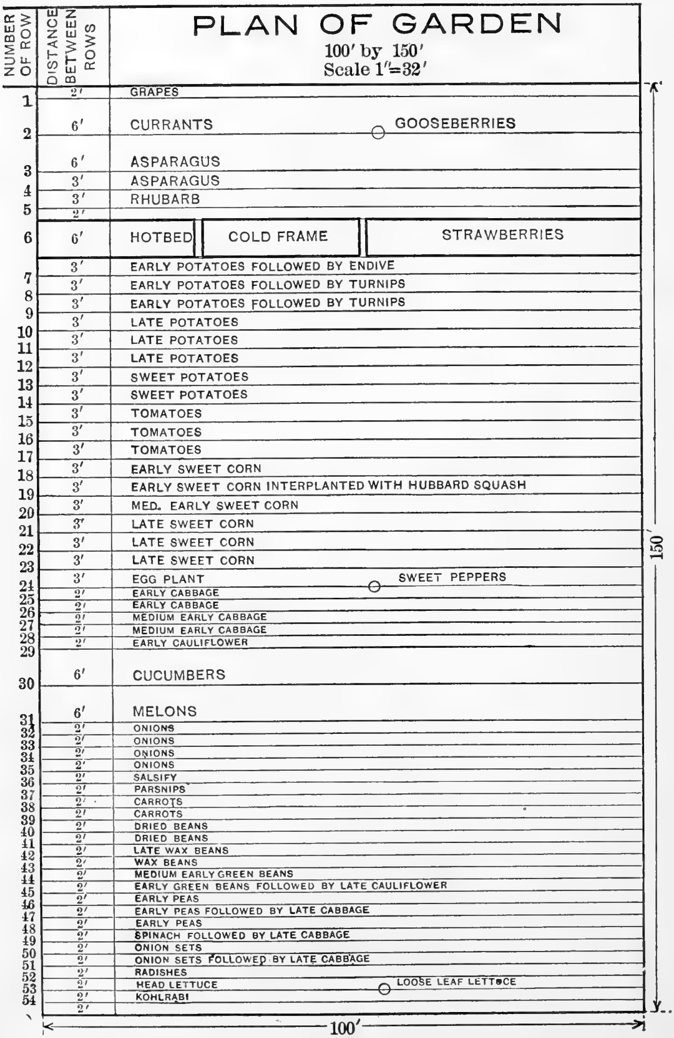


Fig. 6.—A farm garden 100 by 150 feet.

and rhubarb plants should be set 2 feet apart in the rows and the rows 3 feet apart.

Heavy applications of stable manure should be given to the soil every year.

Fig. 6 illustrates a farm garden 100 by 150 feet. This plan provides for the perennial vegetables and small fruits, in addition to the annual vegetables. This garden requires the use of both the horse and the hand cultivators. The space allottment to the hotbed and the cold frame can be either reduced or extended to suit the needs of the individual. The early potatoes can be followed by endive and turnips and one row of the early sweet corn interplanted with hubbard squash. The short season vegetables can be followed with appropriate crops.

Heavy applications of barnyard manure will be found to be of great value and where it is possible fall plowing is advisable.

CHAPTER II.

THE SEED AND ITS NEEDS.

The Seed.—The seed is composed of three distinct parts: (1) the embryo or vital center; (2) the protective coat; and (3) the food materials. The seed is not a lifeless, inert structure, as is thought by many, but, contrary to this belief, it is definitely known that chemical changes are constantly going on within the seed coat. The changes that are known to take place are (1) water and carbonic acid gas are given off, (2) a variation in the color of the seed, and (3) the food materials are undergoing a gradual alteration.

Germination.—Germination is the process by which an embryo develops into a complete plant. It might also be defined as the sprouting of a seed. Germination is said to be finished when the seedling begins an independent existence. There are two distinct stages in the process of germination: (1) that marked by the appearance of the rootlets; and (2) the subsequent development of the embryo into a self-sustaining plant. Since the nourishment for the young plant comes wholly from the seed during both stages, the second stage in the process is quite as important as the first.

In addition to the internal changes which go on there are three distinct external conditions requisite to germination: (1) the proper amount of water, (2) free oxygen or air, and (3) an increase in the temperature.

Water Necessary for Germination.—The amount of water required to start the germination of a seed is that quantity which will give complete saturation. This varies with the seed. The amount of water absorbed also varies greatly in the different climates, but it seems to depend upon two conditions: (1) the character of the stored food and (2) the amount of water already present in the seed. Some seed, like the leguminous seed, absorb a great amount of water, and not infrequently this amount is equal to the weight of the seed itself, and in some of the clovers it amounts to more than the weight of the seed.

A second requisite for good germination of a seed is the proper amount of water in the soil. The soil should be wet but not sticky. The seeds must be in intimate contact with the soil at many points and the soil should be fine and compactly firmed about the seed so the water in the soil can be used. In addition to the proper amount of water in the soil a warm temperature favors the absorption of water, and hastens the germination.

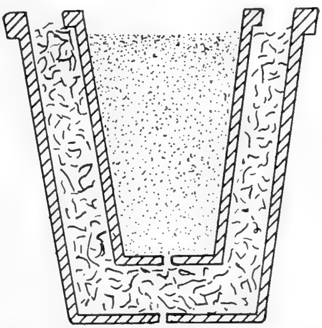


FIG. 7.—Longitudinal section of a double seed pot used to regulate the amount of water for very small seeds.

Regulation of Water.—The calling of a dormant embryo of a seed into life must take place gradually. The chief difficulty lies in the fact that seed require widely varying amounts of water, depending upon the species, the soil, the season of the year, the age, the size, and the state of development. The structure of a seed itself often reveals its requirements as to water. Seed with hard and thick coats require more water than do those with thin soft coverings. Large and heavy seed are less liable to injury by too much water than the small weak ones. Fresh and vigorous seed will endure more moisture than old ones, and to know the requirements of any species, it is usually necessary to know something of the conditions under which the plant producing them grew to maturity.

Except in the case of soaking, water should not be applied directly to seed, but through some medium in which the water can be carefully regulated. The usual media are soils, plant fiber, earthenware, and occasionally bricks or tile.

Seed should not be kept permanently wet, because in such an event oxygen cannot enter the soil which in turn causes the seed tissue to break down with the formation of alcohol, and later oils and acids and the seeds are ruined by rotting. It is a safe rule to allow the seed bed to become quite dry before watering. When watering, the whole mass of earth should be completely saturated. It is rarely ever advisable to give a light sprinkling to the surface. The practice of repeatedly wetting the upper surface of the soil is most detrimental. It causes a crust to form and brings the tender roots to the surface, which are later injured by drying out. A watering pot with a fine spray is the best means of applying the water, because the hose usually packs the soil, washes out the seed and makes it difficult to regulate the quantity.

Oxygen Necessary for Germination.—Oxygen is quite as important to the seed as is water. In the absence of oxygen the food materials in the seed do not pass into solution, and do not become available for the young plant. Without oxygen there can be no organic life, and this is as true of plants at this stage as at any other. It has been found that the movement of the protoplasm ceases at once in sprouting seeds if a supply of oxygen is not present, even when the conditions of moisture and temperature are favorable. In the presence of moisture and the absence of oxygen, alcoholic and other fermentations quickly take place.

In the sowing of seed, the aëration of the soil must be taken into account, so there can be an interchange of gases, especially of oxygen and carbonic acid gas.

The main considerations in securing a supply of oxygen for seed are: (1) Do not drive out all of the oxygen in the crevices of the soil by heavy watering. (2) Do not cover the seed so deep that it will prevent the easy access of the air.

The depth to which the seed should be planted depends partly upon the porosity of the soil and partly upon the size of the seed. (3) Prevent the caking of the soil, which is usually caused either by repeated waterings or by allowing the soil to dry out too quickly.

Temperature Necessary for Germination.—There is a wide range of temperature at which the many kinds of seed will germinate. The proper temperature depends primarily upon the constitutional peculiarities of the seed. Some seed will germinate close to the freezing-point and often they may be repeatedly frozen and thawed without this process causing harmful results. Rye gives a fitting example. The seed of this plant can be germinated on cakes of ice, and seemingly experiences no great difficulty in growing. However, this is an exceptional example and many other seed, which include by far the greater number of species, fail to germinate unless the proper temperature is maintained.

There are *three degrees of temperature* recognized for the germination of seed: (1) minimum; (2) optimum; and (3) maximum. The minimum temperature is the lowest temperature at which a seed will germinate. The maximum is the highest temperature at which a seed will germinate, and the optimum, is the medium temperature between the minimum and the maximum. The optimum is the best temperature at which to place a seed for proper germination. The optimum temperature is not a stationary temperature but it fluctuates up and down, due to the species, the difference in vigor, the ripeness and the general conditions of the seed in question.

There is no way of very accurately controlling the temperature out of doors. The depth of planting is the only practical means of regulating the temperature to any degree and this only slightly. This also influences the degree of moisture in the open ground, as well as the temperature. However, there is a direct influence upon the essential growth of the plant determined by either deep or shallow planting. A seed can be planted much deeper in a light soil than in heavy clay soil. It can also be planted deeper late in the season than early in the season. The seed must not be planted on account of the temperature deeper than is necessary to secure the proper amount of moisture.

Processes of Germination.—The processes of germination are divided into five distinct stages: (1) the seed mechanically absorbs water which causes it to swell; (2) the absorption of oxygen; (3) by the absorption of the water and the oxygen the food materials are brought into solution. Some of the food materials as sugars are soluble in the water, while others, such as the oils and the starch must undergo a chemical change before becoming soluble. The oils are thought to pass through several changes, finally being transformed into starch. All of the starches are then acted upon by certain ferments which convert them into soluble carbohydrates. (4) The soluble food passes to the growing parts of the plant; (5) the food is then employed in the unfolding and the building up of the embryo. After the first two steps the processes go on simultaneously.

The Internal Conditions Effecting Germination.—In considering germination, the internal conditions governing the germination of seed must be emphasized. These are quite as important as the external factors and are four in number: (1) maturity, (2) soundness, (3) viability and (4) germinative energy.

The Maturity of a Seed.—The power of germination in a seed is not one of the distinguishing characteristics of the maturity of a seed because many seeds will germinate long before their color, weight, size or shape indicates maturity. Innumerable experiments as well as many examples seen in the common practice of gardening, have proved that the viability of a seed is not coincident with the maturity but precedes it. Maturity may be summed up by saying that when plants are grown from seed that are immature the following detrimental effects are seen in the plant: (1) there is a loss of vigor shown by the smaller percentage of germination; (2) the weakness of the seedlings; (3) a greater number of plants die before maturity; (4) the full vigor of the plant is never recovered, although it may and usually does produce an abundant harvest; (5) the reproductive parts of the plant are increased in proportion to the vegetative parts.

Soundness of a Seed.—Seeds which are not sound, have their vitality weakened. The soundness of a seed is influenced by: (1) Injury due to thrashing, (2) by the action of physical or chemical agents, (3) by being imperfect or shrivelled, (4) by being produced from plants that were stunted in their growth either by fungi or insects. All of these phases are harmful to the germination of a seed. It follows, then, from facts well in hand, that seeds which are in any way injured should be discarded, and that soundness should be one of the requisites of a good seed. Unsound seed should be destroyed because weakly and sickly plants will be produced.

Seed that are eaten or injured by certain insects, such as the pea weevil or bean weevil, produce great loss annually. Plants grown from seed injured in this way are retarded in growth, with the result that weak plants are produced. The amount of damage resulting to seed by the attack of insects is not always in proportion to the part injured. The pea weevil sometimes destroys most of the stored food in the pea, but if the pumule is untouched the pea will germinate. On the other hand, a slight injury to the pumule will destroy the germinating power of the seed even though all of the food material is uninjured.

Longevity of a Seed.—The length of time a seed is alive is called longevity. The longevity of seed is a much-discussed question, although one that can be easily settled, and a question upon which there is much authentic data. The longevity of a seed depends for the most part upon the species, but also differs widely in this respect. The climatic conditions materially influence the longevity of a seed and none of the qualities of a seed, such as weight, color or size seem to be correlated in any way with the length of life of the embryo of a seed. Poor method of harvesting, poor storage facilities, mechanical injuries of various kinds, which affect the food supply of the embryo, all tend to shorten the life of the seed. Likewise immature seeds begin to fail earlier and die before their natural time. Improper fertilization or poorly formed and imperfect embryo give short-lived seed. The position of the fruit on the plant sometimes exercises an influence on the germinating power of the seed.

Germinative Energy of a Seed.—The germinative energy or the speed of germination is that energy which is required for the germination of a seed. The length of time this energy is available varies from a few hours to several years, depending upon the different species of plants. The reasons for these variations in certain plants are not well understood, although they are probably caused to some extent (1) by the different degrees of ripeness of the seed, (2) by the nature of the seed coat, and (3) by the different degrees of stability of the food compounds. Possibly, the embryo might be influenced to a limited extent by heredity.

The shorter the period of germination the better, because after the seed is once planted it is in constant danger of destruction from various causes, as for example by insects or predaceous animals.

The seed of different species of plants require different germinative periods, but there is an abnormal condition recognized by seedsmen due to the hard condition of the testa or seed coat of some seed, and because of this hardness of the seed coat the absorption of water cannot take place. These seed are known as "hard seed," or hard-shelled seed, and are common in legumes as well as in some other plants. The power to germinate is present in these hard-coated seeds, and their value is not impaired. This defect is caused for the most part by the presence of abnormal quantities of silica, lime and other ash ingredients in the seed coat, and are substances which are not affected by soaking in water. These defects can be remedied (1) by filing of the seed coat, (2) by mixing the seed with sharp sand, (3) by revolving the seed in a cylinder with corrugated edge, (4) by the cracking or the breaking of the seed coat with a hammer, (5) by the treatment of the seed with chemicals such as weak acids.

Seed Testing.—In order to guard against failure, germination tests for all seed should be made every season. Seed testing consists in the counting out of a definite number of seed, of which the usual number is one hundred. The seed must not be specially selected, but should represent a fair sample of the lot.

The testing of seed is very important and its value cannot be overestimated from the stand-point of profits. In all intensive agricultural and more particularly in horticultural work the money made from a given crop is largely determined by the time at which the crop reaches the market. In order to secure the maximum yields from a given piece of land there must be a full stand of plants and not one-half or two-thirds of a stand. If the testing of the seeds is neglected and their vitality happens to be low, the stand of plants will be below the normal number, consequently the yield will be reduced to a point where no profits are made. Unless the seed is tested the stand of plants cannot be ascertained until the seed come up. If a poor stand at this late date is discovered, and even if replanting is then resorted to, the time lost is so great that the crop will come on the market at a time when every grower is producing the same crop, and consequently, the price is so reduced that the crop is often unprofitable. On the other hand, if the seed had been tested, the grower would have known what percentage of seed would germinate and he could plant accordingly. If a given sample tested 95 per cent., it would only be necessary to plant in the normal way with the result of a good stand of plants, but if the sample only tested 50 per cent., then it would be either necessary to plant twice as many seeds or purchase more seed with greater vitality. The progressive grower always guards against a possible loss. Consequently he germinates his seed prior to the time for planting and he knows definitely how many seed can be expected to grow and then plants accordingly.

Seed Testers.—There are four kinds of seed testers. These are more or less distinct and some kinds can easily be made by the grower:

The dinner-plate seed tester (Fig. 8), consists of two large-sized dinner plates, the one turned over the other. Between the plates are placed two or three blotters covered with two pieces of canton flannel. The material is moistened with water and the seed are placed between the blotters and are set in a warm room until they germinate. It is always well to change the blotters after each test in order to guard against infection by fungi, which sometimes cause the seed to mould.

The germinating cup is a small, earthen vessel, 3 inches in diameter or 3 inches square and $1\frac{1}{2}$ inches deep. The cup is covered with a lid of the same size and shape as the top of cup, in which are a number of small holes. The cup is placed in a shallow pan of water and kept at a temperature of about 75° or 80° F. Germinating cups must be thoroughly sterilized before the seeds are placed in them.

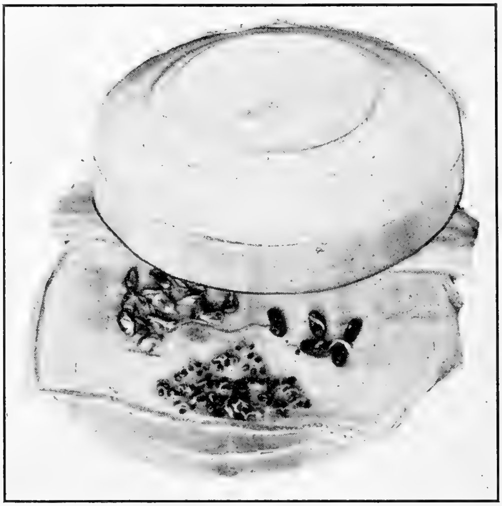


FIG. 8.—The dinner-plate seed tester.

The tile germinator is a large tile 12 x 15 inches and 2 inches deep, in which have been molded pockets varying in size from 1 inch to 3 inches in diameter. This tester is placed in a shallow pan of water the same as the germinating cups. Usually it is advisable to cover the top of the tester with a pane of glass to prevent spores of fungi from falling on the seeds and causing trouble.

The Geneva seed tester is a galvanized iron pan 10 inches wide, 14 inches long and $3\frac{1}{2}$ inches deep, with a ledge $\frac{3}{8}$ inch wide along the sides. The seed are held in folds of cloth suspended on rods which rest on this ledge. The water is carried to the seed through capillarity. A pane of glass is usually placed over the tester after the seed have been arranged.

Seed Bed.—In the growing of plants a good seed bed is absolutely essential and is a very important adjunct to the successful manipulation of the plants.

If the seed bed is improperly prepared, the subsequent growth of the plants is often retarded. The soil, however, is one of the most important parts of the seed bed, and the following points should be given considerable attention before the selection is made: (1) The soil should be possessed with the power of holding water; (2) the soil should be such as to maintain the proper degree of heat; (3) the seed bed should be well drained; (4) the soil must never be allowed to get too wet. If any of these factors are neglected, the efficiency of the seed bed is reduced. Attention should be given to all of these points, with the view of making them as near perfect as it is possible to do. The seed need constant watching and careful attention. The soil, if possible, should be kept a few degrees warmer than the air, and should be uniform in moisture. Cold air should be avoided.

Soil for the Seed Bed.—The soil should be carefully selected and an attempt made to bring it into the best possible shape. Experienced growers know that the choice of soil depends not so much upon the nutritive substances it contains but upon its physical properties, its power of retaining water and its porosity. In the sowing of seed we are not limited to any special soil but may select practically any type having good physical qualities. Experience has taught us that seed of certain species will do better in some special soils. A light sandy soil will probably make the best seed bed for all general purposes, since it has a large number of good qualities. For some seed a muck or a peat soil is considered excellent. Such a soil is very easily handled, and is well suited for seed of a great number of plants. By a little experience, one can judge a good soil by its appearance. If the soil is too heavy, it can be made lighter by the addition of the right proportion of some lighter soil, such as sand or by the use of decaying organic matter, found in well-rotted manure or leaf mould. Sand in too large a quantity is not desirable, because it contains neither life nor humus and tends to make a dead soil. If, however, the soil is too light a clay or a heavy loam may be added.

The physical properties of the soil should be such as not to pack and this can be easily determined by taking a small portion in the hand and firmly squeezing it. If the soil falls apart, it has about the right amount of water, if it is compact it is either too wet or too heavy for the planting of seed, and the best results will not be obtained. A small amount of plant food is an advantage although not a necessity at this stage of growth. The soil for the seed bed should be free from an excessive amount of moisture, the larvæ of injurious insects, and as free as possible from foreign weed seed.

The freezing of the soil will rid it of many of the injurious animal organisms and at the same time will put it in a better physical condition. Whenever it is possible it will be highly advantageous to subject the soil to repeated freezings and thawings before using it in the seed boxes.

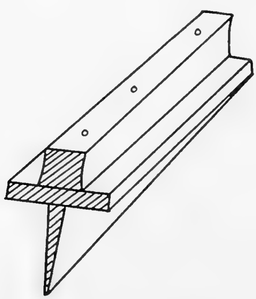


Fig. 9.—A wooden marker to regulate the depth for planting seed.

Depth of Planting.—Seed are covered with soil to secure an intimate contact with the moist earth. Care should be exercised in not excluding the air because that would be highly injurious to the seed. The proper depth must always be judged by the gardner and is determined largely by the size of the seed and the nature of the soil. It is apparent, however, that the small, delicate seed, whose powers of germination are reduced in proportion to their size, should have very little covering, because the tender plantlet will be unable to push through the soil. In the large and vigorous seeds this precaution need not be taken. However, it is never beneficial to cover the seed deeper than is really necessary to secure the requisite degree of moisture. Many small seed are often sown upon the surface of the soil and covered with a thin mulch, while some others need no covering, except a pane of glass to retain the proper amount of moisture. If the seed are planted in the open, the same precautions are necessary.

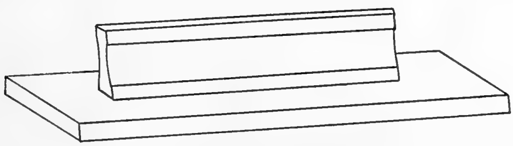


FIG. 10.—A firming board.

Compacting of the Soil.—The seed must be in intimate contact with the soil particles in order to secure the proper amount of moisture to germinate. If the soil is loose about the seed they get but little moisture, which prevents their maximum germination and the subsequent growth of the plantlet. In nearly all cases the soil must be firmed over the seed to give the best results. This is accomplished in many field crops by the use of heavy rollers. In market gardening the roller follows the seed drill and is usually a part of it. When seed is sown in flats a firming board is usually employed to compact the soil about the seed, or the soil may be pressed down with the hands.

Time to Plant.—All plants require a definite period in order to grow to maturity. The proper time then to sow the seed would be such that the growing period would be long enough to bring the crop to its full state of ripeness. The time at which planting is to be done must be kept in mind, remembering, however, that seed of certain plants that are sown too early or too late, and which will encounter unfavorable heat or moisture conditions, will not produce good plants. It is impossible to set a definite date for the sowing of the seed, since the season, the climate, the moisture and the location vary so much that good judgment must be used in every locality. The local vegetation should be used as an index in determining the proper time of planting. As an example of this the seed of hardy plants such as the peas, the onions, and the radishes are usually sown when the peaches begin to bloom, or as soon as the land can be worked in the spring. Other crops which are not so hardy should be sown about a week or ten days later. Warm, tender plants as the tomato, the egg plant, the pepper and many others, should not be planted until all danger of frost has past. The time at which the last frost occurs, of course, varies in all localities as well as in different seasons. In the South the seed can be sown earlier, while farther north where the season is later the seed must necessarily be sown later. In the sowing of seed, it is always a good practice to sow a larger amount than is necessary to secure a good stand, because this will insure against any loss from unavoidable causes. The extra cost in the sowing of twice the amount of seed required is very small in comparison with the time and space lost when a poor stand results.

Sowing of Seed.—There are two methods by which seed are sown: (1) broadcasting and (2) sowing in drills. Broadcasting is the distribution of seed freely over the surface from the open hand through the thumb and fingers. There are also several kinds of hand seeders on the market, all of which broadcast the seed. The most simple kind of hand seeder and the one that is most often used for the seeding of grass and other small seed is one with a rotating distribution. This seeder consists of a star-shaped wheel which is given a rapid rotation by gearing from a crank. A bag is provided with straps which may be carried from the shoulder and the distributing device placed at the bottom. The seeder is confined principally to small areas and often used in the seeding of lawns.

Watering of the Seedlings.—Watering is seldom done properly, and in many cases it is the cause of the amateur failing. It is impossible to lay down any definite rules which can be followed, but a few suggestions might be offered, which will give some aid. Water only when the ground seems to need it, is an excellent rule. But this rule can only be followed by one with some experience, because that is the only way the need can be definitely known. Seed, as well as seedlings, are often injured by too much watering. It is not well to apply water too often, but rather to let the plant feel the need of moisture by slightly wilting.

The best time to water is between sunset and sunrise, and the seedlings should usually be watered in the early part of the day before the sun appears. This is important, because as a rule if the plants go through the night in a damp condition they are more subject to the attack of diseases. A damp atmosphere with a wet soil will be a combination that only the hardiest seedlings can stand if long continued, and a saturated condition of the air and soil, especially if accompanied by undue heat, surely invites the attack of the damping-off fungus. Single copious waterings are much better than several scanty sprinklings. Frequent sprinklings cause the surface to become crusted and hard, while the roots may be suffering from thirst. Moreover, such watering brings the tender roots to the surface, which is an undesirable condition. As soon as the soil dries sufficiently after watering, it should be cultivated and a dust mulch maintained. This introduces air and liberates plant food, which stimulates plant growth. The appearance of mould on a seed bed is a sure sign that the soil is too wet. Tall, spindling seedlings, with light green foliage, indicates too much water and too high a temperature. Watering must not be applied to the seedlings forcibly, since it has a tendency to wash them out of the soil, as well as causing a crust to form, both of which are extremely detrimental to the production of good plants.

Thinning of Plants.—After planting seed of many crops it is usually found that more have grown than can be allowed to stand, and that the process of thinning will have to be practised in order to reduce the number. Such thinning can be made of great value if properly done, since it is a most excellent means of practising plant selection. The poorest and the weakest seedlings should always be pulled out and discarded, and only those plants which have good vitality should be retained and permitted to grow.

Thinning is not only done to give the plants more room to expand and to grow, but also to provide them with sufficient space from which to gather plant food. It should therefore be done as soon as possible, after the plants are up. The early elimination of the surplus plants prevents any loss of the available food.

Thinning is accomplished in several ways according to the crop: (1) By weeders or implements designed for the purpose of cutting out the surplus plants; (2) by hand. Hand thinning is usually practised on such plants as the garden beet or the onion.

Transplanting of Seedlings.—One of the principal reasons for the transplanting of the seedling is to develop a good root system. An ideal root system is one that has a great number of short branches, bearing many small root hairs. Such a root system provides a large area for the absorption of food material in a comparatively small space. An expression for this condition often used by gardeners is "ball of root," which means a well-developed and compact root system. The formation of this ball takes place only after the seedling has been transplanted several times. It is formed when the larger roots are broken off, which causes them to branch and to make a number of small fibrous roots. The root system then is a network of fine root hairs, all of which take food from the soil. Such a root system is easiest and is most readily obtained by the root pruning which takes place during transplantings. With many plants repeated transplantings are an advantage. The first transplanting is most important. It consists in the pricking of the seedlings out of the seed bed. Several precautions must be observed, of which the most important one is the preparatory treatment of the seedlings before transplanting. A few days previous to the time the plants are to be taken up, withhold the water supply and ventilate the plants freely to harden the tissue of the seedlings if they have been grown in a hotbed or cold frame. An hour or two previous to the transplanting of the seedlings give them an abundance of water. In removing the plants from the seed bed avoid injury to the roots, and in resetting them pack the soil firmly about the roots so that they will quickly take hold of the soil. Usually shading of the plants for a day or so to prevent withering after transplanting is important. The plants should be set in the soil nearly up to the first leaf, which enables them to take root more deeply and thus to be better able to withstand drought. In the transplanting of seedlings to the open, after they have attained some size, account must be taken of the loss of a part of the root system. The balance between the leaves and the roots is now broken. It is apparent that in transplanting some roots are always lost, which causes the leaf surface to be in excess of that of the root system. For this reason it is always advisable to reduce the leaf surface, so that it will be in proportion to the root system, thus maintaining the equilibrium or the balance of the plant as near as possible. From one-fourth to one-half of the leaf surface is usually removed. Where it is possible, it is usually never advisable, to transplant seedlings immediately after a rain, because the ground is then in a poor condition, and it cannot be satisfactorily firmed about the roots of the plant. The baking of the soil and the formation of a hard crust is the result when working with a soil that is too wet. After transplanting the ground should be thoroughly cultivated at the first opportunity. A mulch of dry soil should be maintained over the surface.

Sometimes plants are grown and transplanted into small pots. Thumb pots, the smallest size, are selected for the first transplanting and later the plants are gradually shifted to larger sizes. The soil should be comparatively rich, the aim being at this time to develop, as soon as possible, a compact root system before transplanting in the field. Pots are used in order that a severe check to the plant will be avoided.

REVIEW QUESTIONS.

1. What three parts compose a seed?
2. What is germination? What two stages mark the beginning of germination.
3. Name three external requisites for germination.
4. What function has water on the germination of a seed?

5. What is gained by the soaking of a seed?
6. What results when seed are kept permanently wet?
7. Why is oxygen necessary for the germination of a seed?
8. Why must the soil be aërated for good plant growth?
9. Give two ways in which oxygen can be secured for the seed.
10. What three temperatures are recognized in the germination of seed?
11. What are the five processes of germination?
12. Name the internal conditions affecting germination.
13. What is meant by maturity of a seed?
14. Discuss two ways a seed may be unsound.
15. Is germinative energy important to the seed?
16. What are hard seeds? How is the defect remedied?
17. What is seed testing and of what value is it to the grower?
18. Describe four kinds of seed testers?
19. What type of soil is preferred for the seed bed?
20. What determines the depth to which seed should be planted?
21. Discuss the compacting of the soil about the seed.
22. What determines the proper time to plant seeds?
23. Why is it necessary to thin plants?
24. What is a seed bed, and why is it important to have it well prepared?
25. What two methods are used in sowing of seed?
26. Why does shade assist the seedling to start growth?
27. Discuss the watering of seedlings.
28. Discuss transplanting of seedlings.

CHAPTER III.

HOTBED AND COLD FRAME.

THE hotbed and the cold frame is a very important and a very necessary adjunct to the commercial as well as to the home garden. Few people realize the importance of some form of glass. It is not only important in connection with the production of early plants but also valuable for the growing to maturity of lettuce and radishes, either early in the spring or late in the fall. Glass is regarded as being practically indispensable for many garden operations. In certain sections of the country it is a positive necessity especially where certain crops are grown, as, for example, the tomato or the pepper.

In addition to the use of glass for the forcing of early vegetables, it is valuable for the winter protection of partially hardy plants. The greatest economic use is probably in the hastening of the growth of certain crops as well as extending the growing period of others.

HOTBEDS.

The advantages of hotbeds may be summed up briefly under the following heads: (1) Crops can be matured and harvested earlier, thus gaining the advantage of better prices. (2) By starting plants under glass two or more crops may be grown on the same land during a growing season. (3) In sections of the country where the growing season is short, such crops as tomatoes, melons and peppers, can only be successfully matured by starting the plants in the hotbed. (4) Where the plants are large when they are set in the field, there is less danger of loss by insects and diseases, as well as less injury from weeds. (5) Because of the longer growing season afforded some crops, larger yields are obtained.

Location.—In the selection of a location for a hotbed several factors should be considered. Since it is very important that the seeds and the seedlings should not suffer from the lack of water, it is necessary to place the frames in close proximity to a good supply of available water. This cannot be overemphasized, because the failure of many crops to be profitable is due to the lack of water during the early part of their growth.

Hotbeds should be placed so as to be protected from severe cold winds. Usually the cold winds are from the north or the west, and care should be used to see that the frames are protected on these sides. Windbreaks afford the most common as well as the most economical protection and where it is possible natural windbreaks, such as hills, trees, or wooded areas, should be utilized. Where these natural windbreaks are not available, a board fence five or six feet high can be constructed, or a location might be selected back of some outbuildings, such as granaries or buggy sheds.

Exposure.—It is conceded by all growers that the south or southeast exposures are to be preferred over all others. This aspect allows the frames to have the full benefit of the sun's rays at a time of the year when it is most needed. The frames should run parallel with each other so as to facilitate in the handling of the glass. Roads or alley-ways should be constructed between the frames so as to be more convenient when composting the manure and when filling the beds.

Hotbed Pit.—Most of the hotbeds are heated by the fermentation of manures and for this reason a pit or a hole in the ground is necessary. Good drainage in the pit is an absolute essential, and where natural drainage is poor some artificial means of removing any surplus water must be provided. In many soils artificial drainage is unnecessary, but occasionally some artificial means of drawing off the surplus water is necessary. Two ways of providing good drainage is either by the use of 4-inch tile laid in the bottom of the pit, or by placing 6 inches of cinders or coarse gravel in the bottom before the compost is thrown in the pit. Owing to the uncertainty of the weather in the spring it is usually advisable to dig the pit in the fall before the ground is frozen and fill it with leaves or with coarse manure.

The size of the pit will depend upon the size of the hotbed, and whether it is for home use or for commercial purposes. In either case the size of the pit should be just a trifle larger than the frame, so the frame will fit into it snugly.

The depth of the pit depends upon several factors: (1) Latitude. The section of the country or the latitude determines the depth to a large degree, because the inside heat of the frame is materially influenced by the external temperature. (2) The time of the year. When crops are started late in the season, as for example in March or April, less heat and consequently less depth in the pit is required than if the plants are started in February or earlier. (3) The kind of a crop. Certain plants known as tender or warm-weather plants, such as the tomato, pepper, or egg plant require considerably more heat than the more hardy plants as the cabbage or the lettuce. Therefore the pit must of necessity be deeper, to supply the proper amount of heat to grow the warm plants successfully. In the North the customary depth varies from 15 to 36 inches. The depth gradually decreases as one goes south where it ranges from 6 to 12 inches. The heating material which is used and the length of time the hotbed will be needed also influences its depth.

Hotbed Frame.—Five materials are prominent in the construction of the frame: (1) wood, (2) concrete, (3) stone, (4) brick, and (5) cement blocks. Concrete is without a doubt the most durable as well as the neatest, although wood is more generally used because of its cheapness. If wood is used, it is advisable to secure cedar, locust, or cypress, since these woods are the most durable, and will withstand the trying conditions under which the frame is placed. The frame should be made to fit the pit. The length should be determined by the needs of the grower. The usual width is 6 feet, because the standard size of the sash is 3 x 6 feet. It is always more convenient to have the width of the frame about one-half inch less than the length of the sash. The upper side of the frame should be 6 or 8 inches higher than the lower side so as to give the proper slope to the frame.

When the frame is made of wood, crossbars should be provided because they possess many advantages. The chief use of the crossbars is to strengthen and to prevent the frames from warping or twisting out of shape when they are

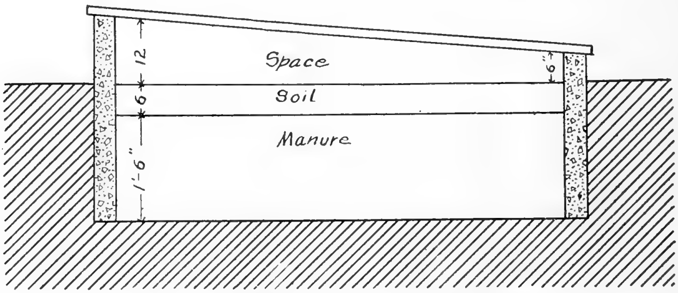


FIG. 11.—A cross-section of a concrete hotbed.

in contact with the moist earth. The crossbar should be made of a piece of wood 2 x 3 inches. It should be of the best material. The crossbars should be placed with the greatest

FIG. 12.—Showing the method of constructing a concrete hotbed. Note the framework which is necessary.

care and precision, because if they are too close together the sash will bind and cause great annoyance. The distance from center to center of the crossbars should be one-half inch more than the width of the sash to insure ease in manipulation.

Hotbed Sash.—Two kinds of hotbed sash can be purchased, the single-glass and the double-glass sash. They can also be made by any local firm. When the sash are constructed locally, specify emphatically that only the most durable wood should be used and cypress or cedar is preferred. Sash differ greatly in length and in width, but the standard size is 3 x 6 feet. Sash of other sizes are inconvenient to handle and possess no advantages over the standard. The usual thickness of the sash is about $1\frac{1}{2}$ inches, but this varies, and usually ranges from $1\frac{3}{8}$ to 2 inches. The lighter sash are easier to handle but the heavier ones are more durable and sustain less breakage.

FIG. 13.—A good rack for hotbed sash.

All sash should receive a priming coat of paint before they are glazed. The cracks and the crevices should be filled with paint in order to exclude all water, so that decay will be lessened. Glass of the best quality should be purchased. The lower grades of glass, as a rule, cause more burning to the plants because of their many defects.

The glass is placed into the frames by either lapping or by butting. Lapping is the most popular and the method that is usually recommended, because there is less leakage and less trouble with the panes slipping down. The glass should be lapped about $\frac{1}{8}$ inch and laid in putty. Each pane of glass should be fastened by glazing points, and putty pressed in the angles formed by the glass and the sash bars. When the glass is butted the two edges of the panes are simply brought together. The greatest drawback to this method is the fact that the glass is never perfectly square and the panes do not fit together tightly. The cracks thus formed between the two panes permit a great amount of leakage to occur which is very injurious to the growing plants.

After the sash are glazed they should be given two or three coats of good white-lead paint. This painting should be repeated at least once a year throughout the life of the sash. The painting materially increases the length of time the sash can be used. When the sash are not in use they should be stored in a dry place (Fig. 13).

A FOUR-FRAME HOTBED.

Fig. 14 represents a four-frame hotbed and a convenient size for the home garden. So important is some form of glass to the garden that no vegetable garden is complete without a two- or four-frame hotbed. When only a small city lot is available for a garden, the hotbed can be made one-half this size.

The arrangement of the crops in the hotbed can be determined by the individual, but Fig. 14 is designed to give several suggestions which might help the novice or one not very familiar with this form of gardening to fill up the space to the best advantage.

In this plan two sash are given over to the growing of lettuce and radishes and early beets, while one is used for the production of the early plants which are to be set in the garden. The fourth is used for the transplanting of the seedlings, in order that large, stocky and healthy plants will result. The first transplanting from the seed bed is essential if good plants are desired, because it not only increases the root system, but it helps the plants to with-

PLAN OF FOUR-FRAME HOTBED.

Onion seed	
Beet seed	↓ Cauliflower seed
Cabbage seed	↓ Pepper seed
Celery seed	↓ Endive seed
Egg plant seed	
Parsley seed	
Lettuce seed	
Cauliflower plants	
Cabbage plants	
Lettuce plants	
Egg plant plants	
Pepper plants	
Parsley plants	
Endive plants	
Tomato plants	
Tomato plants	
Tomato plants	
Lettuce February 25 to March 10	
Radishes and early beets February 25 to March 10	

FIG. 14

stand the more severe operation when they are set in the garden.

If only a two-frame bed is made the space allotted to each crop can be reduced.

The double-glass sash are not to be generally recommended for the following reasons: (1) they are too expensive; (2) they are very heavy to handle; (3) they accumulate and retain moisture between the two layers of glass, which causes their rapid decay; and (4) they collect dirt and moisture between the glasses, which decrease the amount of light that can pass through the glass. However, it must not be thought that the double glass does not possess some good points. The advantages of the double-glass sash may be briefly summed up as follows: (1) a growing temperature is reached earlier in the day; (2) the labor of managing the frames is reduced; and (3) the plants are afforded more thorough protection from cold. Although the double-glass sash do possess certain advantages, the disadvantages seem to overshadow the advantages, and they cannot be generally recommended.

Composting the Manure.—The usual material for heating the hotbed is horse manure. Sometimes forest leaves, spent hops, and occasionally sheep and poultry manure are used, but the sheep and poultry manure is usually of more value for other purposes.

The horse manure should consist of about one-third litter. Where the solid excrement is used entirely the fermentation is usually too violent, and consequently of too short a duration. Straw is the best material for the litter, and manure composed of shavings or sawdust should never be used.

The manure should be composted before it is placed in the pit. The composting should begin about ten days prior to the time the hotbeds are to be made. The manure should first be piled up in compost heaps. A convenient size of the compost pile is 4 or 5 feet wide and about as high, with length enough to fill the frames. After the heating of the compost has started and is well under way, say two or three days after it is piled, the manure must be turned over, thoroughly mixing the outside of the pile with the inside.

If any drying out of the compost has occurred by this time, the addition of a little water will improve the compost. Two or three such handlings of the compost are necessary to give it a uniform and an even fermentation. When the fermentation is complete and uniform the compost is placed in the pit.

Fig. 15.—Students filling a concrete hotbed.

In filling the pit, the manure should be distributed in successive layers of 6 or 7 inches. Each layer must be firmly packed down, particularly along the sides and in the corners. Where the firming along the sides is neglected, there is more settling of the compost along the sides than in the center of the pit, which makes the surface uneven and causes great damage to the young seedlings. The compost will settle several inches and when filling the pit due allowance should be made for this settling. After the compost is placed in the pit from 2 to 6 inches of soil should be spread over the manure. If the plants are to be grown in flats 2 inches of soil will be sufficient, but if the seed is to be sown directly in the beds from 4 to 6 inches of good garden loam is necessary.

After the manure has been placed in the pit, a secondary fermentation will take place, and the heat will often rise as high as 100° to 110° F. At this time it would be very detrimental to plant either seeds or plants in the soil, and a week or ten days should lapse after the hotbed is made before any planting is done. This secondary heating continues for a longer or a shorter period, and gradually falls until it reaches 65° to 75° F., where it remains more or less constant throughout the life of the hotbed. By placing a soil thermometer in the bed it is easy to determine the proper time to plant, which will vary from a few days to a couple of weeks, depending upon the depth of the pit, the freshness of the manure, and several other factors.

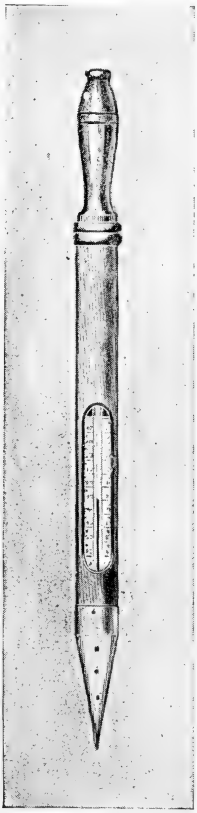


Fig. 16.—A soil thermometer.

COLD FRAME.

A cold frame is a bed covered with glass where no heat is provided except the sun's rays. All the conditions such as the location, the arrangement, the management, etc., that are recommended for hotbeds apply with equal force to cold frames. The cold frame, as a rule, is used later in the season than the hotbed. No pit is required for the cold frame. It simply consists of a wooden frame placed on top of the soil. Occasionally manure is piled around the sides of the frame to offer a little protection. The cold frame is usually employed for the "hardening off" of plants later in the season, but on a small scale the hotbed will serve this purpose. As a rule, the cold frame requires more water, because the plants are grown later in the season, when transpiration and evaporation is greater.

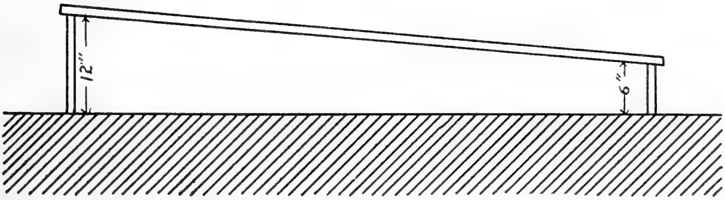


FIG. 17.—A cross-section of a cold frame.

The cold frame has a few advantages over the hotbed. It is more cheaply constructed, it requires no heating materials and needs no excavation. However, the cold frame cannot be used as early in the season as the hotbed, and it should only supplement the hotbed and not replace it.

The frames may be movable or stationary. Portable frames are not, as a rule, popular with the larger growers, and the stationary frames seem to give the best satisfaction.

REVIEW QUESTIONS.

1. Why are hotbeds and cold frames important?
2. Give four advantages of a hotbed.
3. Discuss the location of a hotbed.
4. What is the value of a windbreak for a hotbed?
5. What is the distinction between a natural and an artificial windbreak?
6. What exposures are preferred for the hotbed?
7. Describe the hotbed pit.
8. What is the standard size of the hotbed sash?
9. Name the five materials of which the frame is made.
10. How much higher must the upper side of the frame be than the lower side?
11. What is the value of crossbars?
12. What kinds of hotbed sash are made?
13. Give the advantages and the disadvantages of each kind.
14. Discuss the two ways of placing glass in the frames.
15. Which method is the best?
16. Why is it important to have all frames well painted?
17. Name four advantages and three disadvantages of the double-glass sash.
18. What is meant by a compost?
19. How should the manure be composted, and how long does it usually take?

20. What kind of manure should be used for the hotbed?
21. What is the proper way of placing the composted manure in the pit?
22. Why is it important to have the manure firmly tramped down?
23. What is secondary fermentation and how high does the temperature go?
24. How long after the hotbed has been made before the seeds can be planted?
25. What is the difference between a cold frame and a hotbed?

CHAPTER IV.

CULTIVATION AND TILLAGE.

Cultivation is the process of either breaking up the soil for the purpose of planting agricultural crops or stirring it to accelerate plant growth. Cultivation for the improvement of the crop should be continued at frequent intervals during the growing period of every crop. The importance of cultivation cannot be overestimated and the efficiency with which it is done depends upon the kind of tools used, and how skilfully the operator uses them. Much importance is laid upon the way in which cultivation is done, because often the difference between profit and loss is found in either good or bad cultivation. Good cultivation is one of the secrets of success in all kind of agricultural work, and it is even more important in crops that are grown intensively, as are most of the horticultural crops. Horticultural crops require a great amount of attention to produce the maximum yield and the highest quality. Cultivation goes a long way in bringing about these good results.

It is important that cultivation should be done at the proper time, and much depends upon the character and the thoroughness of the operations. There is always a proper time to perform a piece of work and cultivation is no exception to this rule, and things worth doing at all are worth doing well. Cultivation when properly done should make the soil loose and friable, and all of the large lumps should be broken up.

The failure to cultivate the garden at the proper time often results in the weeds overrunning the plants, which not only reduces the yield, but causes great labor and unnecessary expense in hand hoeing and in weeding. When the conditions of the soil are satisfactory for cultivation, it should be attended to at once, because if it is delayed many circumstances may arise to hinder the work.

Tillage is the most efficient means of assisting nature in converting the plant food into forms that are available to the plants. One of the most noticeable results of cultivation is the fineness of the soil particles which is accomplished by the breaking up of the larger lumps. This pulverization of the soil is very beneficial, because it makes it easier for the roots of the plants to penetrate to a greater depth and to feed over a larger area. The tender rootlets must push their way in between the soil grains, because it is impossible for them to penetrate hard lumps of soil, and where large clods of earth are abundant the growth of the plants is materially checked.

Objects of Cultivation.—Some of the reasons for cultivation may be summed up briefly as follows: (1) Cultivation reduces the soil particles to a fine state of division, which modifies its physical make-up. This pulverization of the soil particles is highly important in that plant growth demands a soil that is fine because it usually will be able to hold more water. (2) Cultivation helps to regulate the water-holding capacity of the soil. This is brought about by the greater number of soil particles which are found in a given area. Since the amount of water that a soil can hold, is determined by the film of water that surrounds each soil particle, it is evident that the greater the number of soil particles that occupy a given space, the greater will be the amount of water that it can hold. (3) Cultivation modifies the soil temperature. When air is permitted to permeate the soil, it carries with it heat and warmth to a lower depth. The heat units entrapped in the soil causes the temperature to be higher and the growth to be more rapid. (4) Cultivation stimulates the increased production of beneficial bacteria. (5) Cultivation aërates the soil. If the soil particles are stirred around, and finely broken up, there is bound to be a greater number of soil spaces, and consequently there must be more air, since the spaces between each soil particle is necessarily filled with air. (6) Cultivation destroys weeds. (7) Cultivation prevents the washing of the soil. By filling up the little gulleys and the ditches, which are washed out during a rain, they are prevented from increasing in size, and thus washing to an appreciable extent is avoided. (8) Cultivation increases the depth of the seed bed. (9) Cultivation offers a means of adding green manures and humus to the soil. (10) Cultivation liberates plant food. This is an excellent means of freeing plant food, because the stirring of the soil particles, brings together the different elements. Chemical action is thus increased and the plant food is liberated, which was previously held in combination, with the other elements that were not available to the plant.

Shallow and Deep Cultivation.—The depth to which a soil can be plowed in order to give the best results must necessarily vary with the condition and the type of soil. On a clay soil or any soil of a heavy type, deep plowing, as a rule, should be recommended, while on the sandy or sandy loam types of soil, deep plowing is not usually advisable, especially if the soil is plowed in the spring. It is conceded that the longer a soil is cultivated, the deeper and the more thorough it should be pulverized. The depth of plowing is also regulated by the season, the location and the time of plowing. Land that has been cropped for a series of years should be plowed deeper than new land, but this varies somewhat, according to the section of the country. It has also been found that deep plowing will give better results if it is done in the fall. The depth of plowing should fluctuate with different years, one year a little shallow, and the next year a little deeper, and so on. If one depth is maintained continuously the pressure of the implements in time produces a hard bottom to the furrow, which greatly interferes with plant growth. In regions of light rainfall, deep plowing should only be done at intervals of from four to five years. However, when the rainfall is about the average for a good crop, deep plowing should usually be the rule on heavy soils.

Shallow cultivation should be given, as the crops advance, and a mulch of fine earth should be kept on the soil. Where frequent cultivation is followed, the capillary tubes near the surface of the soil are broken and the direct connection of the water in the subsoil with that of the upper layer is interrupted. Cultivating prevents the close contact of the surface soil with that of the lower layers and destroys the passageways for the water to escape into the air and be lost. Whenever evaporation from a surface takes place, there is a constant movement of the water upward from the lower depths, and in order to conserve the supply of water this capillary escape of moisture must be prevented. This is easily accomplished by maintaining a layer of fine earth on the soil. This means that shallow cultivation is important in conserving and in holding the soil moisture. The depth of the soil mulch must of necessity vary with the nature of the soil. On a small scale, a garden rake can be used and the pulverization is usually complete, but on a large scale a disk or a harrow is commonly employed. If a disk harrow is used the disks should be set at an angle. The surface cultivation should be 2 or 3 inches in depth. The finer the soil is on the surface, the better the moisture is held. Shallow surface cultivation should be practised in connection with any method of treating the land whether deep plowing, subsoiling or spading.

Water-holding Capacity of the Soil Influenced by Cultivation. —Cultivation not only increases the amount of surface on which the plant can feed, but it also enlarges the water supply by giving the soil a greater capacity for holding it.

There are three forms of water found in a soil: (1) Bottom water, is that water which stands in the soil at a general level and completely fills all of the spaces between the soil particles. Bottom water is only available for the plants, when it can be brought up to the higher levels by capillarity. If the general level of the water table is too high plants cannot grow, and drainage must be provided. (2) Capillary water, which is that water held in a thin film around the particles of soil above the bottom water. The height to which this water can be raised by capillary action depends upon the size and the arrangement of the soil particles as well as the type of soil. Ordinarily the capillary action of the water is confined to a few feet. In close texture soils, as the clays, an increase in the air spaces results in an increase of the capillary spaces, and consequently an increase in the water-holding capacity. In the coarse sandy soils an increase in the size of the air spaces decreases the capillary spaces and consequently decreases the water-holding capacity. (3) Hydroscopic water is that water which is held mechanically in the soil and which is not removed by air drying. This form of water cannot be used by the plant.

All plants are dependent upon the capillary water for their growth. The amount of capillary water which a soil can hold depends upon the total surface area represented by the soil particles. It is therefore apparent that the loosening of the ground and the breaking up of the soil particles during cultivation makes it easier for the rain to enter the soil. Likewise the larger surface presented by the greater number of soil particles, increases the amount of water that the soil will hold. The loose soil also tends to prevent loss of the water by surface drainage.

The capillarity and consequently the moisture content of the soil is materially influenced by the different methods of cultivation, such as deep or shallow plowing, subsoiling, rolling or disking. The treatment adapted to insure the best water supply, must vary with the rainfall, the nature of the soil, and the crop in question. In many sections the rainfall is ample to produce a good crop, but it is distributed so unevenly that all of the water cannot be utilized by the crop at the time it falls. A great amount of this water is lost if it is not properly handled and stored in the subsoil for the future use of the plants. By judicious and systematic cultivation the greater percentage of this moisture can be conserved and used for the growing of the plants. Cultivating after a rain is most essential for the proper conservation of the soil moisture. This cultivation should be given as soon after the rain as the soil can be worked. When evaporation is allowed to take place after a rain, there is not only a loss of water which has just fallen, but there is a loss in the upper layer of soil as well. In addition to these losses there may also be a loss of the water in the subsoil by translocation. The best means of preventing the loss of water is by cultivating the ground with implements that will break up the soil as soon as possible after a rain has fallen. Such a cultivation at the proper time will leave the surface in a fine condition and will check the evaporation of water from the ground.

If the subsoil contains an ample amount of water, and there is a minimum amount in the surface soil, a movement of the subsoil water after a rain frequently occurs. This movement is brought about by the capillarity of the soil, and the surface tension of the film of water about each soil particle becomes greater with the increase of the water in the surface soil.

Fig. 18.—A general purpose plow. (International Harvester Company of America.)

Spring Versus Fall Plowing.—Plowing is the process of breaking up the soil and reducing it to a finer state of division. Much depends upon this process. The difference between loss and gain is sometimes found in the time a soil is plowed. This difference is made possible because the water-holding capacity of a soil is regulated largely by the state of fineness to which it is reduced. It is a well-recognized fact that crops cannot grow and develop without the proper amount of water. This water is increased if the plowing is done at the proper time and the water content can largely be controlled in this manner.

Certain types of soils will admit of fall plowing and they will be greatly improved both in their physical properties as well as in their water-holding capacity. Soils that respond to this treatment are the heavier types, as the clays. Fall plowing, if followed by surface cultivation, conserves the water by checking the evaporation, and the land is left in a better condition to retain the moisture. When fall plowing is done it will be found to be generally better to delay the surface cultivation until the following spring, especially on heavy clay land. If clay land is left ridged, when fall plowed, an irregular surface is exposed, and the rain is held in the furrows and a better opportunity is given for the water to sink into the subsoil.

Fig. 19.—The Osborne disk harrow. (International Harvester Company of America.)

When the soil is not plowed until in the spring there is a greater loss of water by evaporation during the winter and early spring. Besides the loss of water by evaporation the soil has not been able to store up as much water from the rains and the snows during the winter, because it has been packed down, and a large percentage of the water has been lost by surface drainage. Again if spring plowing is practised the dry soil is turned under and the moist soil is exposed, so that if a mulch is not immediately formed by cultivation a great deal of the moisture is lost by the exposure of the soil to the sun and the drying winds.

Bacterial Action of the Soil Influenced by Cultivation.—In all soils there are two bacterial processes continually going on, namely, nitrification and denitrification. Nitrification is the process by which the nitrates and the nitrites are produced in the soil by minute living organisms. These

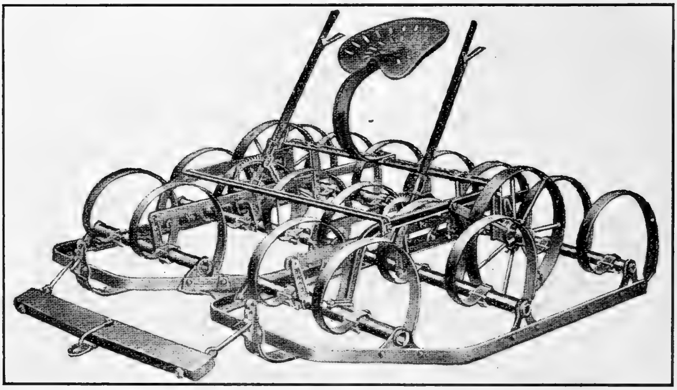


Fig. 20.—The Osborne sulky spring-tooth harrow.

organisms are called bacteria and are very small, microscopic plants. Nitrification results in the changing of the complex organic nitrogen in the soil into other forms that can be used by the plants. In order that this process can be carried on successfully by the nitrifying bacteria, six fundamental conditions are necessary: (1) moisture, (2) oxygen, (3) favorable temperature, (4) absence of sunlight, (5) nitrifying bacteria, (6) some compound on which the bacteria can work. All of these conditions must be maintained. Cultivation, particularly of the heavier types of soil, favor nitrification by increasing the amount of air in the soil,

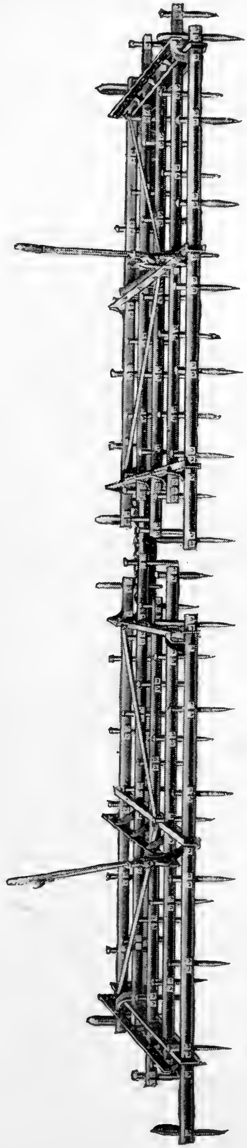


FIG. 21.—The peg-tooth harrow. (International Harvester Company of America.)

by making the soil warmer, and by aiding in hastening the chemical processes.

Denitrification is the reverse of nitrification, and is the result of the working of a class of bacteria that break down the nitrates, setting free nitrogen, which passes off as a gas. The condition necessary for this class of organisms to work is the absence of air, and when frequent thorough cultivation is given and the soil is well aërated these bacteria perish. So it follows that the best way of eradicating these injurious bacteria is to maintain thorough and complete cultivation. Besides destroying the denitrifying bacteria more plant food is made available by increasing and by stimulating the reproduction and the growth of the friendly nitrifying organisms.

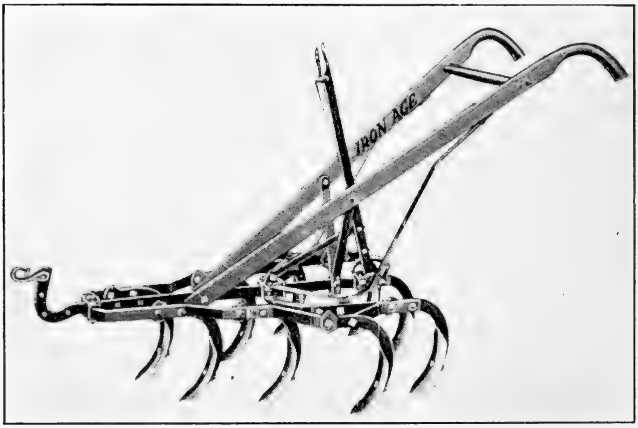


Fig. 22.—A single horse adjustable cultivator.

Implements for Cultivation.—The implements for cultivation may briefly be summed up as follows: (1) The plows, of which there are the walking plow, the sulky plow, the gang plow, the disk plow, and the steam plow; (2) the harrows, of which there are the smoothing harrow, the spring-tooth harrow, the disk harrow, the cut away disk harrow, the spading harrow, and the plow cut-disk harrow;

(3) the rollers, of which there are the smooth iron roller, the tubular roller, the clod crusher, the subsurface packer, and the common planker; (4) the cultivators, which are classified into the single- and the double-shovel cultivators, the horse and the hand cultivators. In addition to the above we can mention the garden spades, rakes, and hoes. All of these implements and tools are for the purpose of putting the soil in the best possible condition as well as maintaining the conditions necessary for plant growth.

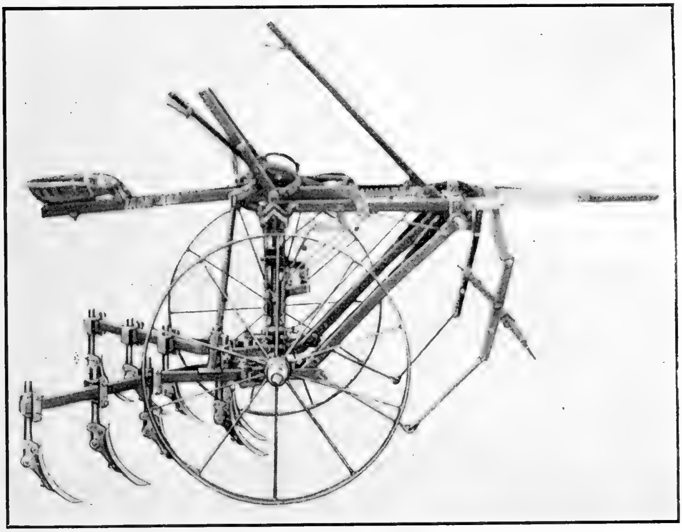


Fig. 23.—An eight-shovel riding cultivator.

REVIEW QUESTIONS.

1. What is cultivation?
2. Is there any difference between cultivation and tillage?
3. Why is cultivation important?
4. Is it important to cultivate at a given time?
5. What are the objects of cultivation?
6. Discuss how cultivation aids in holding water in the soil.
7. How does cultivation increase the bacterial action in the soil?
8. Discuss how cultivation liberates plant food.
9. What is meant by deep and shallow cultivation?

10. What is meant by bottom water, capillary water, and hydroscopic water?
11. Which kind of water can be used by the plant?
12. When should you practise deep and shallow plowing?
13. Why is it necessary to vary the depth of plowing?
14. How can we check evaporation from the soil?
15. Discuss spring and fall plowing.
16. What is meant by bacterial action in the soil?
17. Name the two processes that go on in the soil that are due to bacteria.
18. Discuss the conditions necessary for nitrification.

CHAPTER V.

PLANT PROPAGATION.

PLANT propagation is the multiplication and reproduction of plants. There are two distinct kinds of reproduction, namely, sexual and vegetative. (1) Sexual reproduction is the multiplication of plants in which the male and the female elements enter into the formation of a new and a distinct individual as found in the seed. Most seed of economic importance therefore are the result of a sexual union of the male and the female cell. (2) Vegetative or asexual reproduction is the multiplication of plants in which the sex elements play no part. It is simply the continuation of the growth of the parent plant in a new location with only the one parent concerned.

Vegetative reproduction is without doubt a most important form of propagation. It is used in the perpetuation of many plants, especially those in which the exact parental form is desired. The different kinds of vegetative reproduction may be enumerated as follows: (1) hardwood cuttings, (2) softwood cuttings, (3) leaf cuttings, (4) root cuttings, (5) layers, (6) suckers, (7) stolons, (8) tubers, (9) budding and (10) grafting. In addition several specialized forms are also recognized.

Vegetative propagation can be divided into two great classes: (1) Propagation by parts intact by which is meant that the part of the plant which is selected for propagation is not separated from the parent until the organs needed to make it self-supporting are formed, as, for example, layers, suckers and stolons; (2) propagation by parts detached, by which is meant that the part of the plant which is intended for propagation is cut from the parent at the beginning and is placed under favorable conditions, so that the formation of the organs needed to make it self-supporting takes place. Examples of propagation by parts detached are seen in all cuttings, in budding and in grafting.

Bulbs.—Bulbs of all kinds are specialized buds. They are composed of a short rudimentary axis closely encased in thickened leaves or bulb scales. A bulb is also a more or less permanent and a compact leaf bud, which is usually found at the base of the stem. It is subterranean. Roots

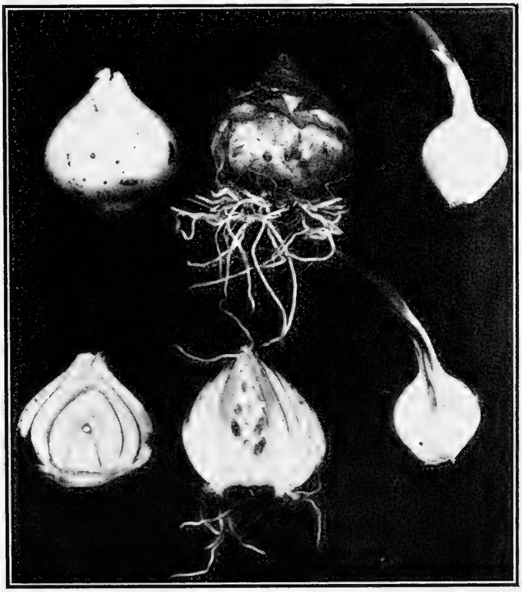


Fig. 24.—Bulbs of the tulip, hyacinth and onion.

are always sent out from its base. The thickened bulb scales are stored with food, which is used during the subsequent growth of the plant. Bulbs usually occur in plants that are subject to a long period of inactivity and a short period of growth.

Bulbous plants are propagated most easily by means of little bulbs, which are borne about the mother bulb. These small bulbs are often called *bulbels* or offsets, and are usually borne near the base of the parent bulb. In some of the lilies the bulbels form at the top or crown of the parent bulb; in other cases they form on the lower part of the flower stalk, while in still others they are always borne beneath the scale leaves of the parent. Bulbels vary greatly in their size and number in the different species.

Corm.—A corm is a short, thick and fleshy stem which is solid throughout. A vertical axis fills the center. The corm is covered with a few thin, scaly leaves. Corms are always subterranean. In general shape and appearance a corm resembles a bulb. Common examples of a corm are the gladiolus, the crocus, the cyclamen, and the Indian turnip. The corms of the different species often behave quite differently. The corms of the gladiolus and the crocus are reproduced annually upon the top and at the sides of the parent. As a rule a new corm is produced above the old one each year, which commonly bears flowers the following year.

FIG. 25.—Side and top views of a corm.

Rhizomes.—Rhizomes are subterranean stems bearing scale leaves. They grow more or less horizontally and the internodes vary in length and in thickness; they bear roots at the nodes. Every species has a type of rhizome peculiar to itself. Familiar examples of rhizomes are the slender root stocks of the mints and the thick, fleshy ones of the canna and the iris. Rhizomes are easily distinguished from roots by the leaf scales in the axils of which are born buds. In the majority of cases the buds of a rhizome are exceedingly tenacious of life, making the plants bearing them difficult to destroy and the propagation of the plant extremely simple. Plants bearing rhizomes are propagated either by separating naturally at the close of the growing season, or by being divided into as many parts as there are buds. Each part of the rhizome bearing a bud will develop into a new plant. The divided parts are treated in much the same way as bulbs. However, a little experience is necessary in their management if the best results are to be expected.

Tubers.—A tuber is the localized thickening of a shoot. It is usually subterranean and is rarely ever found above ground. Tubers bear scale leaves which are analogous to the leaves on ordinary stems. The scale leaves are small and insignificant and sometimes are not recognized in mature specimens. The scale leaves are always at some distance from each other, and they never overlap. The buds, which develop in the axils of the miniature scale leaves, are called eyes. These are indicated on the tuber by ridges or lines of protuberances. Generally, tubers are extremely perishable organs, and they can only carry the life of the plant from one season to the next. Plants bearing tubers are easily transported long distances because of the reduced and compact form.

Tubers reproduce themselves by offshoots. A fully formed tuber becomes detached from the upper part of the plant by the decay of the slender stem. This connection of the tuber with the parent has previously supplied it with food. After varying periods of rest a stem springs from the eyes of the new tubers, and these in turn bear tubers similar in structure to those of the parent.

Propagation by tubers is extremely simple. It consists either in planting the whole tuber or a portion of it, each part of which must contain an eye or a bud.

Procumbent Stems.—A procumbent stem is a stem that either droops to the ground or trails over it. Usually the habitat of this class of plants will be found to be such that erect plants are unable to maintain themselves, and the drooping habit is acquired in order that the plant is able to live. A poor, sandy soil, a windy hillside, a rocky or rough piece of ground is the habitat which is usually found where the great majority of these plants are seen growing. In many cases the trailing stem serves the usual purpose of supporting the leaves, but in others the procumbent stem becomes a means of perpetuating and distributing the species. These stems are usually characterized by the buds at the nodes taking root and growing into new plants. After the new plant is thoroughly established, the part joining it to the parent gradually disappears and the new plant becomes an independent unit. Procumbent stems differ somewhat from the true upright stems, in that they are more slender and usually bear little or no foliage. There are two distinct types of procumbent stems, the runner and the stolon.

Runner.—A runner is a prostate stem with long internodes and destitute of foliage, which grows out from the parent plant. It is sometimes spoken of as a slender bud bearing procumbent stems. At varying intervals on the stem are nodes from which root protuberances are formed when the proper stimulus is given. At the tip of the runner, under the stimulus of the damp soil, roots develop and a new plant begins to grow. When the new plant is well established, the connecting stem usually dies, and an independent plant is the result. The strawberry plant furnishes a good example of the runner.

In moist, sandy soils the young plants will usually take root without artificial aid, but in hard, heavy soils the runners must be kept in contact with the earth either by pegging or by laying a weight of some kind on the runner.

Stolon.—A stolon is a procumbent stem which takes root either at the tip or at the node of the stem, and grows into a new and an independent plant. A stolon differs from a runner in having a more procumbent and a less prostrate stem. More foliage and shorter nodes also characterize the stolon. Besides the brambles, many of the ornamental plants may be multiplied by means of stolons. The black raspberry is a good plant to illustrate propagation by the use of the stolon. The young raspberry canes at first grow erect, but later in their growth the ends of the growing shoots bend toward the ground, finally touching it, where root protuberances slowly develop and finally roots appear and a new plant is produced. When the cane reaches the ground the stimulus of the moist soil causes small protuberances, the beginning of the roots, to form. As the contact of the cane with the soil becomes closer, the roots develop more rapidly and as they become stronger and better established the tip of the cane is drawn closely to the ground. The following spring and occasionally the same season a leafy shoot appears from this tip and, nourished by the root, it rapidly grows into a new plant. Through decay and subsequent division of the old stem the young plant becomes detached and the new plant begins an independent existence.

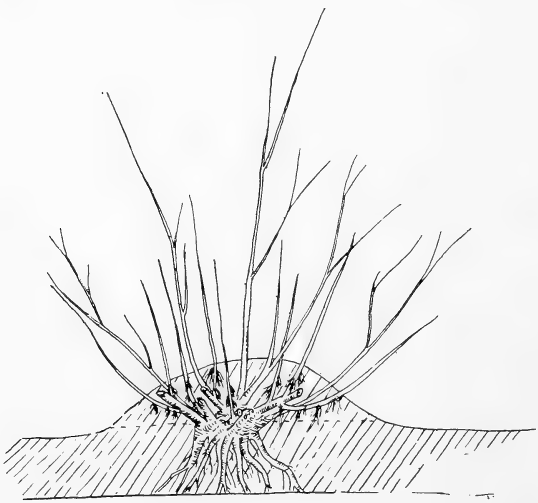


FIG. 26.—Mound layering.

Layer.—A layer is a stem of a plant bent to the ground and allowed to take root without being detached from the parent plant. It is nothing more than an artificial stolon. Occasionally the young shoots from the parent are hilled up with soil about their base where they take root. A layer differs from a stolon only in the implication that man has taken a hand in the process of reproduction to aid nature by either bending the branch to the ground or by hilling up the soil around the young shoots. The chief advantage of layering lies in the fact that the parent plant supplies water and food for the young plants until they are able to sustain themselves. It also has the advantage of being an extremely simple operation and of being more certain than most of the other methods of vegetative propagation. Layering is practised chiefly on the hard-wood plants, because herbaceous plants are usually more readily propagated from cuttings. Theoretically nearly all of the woody plants can be multiplied by layering, but in practice this process is confined for the most part to vines or to those plants having long, slender shoots. The chief reason for the selection of this class of plants is because of the ease in bending. Bending is more easily performed on such plants as the brambles, the grapes and occasionally the currants. Nevertheless many similar plants are often increased by layering, and even the apple, the quince and the pear may be so propagated if the proper medium is supplied to the layering wood. In layering, the roots are not, as a rule, developed in proportion to the stem and their place of development is not predetermined, but is fixed by some external agent or stimulant, as for example the contact with moist soil. Warm, moist soil will act as a stimulus in some species and will induce the formation of roots, while in other species and by far the greater number, root formation is greatly facilitated by the wounding of the stem where the new plant is wanted. Such wounding causes adventitious buds to form.

Mound Layering.—Occasionally the stems of plants cannot be readily bent to the ground for layering. In such an event a mound of earth is heaped about the plant, which stimulates the formation of roots on the previously prepared shoots, and this is called mound layering. Plants for this purpose are usually first prepared by heading back in the spring, with the result that a large number of young shoots will be produced about the crown of the plant. The following summer a mound of earth is placed about these young shoots. Rooting will be facilitated if the shoots are first injured in some way, as twisting, girdling or ringing. Each shoot in the stool forms a root system near its base, making in most cases a straight, strong and stalky plant. Mound layering is best adapted to the low-branched trees or shrubs that are stiff and erect and will not permit bending, as, for example, the English gooseberries or the quince.

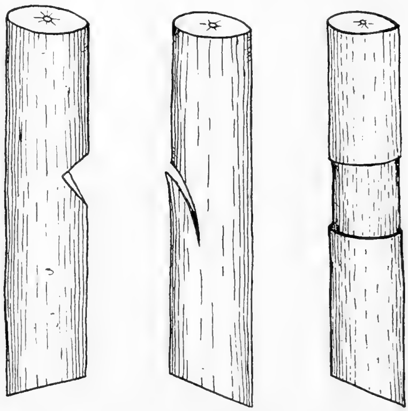


Fig. 27.—Notching, tongueing and ringing.

Tip Layering.—Plants that have willow-like branches or canes similar to those found on the raspberries are propagated by tip layering. Tip layering is performed by bending the cane or branch of the plant down to the ground, where it is held in contact with the moist earth by being covered with several inches of soil. In a short time roots will be formed at the tip of the cane and a new plant will start to grow. When the young plant is well established the cane is severed and it is removed to a new location. Tip layering is so named because the plant is rooted at the tip of the branch.

Trench Layering.—Trench layering is performed by digging a shallow trench and laying the branch of the plant in the bottom of the trench. The entire branch is covered with earth except the tip. The tip is allowed to grow out of the ground so as to draw the plant food through the portion of the branch which is covered. The covered branch should first be twisted or ringed so that it is slightly injured. This injury will stimulate the plant to send out roots. In some plants roots will form at each node, and in a short time several young plants will be developed from this branch. When the plants are well established, they are cut apart and each one set in a new location.

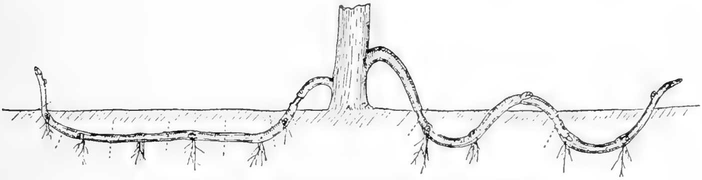


FIG. 28.—Trench and serpentine layering.

Serpentine Layering.—The serpentine layer is similar to that of the trench layer. It is usually practised on plants which have long flexible branches, as the grape. The name serpentine is taken from the way the branch is bent. Serpentine layering is done by bending the branch in an undulating manner and the roots form from every covered part. As soon as the roots develop, the top begins to grow, and when the plants are well established they are cut apart and set in their new location.

FIG. 29.—Aërial layering of the oleander. Note the moss is held around the branch by a divided flower pot.

Aërial Layering.—Aërial layering is propagation in which no soil is used as a medium in which to root the plants. Aërial layering is adapted to such plants as the India rubber plant and the oleander. Perhaps the plant which is most often propagated by this method is the rubber plant. To perform aërial layering the branch is first wounded by either ringing or tongueing. When this operation is finished the wounded part is covered up with damp phasgnum moss, which is tied around the wounded part. Sometimes a divided flower pot is placed around the branch and filled with moss. The moss must be damp and never allowed to dry out. It usually requires from six to eight weeks before sufficient roots have developed to remove the plant from the parent. When the roots have filled the moss the branch should be cut from the parent below the phasgnum. Set the new plant in a pot but do not remove the moss. Fill the pot with good soil and set the plant in a shady place for a week or ten days and keep the soil moist.

Time for Layering.—The spring, when the growth is the most rapid, is considered the most favorable time for layering. The operation is much more successful in a moist and a warm climate than in a dry or a cold one. Occasionally it is advisable to make the layer late in the fall so that the wound may callus over before spring, or that bleeding which occurs in some species in the spring may be obviated. Layering may easily be practised on many of the plants grown about the home. The grape, the currant or the gooseberry are easily propagated by layering, and for the amateur it is a very satisfactory method. Layering is a good method of propagation because the young plant is nourished by the parent until the roots are formed.

Cutting.—A cutting is a detached member of a plant which is placed in the soil or some other medium to be rooted. Cuttings are conveniently divided into four classes with respect to the part of the plant from which they are made: (1) Tuber cutting, (2) root cutting, (3) stem cutting, (4) leaf cutting.

Tuber Cuttings. — Tuber cuttings are made by dividing the tubers into sections containing a bud or an eye. The most common example is that of the potato. This method of propagation is common in the planting of potatoes. Each tuber is cut into a number of pieces with each portion containing one or more eyes. Several other plants

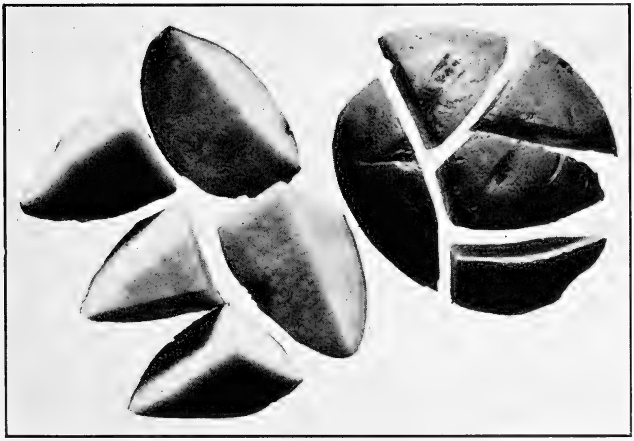


Fig. 30.—A tuber cutting.

Fig. 31.—A plant grown from a tuber cutting with the cutting still attached.

are propagated by this means. The essential requisite in the tuber cutting is to have an eye in each piece.

Root Cuttings.—Many plants can be multiplied with ease by means of short cuttings of the root. This is particularly true of all species that possess a natural tendency to sucker. True root cuttings possess no buds, and the buds develop after the cutting is made. The roots are cut into pieces, varying from 1 to 3 inches in length and are planted in the soil horizontally. Root cuttings thrive better if bottom heat is given. Many of our fruit trees, such as the apple, the pear, the cherry and the peach, can be easily grown by root cuttings, as well as many brambles such as the blackberries and the raspberries. However, it is never recommended that the fruit trees be propagated by root cuttings, except only where stocks are wanted for grafting or budding. The horse-radish furnishes a familiar example of propagation by root cuttings. This plant is thus propagated in a commercial way and is practically the only means of securing a stand.

Stem Cuttings.—Stem cuttings are made from the stem of a plant. They are divided into three general classes: (1) Soft or green-wood cuttings; (2) semihard-wood cuttings; (3) hard or mature wood cuttings. The classes gradually shade into each other and no hard-and-fast line can be drawn between them.

Green-wood Cuttings.—A green- or soft-wood cutting is made from a plant which is in active growing state. Green-wood cuttings are very popular because they strike root quickly. Soft-wood cuttings can also be handled very easily under glass in the winter, and more species can be propagated by this cutting than by the hard-wood cutting.

A green-wood cutting is sometimes called a slip. The term is usually restricted to designate those cuttings which may be made by pulling or slipping off of a small shoot. The term slip should be discarded since cutting is by far the more proper to use. The term slip is also applied to the multiplication of plants that are grown in the window garden. All of the soft-wooded plants and many of the ornamental shrubs may be increased by green-wood cuttings.

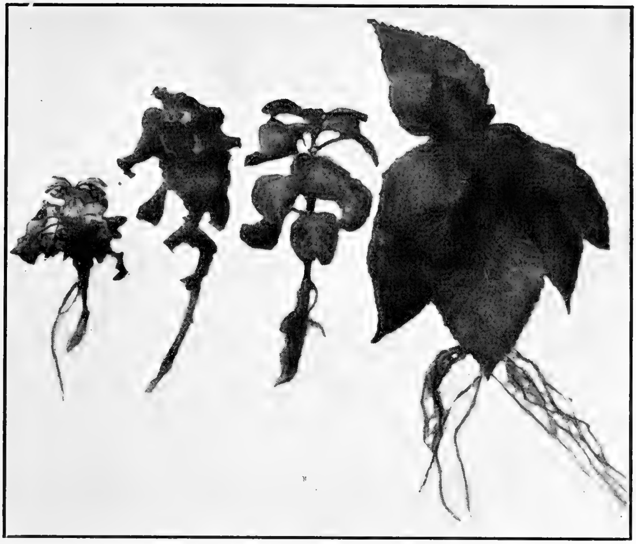


FIG. 32.—Green-wood cuttings.

FIG. 33.—Division of a plant.

Hard-wood Cuttings.—Hard-wood cuttings are made from mature and dormant wood of the woody plants. Hard-wood cuttings are taken either in the late fall or in the winter. They differ from the soft-wood cuttings in having no leaves and in bearing buds that are dormant. Hard-wood cuttings should be taken from wood of the previous season's growth, and they should be shoots of medium size.

The length of a cutting depends somewhat upon the plant as well as upon the length of the internodes. Usually it is made 6 inches in length, but in some plants and under some conditions the length may vary from 8 to 10 inches. In the grape, where a three-eye cutting is used, it must of necessity be from 7 to 10 inches in length. On the currant, the gooseberry and many of the ornamentals, where the internodes are short, it is advisable to make the cutting 6 inches in length. In taking the cutting it is considered wise to make the cut on the proximal end just below a bud because it is thought roots will start more readily when cut at that point.

Storing and Handling of Hard-wood Cuttings.—Cuttings made from dormant wood must be gathered in the fall and the winter and stored until spring to produce the best results. They are usually packed in damp sand and stored in a cellar that is cool and moist. Sufficient warmth should be present in order to permit the callousing of the ends and to encourage root development but not heat enough so that the buds will swell. Damp sawdust, clean sand or a loose loam furnish the best mediums in which to store the cuttings. They can also be buried in the open ground below the frost line.

Hard-wood cuttings treated in this manner will develop root protuberances before any top growth takes place. When the cuttings are taken directly from the parent plant and placed under conditions that favor leaf growth before callusing has taken place the resulting plants will be inferior to those which have been allowed to callus over. Just why this should occur is not definitely known, except that the callusing of the tissue in some way stimulates the formation of a good root system, which in turn gives a healthy and robust plant.

Semihard-wood Cuttings.—Semihard-wood cuttings are made from wood that is nearly mature. Common examples are the roses and the hydrangeas. These cuttings are often made in the late summer or the early fall when the buds have become fully developed and the wood has partially matured. Semihard-wood cuttings occupy a place midway between the soft-wood and the hard-wood cuttings. They are cut about the same length as the hard-wood cuttings, and are not stored but are planted at once in the propagation bed. Bottom heat should be provided if the best results are to be expected, especially if they are rooted in the fall or the winter. Semihard-wood cuttings should not be planted too deeply and from $1\frac{1}{2}$ to 2 inches is about the proper depth. The length of the semihard-wood cuttings varies, and ranges from 3 to 5 inches. One leaf is attached to each cutting.

Methods of Handling Soft-wood Cuttings and Semihard-wood Cuttings.—The soft-wood and the semihard-wood cuttings are not handled in the same way as the hard-wood cuttings. Since the tissue is soft and green and in a growing state, it would be highly injurious to the cuttings if they were stored in any way before being planted. Owing to the nature of the wood from which they are made it is essential for them to be planted directly in the propagating bed as soon as they are made.

The propagation bed is of any convenient size. It sometimes consists of only a shallow pan or a saucer in which some clean, sharp sand has been placed. This is sometimes called the saucer method for the propagation of cuttings. Flats of any standard size may be used as receptacles for holding the sand. The best and the most efficient place to construct a propagating bed is in a greenhouse. A given amount of greenhouse bench space should be provided and filled with clean, sharp sand free from organic matter. It is important that no organic matter of any kind is in the sand, since this often causes great injury to the cutting by rotting.

The cuttings are placed in the sand of the propagating box as soon as they are removed from the plant. When the soft-wood cuttings are propagated about two-thirds of the leaf surface is removed in order to reduce the transpiration. It requires from three to six weeks for the cuttings to strike root and with some plants even a longer time is necessary. Gentle bottom heat is valuable in assisting or stimulating the cuttings to form roots. As soon as roots have been formed, the cuttings are potted in small thumb pots and shifted to larger sizes as the plants grow.

REVIEW QUESTIONS.

1. What two kinds of reproduction occur in plants?
2. What is sexual reproduction; vegetative reproduction?
3. How does sexual reproduction differ from vegetative reproduction?
4. Name ten kinds of vegetative reproduction.
5. What is a bulb?
6. How are bulbs propagated?
7. How does a corm differ from a bulb?
8. What is a rhizome; a tuber?
9. Differentiate between a rhizome and a procumbent stem.
10. What is the difference between a runner, a stolon and a layer?
11. What kind of plants are usually propagated by stolons and by layers?
12. What is tip layering and give an example?
13. Distinguish between a tuber cutting and a root cutting.
14. Differentiate between a stem cutting and a leaf cutting.
15. Discuss the storing of hard-wood cuttings.
16. How do semihard-wood cuttings differ from soft-wood and hard-wood cuttings?
17. Why must soft-wood cuttings be handled differently from hard-wood cuttings?
18. Discuss the planting of soft-wood cuttings.

CHAPTER VI.

BUDDING AND GRAFTING.

BUDDING.

PROPAGATION by budding consists in placing a bud of the desired variety bearing little or no wood under the bark of the stock, in such a way that the cambium layer of the bud and the stock are in apposition. The bud is a branch bud attached to a small piece of bark. The stock is the part of the plant on which the bud is placed. The bark of the stock is closed over the bud in some cases. In other cases the bark is removed entirely, and the bud is tied firmly to the stock. If the operation is successful the bud and the stock will fuse together and in due time the bud will grow and make a new plant.

Time to Bud.—The proper time to do budding varies greatly with the locality as well as with the plant. It is very important when budding to select a season of the year when the plant is not growing too rapidly, in order that strangulation of the bud will not take place. Strangulation is caused when an abundance of sap is present in the plant tissue and after the incision is made for the bud the wound bleeds profusely. When the bud is placed in the incision on the stock, the flowing out of the sap is so great that it prevents the bud from uniting to the stock, and in many cases it is washed out of place.

Budding is performed during the growing season, but at a time when the plant is not too actively growing. Aim to select a time when the growth is on its down path after its zenith has been reached, and when the plant is beginning to prepare itself for the winter. In some sections of the North budding is usually performed during July, August, or early

September. In some parts of the South, however, budding is done in June and is then known as June budding.

FIG. 34. — A bud-stick, showing the method of cutting the buds.

Cutting of the Bud.—The cutting of the bud must be done with great precision. A sharp, thin-bladed knife, of which there are several styles on the market, is to be preferred. Select a budding knife made of the best steel, and one that has a circular cutting end. The curved end of the knife is essential for making the incision in the stock. In some budding knives the handle runs to a thin scalpel at the end, and this part is designated for the lifting of the bark on the stock.

The bud is cut about an inch in length. In the shield or the prong bud, the budder can either cut up or down on the stock. The cutting is determined by the inclination of the person doing the budding, although the upward cut is preferable. In removing the bud there is usually a small bit of wood that is taken off with it, especially in shield and prong budding. There is some difference of opinion as to whether or not this wood is injurious to the subsequent growth of the plant. Where there is a large amount of wood left on the bud it should be removed, but where only a thin piece exists it can remain. The greatest disadvantage of having a small piece of wood attached to the bud is that the wood interposes a foreign body between the two healing surfaces. In other forms of budding no wood should be permitted to remain on the bud. The edges of all buds must be cut even and smooth and not left ragged or broken.

Shield Bud.—Shield budding is perhaps the most important kind of budding. It is the form most often practised. It takes its name from the shield-like shape of the portion of bark bearing the bud. It is also called T budding because of the T-shaped cut made in the stock for the insertion of the bud. This method of budding is also called eye budding by some propagators.

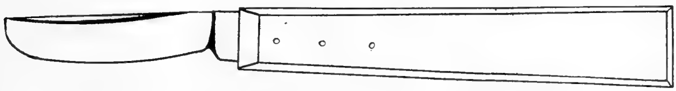


Fig. 35.—A good type of non-folding budding knife.

The bud is cut from the stock by either a downward or an upward sloping cut. A sharp knife is necessary in removing

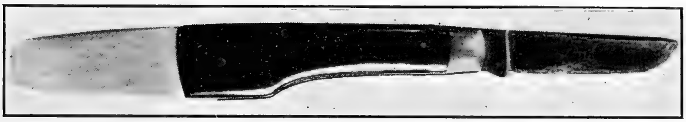


Fig. 36.—An excellent type of a folding budding knife.

the bud, and as little of the wood as possible should remain attached to the bark. While it has never been proved that

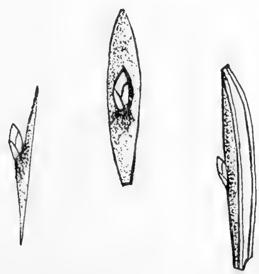


Fig. 37.—Several views of the bud for shield budding, showing the shield-like shape.

the wood is very injurious, it is apparent that an inert object back of the bud would interpose a foreign substance and would prevent the complete union of the bud with the stock. After the bud has been removed it resembles a shield in shape and in appearance. It should be from one to one and one-half inches in length.

To practice shield budding a vertical cut is made about one and one-half inches in length. On the stock at the point

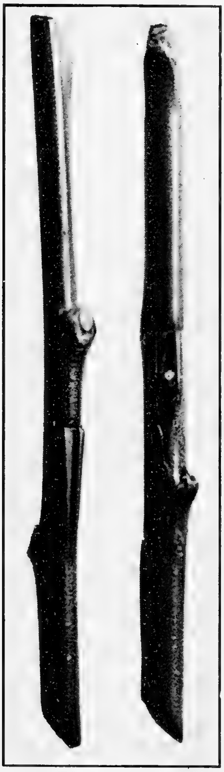


Fig. 38.—Successive stages in shield budding.

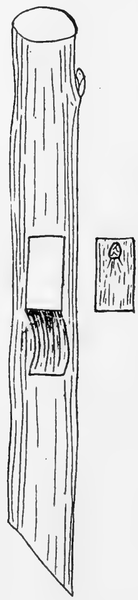


Fig. 39.—Plate budding, showing the cut on the stock and the bud.

where the bud is to be inserted a second cut is made about one-half inch in length, and placed near the top of the vertical cut and usually at right angles to it. In certain sections of the South the transverse cut is made at the bottom of the vertical cut, which gives the appearance of an inverted ⅃, while in some other sections of the country the cut is made at the top which forms the letter T in an upright position. There is little difference seen in the subsequent results no matter what method is used, and it is usually left to the individual as to which way the cut is made.

Plate Bud.—Plate budding is not a very important commercial form. It is occasionally used on some of the ornamentals and some other rare stocks. Plate budding takes its name from the plate-like piece of bark that is cut and allowed to hang down in the form of a hinge. Plate budding is performed as follows:

A rectangular incision one-half to three-fourths of an inch in width and one to one and one-fourth inches in length is cut through the bark on the stock. Three sides of the bark are cut, leaving the fourth intact. This method of making the incision permits the bark to bend back on the fourth side, forming a hinge. The bud is cut rectangular in shape to fit the cut made on the stock. No wood should be attached to the bark bearing the bud. The bark should be cut in such a way that the bud will be closer to the upper edge of the bark. The bud is then fitted to the stock and the flap of bark on the stock is turned up over the bud and firmly tied in place. The cord used for tying should pass around the stock underneath the bud, so as not to interfere with the subsequent growth of it. In this method of budding the bark serves as a protection to the bud until it starts its growth.

GRAFTING.

Grafting is the vegetative multiplication of plants. A cion which is a twig with one or more buds is inserted into the stock of a plant. The cion is usually placed into an incision or a cleft in the stock, made for that purpose. Grafting is divided into several different types. Each type is designated by the way in which the stock and the cion are joined. It is also classified with reference to the position of the union upon the plant.

Four general classes of grafting are usually made with reference to the position of the cion on the stock: (1) Top grafting, which is the grafting in the top or in the branches of the tree. Under this head is usually included cleft and bark grafting. (2) Stem grafting, which is the grafting in the trunk or the main stem of the tree. Under this head is included side grafting and sometimes bridge grafting. (3) Crown grafting, which is the grafting performed at or near the crown of the plant, just at the surface of the ground. (4) Root grafting, which is the grafting done entirely upon the roots, or in which the stock is a root. For the purpose of description the best classification is that which considers the ways of making the union. There are many modifications of each form of grafting and only the most important types are discussed.

Purpose and Value of Grafting.—Grafting as well as budding is used to perpetuate and to propagate a known variety of a plant which may be either a fruit or ornamental. It is a vegetative means of plant multiplication in which a plant of known quality is propagated in a commercial way. It is of great value, because it enables the grower to multiply and to increase a good variety, which might be lost if propagation by seed was undertaken. Grafting is also of value because the grower is sure just what his new plant is going to be and he knows for a certainty that the new plant will be like the parent plant.

Uses of Grafting.—Grafting is used for several reasons, of which some of the most important are: (1) To perpetuate a known variety. This is the most important use of grafting. (2) To increase the ease and the speed of multiplication of plants. (3) To produce some radical change in the habit and the nature of the two parts. Grafting will modify the stature of a plant. It is the most common means of dwarfing trees. The pear is dwarfed by grafting it upon the quince, and the apple by grafting it on the dwarf paradise stock. (4) Grafting may be used to adapt plants to adverse soils. A common example is seen when the plum is grafted on the peach so that the plum can be grown on a sandy soil, and *vice versa*. (5) Grafting may be used to correct a poor habit of growth, as, for example, the Canada Red apple which has a straggling habit of growth, is grafted on some straight growing tree, as the Tolman Sweet. (6) Grafting is a means of hastening fruitfulness. It has been demonstrated that cions placed in old and mature trees will bear earlier than if they are placed in young growing trees. (7) Grafting in some cases will modify the color of the foliage, the fruit and the flowers of certain plants. (8) Grafting increases the size of certain fruits, as, for example, the fruit of a few varieties of pears is larger when grafted on the quince than when grown on the standard trees.

Cion.—A cion is a twig taken from a tree which is to be used for grafting. The size is determined by the method of grafting, and by the quantity of available grafting wood. Cions vary in size from one bud to six or seven buds and in some cases even more. The latest work on grafting, however, would indicate that the number of buds should be either three or four. Taking this number of buds as a basis, the length of the cion would vary from three to five inches.

The cions can be collected any time in the fall after the leaves have fallen, or in the spring. It is thought better, however, either to cut them from the tree before they have frozen, or to wait until they have thoroughly thawed out. It is sometimes injurious to cut the cions from the trees while they are frozen. In case the cions are not used for root grafting, and have to be held over winter they must be carefully stored in a cellar. The best way to do this is to cut the cions from the varieties selected, tie them in bundles, label each bundle carefully and cover them with damp sand or sawdust, then place them in a cool cellar. The temperature must be low enough so the buds will not start into growth. About 35° F. is a good temperature to maintain in storing the cions. The cions should not be permitted to freeze or to dry out while in storage.

The cions should always be cut from healthy mature trees. Only the best twigs from the current season's growth should be selected. Wood that is two years old is occasionally used but never recommended, where the best results are desired. While the two-year-old wood will occasionally grow it will never produce as good plants as the younger wood. Occasionally, well-matured water sprouts are used, but this kind of wood is not recommended unless it is impossible to get enough of the better wood. The growth at the tips of the branches of a mature tree is by far the best cion wood, and whenever it is possible wood of this kind should be chosen.

Stock.—The stock used in grafting is that part of the plant into which the cion is placed. It varies in size and in age. Sometimes the stock is a small root, other times it is a small twig, occasionally it is a trunk of a tree, and sometimes it is a branch one or two inches in diameter. Therefore the size or the age of the stock is determined by the kind of grafting. If the best results in grafting are expected, the stock should be in good condition, so that growth will start at the proper season.

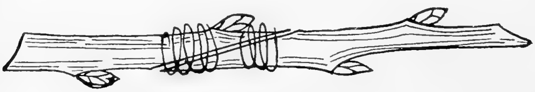


Fig. 40.—The splice graft.

Splice Graft.—Splice grafting is the most simple kind of grafting. As its name signifies, it is nothing more nor less than the splicing together of two plants, both of which are about the same size. One part is called the stock and the other part is called the cion. To make this graft, the cion and the stock are each cut diagonally across and the two cut surfaces are placed in contact with each other. The diagonal cut should be from one to one and one-half inches in length. The two parts should be placed so that the cambium layer in each piece is in contact at one or more points. The two pieces are then tied together firmly with grafting cord, and occasionally they are waxed over. Splice grafting is commonly employed on such plants that have soft and tender wood which will not split without injury to the parts.

Tongue Graft.—The tongue graft is very similar to that of the splice graft, and it might be regarded as a modification of it. In the tongue graft a split is made in addition to the diagonal cut of the splice graft. The split in the two parts ensures them of being held more firmly together. This form of grafting is also called whip grafting, and the expression of tongue and whip grafting is often heard. Tongue grafting is employed only upon small stocks, and in the majority of cases a seedling root is the stock which is used for this kind of grafting. The tongue or whip graft is very important in the propagation of nursery stock, because it is easily made, and usually a good percentage of the grafts grow. This graft is used almost universally in root grafting. When selecting the root for the stock, all knots or shoulders should be avoided, because they will interfere with the work.

FIG. 41. — A piece-root whip and tongue graft.

To make the tongue or whip graft, select stocks and cions which are of one size. The same size for each part is not absolutely necessary but very convenient. Cut both the cion and the stock diagonally across. The diagonal cut should be from one and one-half to two inches in length. One-half inch from the end on the diagonal cut make a slit about one-half inch in length on both the stock and the cion. Do not split either the cion or the stock, because that will leave a rough surface, and the two parts will not fit together tightly. The stock and the cion are now fastened together by shoving the tongue of the cion into the cleft of the stock. The two parts are held together by tying them firmly with grafting cord or with raffia. In nursery work a method often employed is to firmly force the two parts together without tying; and pack them carefully in boxes. The grafts should then be covered with sand. By careful handling, the two parts will callus over and become united and a strong union will be made before the time arrives to plant the grafts.

Root grafting is usually performed in the winter when other work is scarce. After the grafts are made they are stored away in a cool cellar, and usually covered with sand until the following spring, when they are set out in the nursery row. A temperature of about 35° to 40° F. is required for storing the grafts. In tongue or whip grafting the cion usually bears from three to four buds. The number of buds, however, is also determined by the section of the country in which the grafting is done. When root grafting is performed in the northern sections where winter killing is apt to occur, sometimes long cions taken from trees that are acclimated to that region are used. Cions eight or ten inches long are used in these regions because they can be planted deep, and roots will finally develop on the cion. In such a case if the stock of the graft is winter killed the plant will still grow. The piece of root on which the grafting is done acts as a temporary support and aids the plant to get started.

FIG. 42.—A root graft after one year. Note the union in the longitudinal section.

Saddle Graft. — Saddle grafting is usually employed upon herbaceous plants or plants that have thick fleshy tissue like the cacti. It is very convenient for grafting small plants. In making the saddle graft the cion is split near the middle. The stock is then cut wedge-shape by two draws of the knife, and the cion fitted over the wedge and secured in some way. In the grafting of cacti by this method it is the common practice to use one of the spines to hold the two parts together.

The union of the two parts will soon take place. In woody plants the graft is tied in the same manner as the splice or the tongue graft. Occasionally the joint is waxed over. The saddle graft is employed principally when a terminal bud is used.

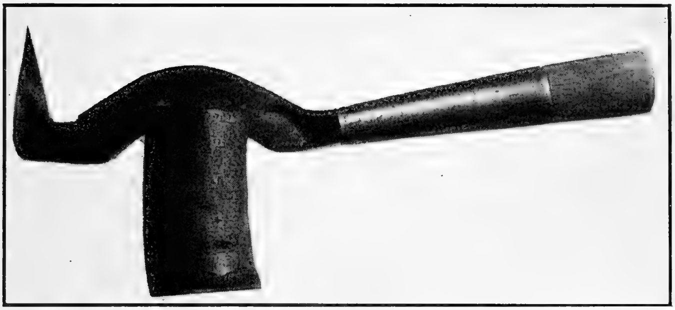


FIG. 43.—An excellent grafting chisel, showing the first position in the cleft graft.

Cleft Graft.—Cleft grafting is preëminently the form of grafting that is the most popular in the top working of trees.

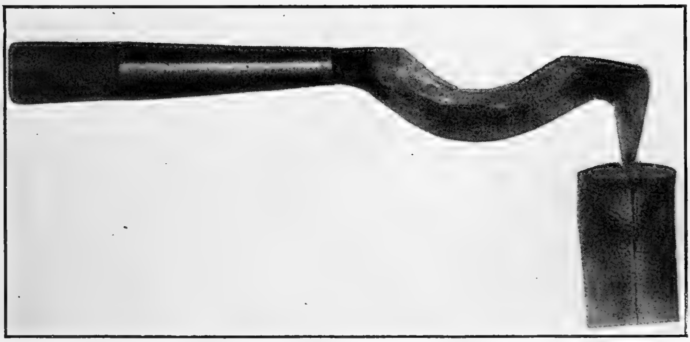


FIG. 44.—The second position of the grafting chisel in the cleft graft.

It can be successfully used on limbs up to about two inches in diameter, but it is not considered valuable for use on larger limbs. When the cion is placed in larger limbs the pressure of the two parts of the stock is so great that the cion is crushed. To make a cleft graft the limb is selected and sawed off squarely. It is then carefully split with a grafting chisel. If no grafting chisel is available, fairly satisfactory work can be done with a wood chisel of the proper size. In cutting the stock select a place free from knots, because a clean straight cut will not result if the chisel strikes a knot in the wood.

The remaining portion of the limb after the top is cut off is called the "stub." The stub is usually large enough to accommodate two cions. Occasionally under certain circumstances, four cions are placed in a stub, but this is the exception rather than the rule.

FIG. 45.—The cleft graft with the cions in position.

FIG. 46.—The bark graft with the cions in position and the stub waxed.

The cions are cut wedge-shape at the base and are inserted into the cleft made in the stub. The cions bear from two to four buds, but the number usually preferred by most grafters is three. The cions are cut by two draws of the knife, and one side should be slightly narrower than the other. This double wedge aids in holding the cion more securely in the stub. The narrow side of the cion should face toward the center of the stock. To insert the cions in the stub, first spread apart the two halves of the stub by means of the wedge on the grafting chisel. In placing the cions in the stock, the utmost care must be exercised to see that the inner bark of the cion and the stock come in contact with each other, so that the cambium layers of the two parts are together. The matching of the cambium layer of the cion and the stock is made more certain if the cions are slanted outward at a slight angle. The cions should be forced into the cleft to the first bud and sometimes deeper. The wedge should be made from one to one and one-half inches in length, and fit snugly into the cleft.

After the cions are placed in the stub and properly adjusted, the cut surfaces should be covered with grafting wax. The wax should extend over the stub for a quarter of an inch. Fill the split along each side of the stub with wax in order to prevent infection of any kind entering the stub. The bark graft is similar to that of the cleft graft, except the cions are placed between the bark and the wood. Bark grafting is used on larger limbs than cleft grafting.

Bridge Graft.—The bridge graft is considered a form of bark grafting. Bridge grafting is not used as much as its value would warrant. The purpose of the bridge graft differs somewhat from that of the other forms of grafting already enumerated. The bridge graft has for its chief purpose the preservation of a tree, rather than the propagation of it. The principal use of the bridge graft is to preserve and to save trees which have been either girdled by rodents, such as mice or rabbits, or to repair trees that have been injured by cultivating implements. To use this graft the injured portion of the tree must first be cleaned out. All of the ragged edges must be made smooth. The bruised parts must be cut back to the firm bark. In order to loosen the bark so the cions can be inserted, a longitudinal slit should be made both above and below the wounded area, at the points where the cions are to be placed. The edge of the bark should be slightly raised to give a point of entrance for the end of the cion. The cions must be cut two inches longer than the space to be bridged. Each end of the cion

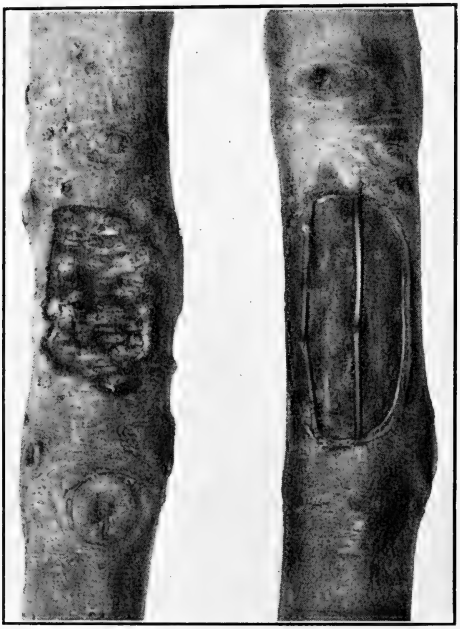


Fig. 47.—Bridge grafting of a wounded trunk.

is bevelled off on one side, and the bevelled face is placed against the wood of the limb. The cions are placed from one and one-half to two inches apart. When the cions are in place the whole surface should be covered with grafting wax.

Top Working of a Tree.—The cleft graft and the bark graft are the two forms of grafting used in the top working of large trees. The cleft graft is by far the most important and it is principally used in working over old trees. It is preferable to graft the smaller limbs which are better suited to cleft grafting than to bark grafting.

The top working of a tree is very important in many instances. It enables the grower to change an inferior sort to a good variety, after the tree has come into bearing. Occasionally it is desirable to change a given variety after the tree has become large. Top working the tree by cleft

FIG. 48.—An apple tree top worked by cleft grafting.

grafting is the only practical method. Sometimes varieties are sterile and it becomes necessary to graft other fertile varieties into these barren trees before any fruit will set.

Whenever top working is practised to any great extent, it is necessary to extend the operation over a period varying from three to five years. A period of this length is necessary because when a tree is severely headed back the balance between the top and the root is broken. As a result of this unbalanced condition a large number of water sprouts will be formed. The excess number of water sprouts can be prevented if a few limbs are grafted each year. This practice enables the plant to maintain a better equilibrium and therefore furnishes better growing conditions for the grafts.

Grafting Waxes.—There are three distinct kinds of grafting waxes: (1) Beeswax and resin waxes, (2) Pitch waxes, (3) Alcoholic waxes. Within each kind of wax there are many modifications, determined largely by the varying proportion of the ingredients. The beeswax and resin wax is generally used, because it is simple to make and is composed of materials that are easy to procure.

Beeswax and Resin Waxes.

formula 1.

Resin	4 pounds
Beeswax	2 "
Rendered beef tallow	1 "

Place the ingredients in a granite or an iron kettle and melt them until they are thoroughly incorporated. Remove the kettle from the fire and allow the mass to cool slightly, after which pour it directly into a vessel containing cold water. As soon as the mass is cool enough to handle, remove it from the water and work it with the hands until it assumes a light brownish, or a creamish color. The wax should now be made into balls of any convenient size and each ball wrapped in oiled paper until it is used.

The hands are first greased with tallow when working the grafting wax. The tallow prevents the sticking of the wax to the hands.

Where a very hard wax is wanted, and especially in the warmer sections of the country, a larger quantity of resin should be added to the mixture.

Pitch Waxes.

formula 2.

Resin	2 pounds
Burgundy pitch	1 "
Rendered beef tallow	$\frac{1}{2}$ "
Red ochre	1 "

Place the resin and the white pitch into a granite or an iron vessel and melt them. Melt the beef tallow in a separate vessel and add it while hot to the other melted mass. Now slowly stir the red ochre into the mixture. This can be used either hot or cold.

Alcoholic Waxes.

FORMULA 3.—LEFORT'S LIQUID GRAFTING WAX.

Resin	1 pound
Rendered beef tallow	1 ounce
Alcohol	8 ounces

REVIEW QUESTIONS.

1. What is propagation by budding?
2. When is the proper time to perform budding?
3. Discuss the cutting of the bud.
4. Discuss the growth of the bud after it is inserted in the stalk.
5. Differentiate between the shield and the plate bud.
6. Tell why shield budding is the most important form of budding.
7. Differentiate between grafting and budding.
8. What is the purpose and the value of grafting?
9. What is meant by the terms cion and stock?
10. Discuss the uses of grafting.
11. When is tongue grafting usually performed?
12. What is the difference between cleft and bark grafting?
13. Where is the bridge graft employed?
14. Discuss the top working of trees.
15. Give one formula for each kind of grafting wax.

CHAPTER VII.

THE PESTS OF CULTIVATED PLANTS.

THE great damage done to the crops grown both in the home as well as in the commercial garden is caused by several classes of pests. These pests briefly stated are: (1) insects, (2) plant diseases, (3) physiological troubles, (4) predaceous animals.

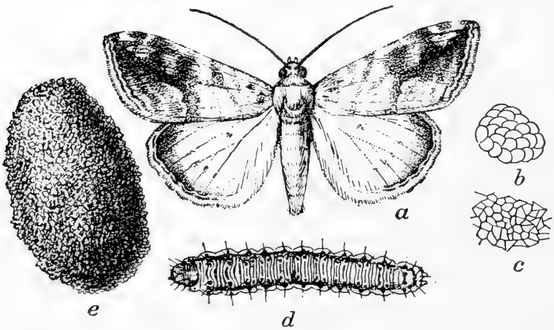


FIG. 49.—Southern cabbage worm, showing complete metamorphosis. *a*, adult; *b*, egg mass; *d*, larva or worm; *e*, cocoon. (Chittenden, United States Department of Agriculture.)

Few people realize the enormous loss due to these enemies, chiefly because many growers are neither familiar with the injury by the insects, nor do they see the small microscopic parasitic plants which sap the vitality from the growing host. The injury usually develops slowly, and when it is discovered it is too late to remedy the damage. Many people, who are close observers, know their plants are not doing as well as they should, but they are not familiar enough with the habits of the insects or appearance of the plant diseases to correctly diagnose the trouble.

INSECTS.

The insects are divided into three groups: (1) the biting or chewing insects, (2) the boring insects, (3) the sucking insects.

In order to understand insect injury, the reader must first know the various stages of the life history through which insects pass. The changes in the life of an insect are known as metamorphosis. Complete and incomplete metamorphosis are recognized in the life of the different insects.

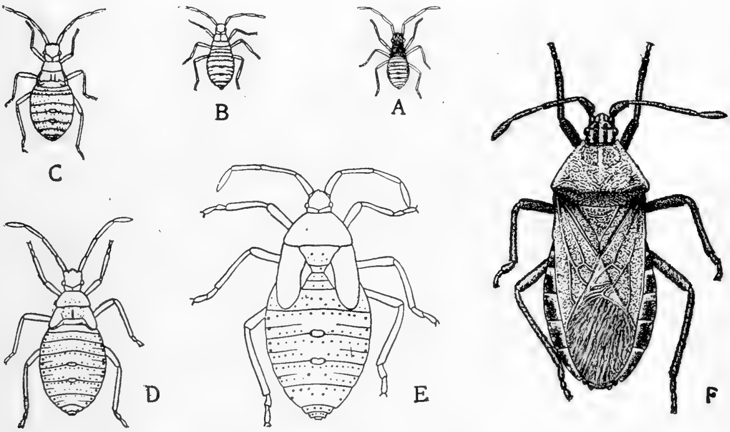


Fig. 50.—Showing the successive stages of the squash bug which is the incomplete metamorphosis. (Folsom.)

Complete metamorphosis means that the insect passes through four complete changes during its life. Beginning with the adult, we arrange the stages in the life history in the following order: (1) the egg stage, (2) the larva stage, (3) the pupa stage, (4) the adult stage. The adult lays the egg from which hatches the little worm or the larva. The worm eats the plant upon which it is placed, continues to grow larger and to consume more of the plant tissue until it finally reaches its full growth. When this feeding period is finished, the worm goes into a quiescent stage, and this stage is called the pupa. During the pupa stage the insect does no damage, but remains quiet while internal changes are taking place, and an entire reorganization of its body goes on. When the transformation period is completed the insect emerges from the pupa case or the cocoon as a full-grown insect, as, for example, a butterfly, a moth, or a beetle. These forms are called the adults. By far the greatest damage which is done by most of the insects is in the larva or the worm stage, but a few adult insects do great damage. It is because of this change in the form of an insect that it becomes imperative for the grower to know the life history of an insect before adequate measures of control can be used.

Incomplete metamorphosis is, as the term signifies, an incomplete change in the development of an insect. The adult form is reached without going through the four stages necessary in complete metamorphosis. In incomplete metamorphosis the insect completes its life history without radical changes in its form. The insect hatches from the egg into a form resembling the adult, although considerably smaller and without wings. It begins to feed at once on its food plant and continues to feed for a longer or a shorter period of time, going through several moults, in which it sheds its skin when it gets too large for the old one. After passing through several of these moults, the number being determined by the species and the food supply, the nymph becomes an adult. Such insects as the common grasshopper, the cockroaches, the bugs, and several more belong to this class.

The growth of insects with incomplete metamorphosis is somewhat different from those with complete metamorphosis. It is a known fact that the skin of an insect hardens, due to the presence of a horny substance known as chitin. This hardening usually occurs to a greater extent in the adults than in the young. However, in all insects with incomplete metamorphosis the skin soon becomes so firm that it cannot stretch, and consequently this hardening prevents any more growth from taking place. The result is that the skin becomes too small, and it must be shed before the insect can grow. As the old skin grows hard a new skin forms under it and the old hardened skin splits and bursts open, permitting the insect to crawl out, clothed in a new skin which stretches for a short time. This new skin finally hardens again, and the process must be repeated. After several such moults, the insect reaches the adult stage and never passes through a quiescent or a pupa stage, but always resembles the parent.

Control Measures for Insects.—Insecticides are used for the control or the prevention of insect injury. An insecticide may be defined as a chemical, either liquid or powder, that is used for the killing or the repelling of insects. An insecticide should be applied to the plant before any great amount of damage is done.

Insecticides are divided into two classes, according to the way in which they control the insect, and based upon the manner in which the insect does its feeding upon the plant. When the insect devours or eats up the plant it is called a chewing or biting insect. It is apparent that if some poison is deposited upon the plant where such insects are feeding, it will kill the insect enemy. In such case the insect is destroyed by the direct effect of the poison acting through its digestive tract. The great majority of the insecticides used for this purpose contain arsenic as the active poison, and it is from this source that the name arsenical insecticide has been derived. Paris green and arsenate of lead are the most common arsenical poisons for the biting insects. Common examples of chewing insects are the cabbage worms, the webworms, and all of the caterpillars.

Besides the eating or the chewing insects there is another large class, known as the sucking insects, that is exceptionally injurious to growing plants. These are the most injurious to the woody plants. Sucking insects cannot be killed by any arsenical spray, because they do not eat the plant tissue, and consequently it is a waste of time and a needless expense to apply arsenical sprays of any kind to the plant. Sucking insects, instead of devouring any part of the plant, insert their sharp mouth parts, which are constructed in the form of a long, narrow, cylindrical tube, through the plant tissue and suck out the plant juices. An insect that feeds in such a manner cannot be killed by coating the surface of the leaves or the stems with any stomach poison, because it is impossible for the poison to reach the stomach of the insect. Hence, in order to kill sucking insects, some material that will either smother the insect by clogging up the spiracles or the openings of the breathing system, or kill it by the corrosive action on the body of the insect, must be used. Insecticides of this class are called contact insecticides. Kerosene emulsion, tobacco sprays, and lime sulphur are the most common sprays for the sucking insects. Common examples of sucking insects are the scale insects, the plant lice, and many others.

Besides the biting and the sucking insects, a third class of insects exists that must be controlled in still another way. This group includes those insects that live in the tissue of the plant, and hence cannot be reached by either the arsenical or the contact insecticides. This class of insects includes all forms of borers, which burrow into the plant and spend their life within the plant tissue.

There are two methods for the control of the boring insects, namely, by the use of repellants, which are chemicals used to prevent the attack of the insect, and by the digging out by hand the insects after they have entered the plant. The boring insects can be destroyed by first locating the burrows which are usually detected by the exudation of gummy material, covered by the chewings and the castings of the insect. By the use of a sharp knife the bark can be cut away and the larva killed. Another method is to probe in the burrows with a piece of wire, thus killing the larva. Common examples of the boring insects are the peach tree borer and the locust borer.

Repellants.—Repellants are chemicals with unpleasant odors. These materials are placed either on the ground around the plants or distributed over the plants themselves. By the giving off of unpleasant odors they drive the insects away and in this manner the plants are saved from destruction. Turpentine and carbolic acid are often used as repellants. These materials are usually mixed with ashes or any dry powder and either spread on the ground around the plant or dusted over the leaves. Repellants are effective in controlling the striped cucumber beetle and many other insects.

Poisoned Bait.—Poisoned bait is very effective against certain kinds of insects, namely, the cutworms. Poisoned bait is made by dipping freshly cut clover into a strong mixture of Paris green and water or by making a stiff mash, composed of 6 pounds of bran to which about $\frac{1}{2}$ pound of Paris green or white arsenic is added. Use only enough water to hold the bran together. A small quantity of sugar or molasses is added to make it sweet. The bait is then placed in small piles which are scattered around the area to be planted. The best results will be secured if the baiting is done a few days before the time of planting.

PLANT DISEASES.

The diseases that affect the cultivated plants may be arbitrarily divided into: fungous diseases, bacterial diseases, and physiological troubles.

As we go more deeply into the nature of the changes which take place in the plant which are brought about by disease, it is necessary to distinguish between the different kinds. A plant may be diseased as a whole, because all or practically all of its tissue is in a diseased condition, such as occurs when a fungous or a parasitic plant invades all parts of the host. Again, a plant may die throughout, because some organ which is essential to its life is seriously affected, as for example when the roots rot, due to the presence of some parasite which hinders the supply of plant food. In a large number of cases we find the disease to be purely local and never extending into the rest of the tissue beyond that which is affected, and which only causes death to the affected part.

Symptoms of Disease.—Many amateurs and all experienced growers know that certain symptoms are present in the sick plant as well as in the sick animal. The symptoms in a sick plant vary according to the kind of a disease. Many symptoms are often present which indicate that the plant is not in a healthy condition, and it should be attended to at once, but further diagnosis is difficult.

Generally speaking, a common symptom in a physiological trouble is the yellowing of the leaves accompanied by wilting of the plant. This is usually attributed to the fact that the transpiration of water from the leaves is greater than the absorption by the roots. A similar condition is also noted when insects, such as the cutworms or the wireworms are eating the roots, thus cutting off the supply of food and water and causing the plant to turn yellow. The yellowing of plants also results from the presence of gases, either in the atmosphere or in the soil. This trouble is often found in cities where leaks occur in the gas mains, and it does great damage to shade trees and to ornamental shrubs. Where the root and the crown of the plant are injured from gas it results in the improper physiological process going on, which in turn prevents the transpiration of water and the entire plant is affected.

Fig. 51.—A diseased tomato plant.

The turning brown of little patches on the leaf with the dead portion finally falling out, leaving a small hole in the leaf, is usually a clear symptom of a fungous trouble. The brown and the discolored areas on fruit, such as the rots of the apple or the peach, are the outward signs of a fungous disease. The abnormal swelling of certain portions of some plants are indications that they are affected with some organism. Two well-defined examples of abnormal swellings are the black knot of the plum or the cherry and the crown gall of nursery stock. The sudden wilting of a plant is usually indicative of a bacterial trouble, which attacks the plant suddenly and cuts off the water supply by clogging up the water-carrying ducts or canals. In addition to the symptoms of unhealthy plants already mentioned several more exist which can easily be detected where the plant is carefully studied.

Fig. 52.—A diseased fruit.

Fungous Diseases.—These diseases are caused by small, microscopic, parasitic plants living upon the tissue and sapping the vitality from the host. Some fungous diseases spread to all parts of the plants, such as the leaf spot of the apple, while others are local and only affect a small portion, as the black knot of the plum or the cherry. The greatest damage to our cultivated plants may be attributed to the fungous diseases, because they are more numerous and affect the root, stem, leaves, and fruits. The potato scab and the apple scab are good examples of fungous diseases.

Control Measures for Diseases.—There are various means at our command for the control of many of the diseases that affect our cultivated plants. It is apparent, however, that different methods must be adopted for the different diseases on the plants just the same as different remedies must be used for the control of diseases in the human system.

Spraying, dusting, and controlling the conditions under which the plants are grown and removing the affected parts are some of the methods employed to save our economic plants from destruction from the various diseases that prey upon them. It is evident that certain diseases as well as certain insects cannot be controlled by spraying, and also that several sprays are needed to control the different kinds of diseases.

The fungous diseases can usually be controlled or at least held in check by the application of fungicides to the plant. The fungicide which is a chemical compound of some kind is either placed in water and sprayed on the plant or dusted on by some method.

The bacterial diseases cannot be controlled by the application of any fungicide and the only means of control is to cut away the affected part or destroy the entire plant.

The following troubles are a few that cannot be controlled by spraying, but must be held in check by other means: peach yellows, little peach, potato scab, melon wilt, pear blight, apple-twig blight, and dry rot of the potato.

Bacterial Diseases.—Bacterial diseases are caused by the action of small microscopic organisms commonly known as bacteria. These are very small, usually one-celled plants that live for the most part in the cell sap or in the juices found in the plant tissue. From the nature of their attack it is apparent that they are responsible for a disease that from its nature is extremely difficult to control. Since the bacteria are internal, either precautionary or very drastic means must be devised to hold them in check.

Bacteria ordinarily are extremely simple in form, and are usually confined to three types, namely spheres, cylindrical rods of greater or less length, and spiral rods. In size they are very minute, being by far the smallest living organisms known, and demanding the highest power of the microscope for their study.

Many bacteria have the power of motion, which is produced by slender, motile hairs arising from their bodies. By moving these little hairs back and forth the bacteria produce locomotion and change their position. These hairs are called flagella. Bacteria are divided into three easily recognizable divisions: (1) Coccus or spherical bacteria, (2) bacillus or rod-shaped bacteria, (3) spirillum or spiral bacteria.

Multiplication of Bacteria.—The common method of reproduction of bacteria is by simple division. Although this method is common to all bacteria, there are some forms which frequently reproduce themselves by the formation of

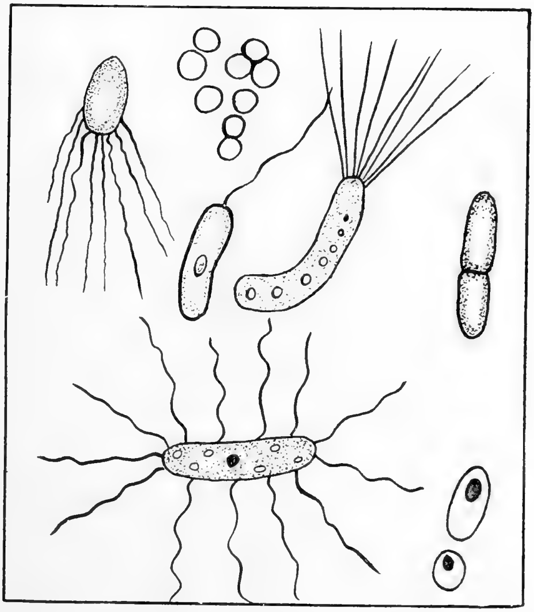


Fig. 53.—Several forms of bacteria greatly enlarged. (After A. Fisher.)

reproductive bodies called spores. The spores are formed in the body of the organism in the shape of small rounded masses, and later the body bursts open and the spores are set free. The spores are known as resting forms and their function seems to be to enable the bacteria to exist through unfavorable conditions. The spores have great vitality and they can be subjected to high temperature and to long periods of drought without suffering from such treatment.

The most important factor connected with the life of bacteria is their exceptionally rapid power of multiplication. The division of the bacteria which results in two plants often takes place in less than half an hour, and in less than half that time each division is again ready to reproduce. The reproduction in this ratio results in an increase in number which is almost inconceivable.

Bacteria are also divided into two kinds, with regard to their needs for oxygen. Most bacteria demand oxygen to enable them to grow, but there are some species, and these are quite numerous, that can live without a supply of oxygen, and in fact can only grow and multiply when in an atmosphere devoid of oxygen.

Bacteria bear the same relation to temperature as do other ordinary living organisms. If the temperature is high the multiplication of the bacteria is more rapid, and as the temperature approaches the freezing-point, the activity of the bacteria ceases. The temperature at which the maximum growth of bacteria occurs is quite variable and varies from 70° F. to about 95° F., while other forms will grow well at still higher temperatures.

Environment and Soil Sanitation.—The environment in which a plant is grown regulates to a large degree the prevalence of certain diseases. The "damping off" of seedlings is commonly due to poor environment. While it is known there is a definite cause for the trouble in the form of a fungus, it is conceded that if the proper growing conditions are maintained, the plants will not be attacked by this fungus. It has been demonstrated conclusively that if good fresh air is given, the proper temperature is maintained, and the correct amount of water is given at the right time, the seedlings will not be attacked by the fungi that cause this trouble. An oversupply of water accompanied by excessive heat affords ideal conditions for the growth of fungus troubles which often attack the plant and cause serious injury. The damping off of seedlings, while due primarily to a parasitic growth at the crown of the plant, is brought about by unfavorable conditions of growth of the parent plant and can only be controlled by regulating the conditions under which the plant is growing. The control for this trouble usually means the cleaning out of all diseased plants, withholding the water supply, and providing for better ventilation.

The cleaning up of the soil by steam sterilization or by the treating of it with formalin is also effective in destroying certain fungous diseases which are found in the soil. These fungi oftentimes remain alive for a number of years and attack the plants when they are planted.

It is always advisable, therefore, to have the soil clean and free from fungi. The plants should be grown where they will have plenty of sunshine and have a good circulation of fresh air so that the damp air will be blown away and never allowed to collect about the seedlings.

PHYSIOLOGICAL TROUBLES.

Any serious disturbance in the life processes of the plant which cannot be attributed to an organic factor, such as insect, fungus or bacteria, is called a physiological trouble. The peach yellows and the little peach are two common examples of injury that are included under physiological trouble. The most recent work on physiological troubles seems to indicate that the plants are growing under unfavorable conditions, and that there is a lack of certain elements in the soil which produces these troubles. In fact physiological troubles are not well understood, although more information is being gained every year and perhaps in the near future more suggestions can be offered.

Control Measures of Physiological Troubles.—No definite remedial measures are at our disposal for the control of the so-called physiological troubles. By that is meant that it is of no avail to spray or to treat the plant with any solution for the control of this class of troubles. A physiological trouble, as the term implies, is some interference with the natural process of the growth of the plant, and is thought to be the result of insufficient iron or some other element in the soil.

The only means of control, therefore, would be to supply the material that is lacking, so the plant will develop normally.

INJURY BY PREDACEOUS ANIMALS.

Predaceous animals include all rodents, such as mice, rabbits, woodchucks, and moles. The loss due to this class of pests is confined principally to the younger trees and to bushes, yet there are many herbaceous plants in the garden like the cabbage, lettuce, etc., which are often attacked and severely injured. The loss in the aggregate due to rodents is considerable, when all plants are included. The amount of injury would be far less than it is if the rubbish and the grasses which serve as places of concealment were destroyed. In the average home orchard and in the garden the danger of rodent injury is greater than in a commercial plantation, because the possible means of protection for the plants are more generally disregarded.

Control Measures fcr Predaceous Animals.—The injury done to plants by predaceous animals is due to the eating of the plant tissue by certain destructive rodents, such as mice, rabbits, or woodchucks. The control for such injury must of necessity be one of prevention rather than one of destruction. The control of the predaceous animals is accomplished by protecting the plant in such a way as to keep the animals away from the plants.

There are various ways and means which are used for the protection of our plants. The banking or mounding of soil about the trunk of the trees is often used. The mounding is not so very effective in itself, but when used in conjunction with other mechanical devices aids materially in the protection of trees. Mice in particular rarely ever injure trees, unless grass, manure or trash is found near their bases. For mounding to be effective the grass must first be cleared away from the base of the tree, and the soil thoroughly firmed about the base of the trunk. A covering of cinders well pressed into the soil should cap each mound. The mound should be from twelve to fifteen inches in diameter at the base and from five to six inches in height. The mound should be allowed to remain throughout the year, but it must be repaired from time to time to insure its efficiency.

The most complete and the most ideal plant protector is a wire screen. This protector is made of screen, the meshes of which vary in size from one-eighth to one-half inch,

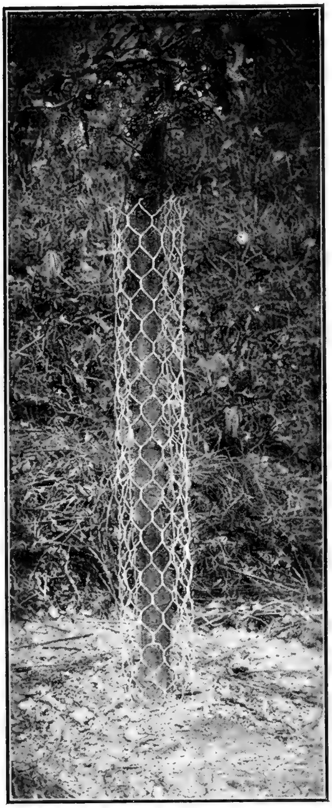


FIG. 54.—Tree protected by small mesh poultry netting. (After Ballou, Ohio Agricultural Bulletin No. 208.)

FIG. 55.—A combination of wire cloth and building paper as a tree protector. (After Ballou, Ohio Agricultural Bulletin No. 208.)

but the usual size is one-fourth inch. The wire screen protector is more expensive than the earth mound, but nevertheless it is considerably more effective against all kinds of rodents which prey upon the stems of young trees. The screen protector is light and open and presents the least obstruction to strong winds, yet at the same time admits the sun and the air. The wire screen neither affords any dark nor obscure places for the concealment of any kind of injurious insect pests.

The wire screen protectors vary in size, depending primarily upon the size of the tree. A good size that seems to be adapted to many trees is twelve by twenty-four inches. This protector is really nothing more than a piece of galvanized wire cloth with one-fourth-inch meshes. It is then bent or rolled over a small, round piece of wood, shaping it into a cylinder about two and one-half or three inches in diameter. The cylinder is then placed about the stem of the tree where its own tension will hold it in place. A protector made from the ordinary one-inch mesh, galvanized chicken wire is quite effective against rabbits, but this size of wire will not protect the trees from mice. Spiral wire protectors are sometimes made from a galvanized iron wire. The spiral protectors are in the form of a spiral or a spring, and while they are effective against rabbits they are not to be recommended generally. Their chief drawback is the large spaces between the wires, which permit the rodents either to squeeze through entirely or to push their heads in far enough to reach the base of the tree.

Probably one of the most effective plant protectors for all purposes is found in the wood veneer protector. This style is quite effective against all kinds of rodents. However, they are close and tight, and exclude almost all the light, and often various forms of insects harbor in the crevices and the rough portion of the bark and may become troublesome. The veneer protectors should be removed from the trees during the summer and replaced before winter.

In addition to the wire protectors already mentioned, which are classed as more or less commercial articles, there are several home devices which may be used with varying degrees of success. Cornstalks, for instance, are very effective against rabbits and ground hogs, and at the same time have the advantage of being very cheap. There is practically no cost to this material. The stalks should be selected as they come from the field and all of the leaves stripped off. Square the ends of the stalks by laying them on a board or a box and using a large knife. Cut the stalks into pieces about two feet in length. When the stalks are prepared five or six of them are bound firmly around the stem of the young tree.

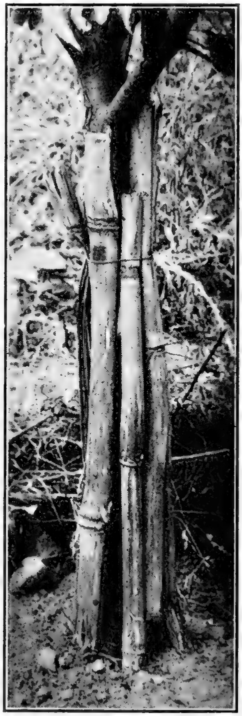


Fig. 56.—A tree protector made by tying cornstalks around it. (After Ballou, Ohio Agricultural Bulletin No. 208.)

A combination of the cornstalk and the wire-cloth protector is popular in some sections. This combination protector is made by an eight- or a ten-inch wire-cloth cylinder about the base of the cornstalk protector. If the tree has previously been well mounded up with soil, this combination protector completely baffles all kinds of rodents and makes the trees quite secure from their attacks.

Cylinders made from either the common heavy wrapping paper or the building paper make a very effective and a secure protection for the trees. The greatest drawback to this protector is its fragility and its short length of life. Only the heaviest wrapping paper should be used, and a good grade of building paper is preferred. These wrappers are placed on the trees—either in the form of a cylinder or wrapped spirally around the stem to the desired height. When the spiral method is adopted the paper is cut into narrow strips. Two points in favor of the spiral form, is that a crooked bodied tree can be more closely and more neatly covered, and that it is more resistant to the strong winds.

Cultural Control Measures.—The control of all pests affecting cultivated plants can be materially affected by cultural practices. Certain classes of pests, particularly insects, can be controlled easier than certain others, but relief can be had from many pests by following good cultural methods.

Crop rotation is an important factor in controlling some of our plant troubles. Rotation is beneficial in combating those insects and diseases that remain in the soil over winter and which are not killed by the cold weather. Besides insects there are many diseases which are found in the soil and that will grow on one class of plants but will not attack other classes. These diseases therefore can be killed out by the growing of a different crop on that land. For this class of diseases it is never advisable to grow the same kind of a crop on a piece of land any two years in succession. By rotating the crops we not only control many insects and diseases but we improve the general condition of the soil as well.

Fall plowing is valuable in destroying some insects. Many insects pass part of their life history in the ground. These insects make small burrows or homes in which they spend the winter. If they are allowed to remain undisturbed they will live through the cold weather, but if the soil is plowed up in the fall and the insects exposed to the cold, a great many of them are killed. This same treatment is valuable in destroying the eggs of many other insects that lay them in the ground. When the eggs are exposed to the winter weather they are also killed.

REVIEW QUESTIONS.

1. Describe the four classes of pests that attack plants.
2. Is the damage done to plants by these pests large or small?
3. Into what three classes are the insects divided?
4. What is complete and incomplete metamorphosis?
5. Give the four stages in complete metamorphosis.
6. Give the three stages in incomplete metamorphosis.
7. How does an insect with incomplete metamorphosis grow?
8. Name and describe the three divisions into which plant diseases are divided.
9. Discuss some of the symptoms of a diseased plant.
10. Discuss bacterial and fungous diseases.
11. Name and describe the three classes of bacteria.
12. How do bacteria multiply?
13. Discuss the injury to plants due to predaceous animals.
14. Discuss physiological troubles of plants.
15. How can physiological troubles be controlled?
16. Discuss the means of control for insects and diseases.
17. Describe several devices for the control of predaceous animals.
18. What is meant by cultural control measures for plant pests?

CHAPTER VIII.

SPRAY MACHINERY AND SPRAY MATERIALS.

SPRAY MACHINERY.

THE most improved spray machinery is necessary for efficient work. Without effective spraying there is seldom any good that ever results from the practice. There is no other operation in horticultural practices that calls for so thorough work as does the application of spray materials to all plants. It has been found that the most effective work can be done with those machines which permit of high pressure. This does not mean that the small hand sprayers are not valuable, but where the orchard or garden is large enough to warrant the purchase of a large machine better spraying can be accomplished.

Kinds of Sprayers.—There are six distinct types of sprayers on the market. Each type is made primarily for certain kinds of spraying. The capacity of each one varies, and the efficiency of the several types depends to a large extent upon the size of the sprayer. The six types are: (1) the hand atomizer, (2) the bucket sprayer, (3) the automatic compressed-air sprayer, (4) the barrel sprayer, (5) the twin-cylinder hand sprayer, (6) the power sprayer, of which there are three sizes, namely, the pony outfit, the medium-sized sprayer, and the large sprayer.

Hand Atomizer.—The hand atomizer is the most simple kind of a sprayer. It consists of a small can or glass jar attached to a tube into which fits a piston. The piston is attached to a handle and by working it back and forth the spray material is forced out on the plant. This sprayer is too small to be of much value only on small plants.

Bucket Sprayer.—The bucket sprayer is the next larger size and does better work. This sprayer consists of a small pump which usually has two small brass ball valves. The pump cylinder and air chamber is usually made of brass. This pump is capable of developing considerable pressure and is valuable for spraying many kinds of plants. The pump is separate and in order to spray it must be set into a bucket containing the spray material. This is the chief drawback to this sprayer, since it is awkward to carry around in an open bucket filled with the spray mixture. A small piece of hose and a spray nozzle is attached to this pump.

FIG. 57.—A good hand sprayer for small truck and bush fruits. (The Deming Company.)

Automatic Sprayer.—The automatic sprayer is a more convenient form than the bucket sprayer. This sprayer can be filled and then pumped up with air, and the entire attention of the operator can be devoted to spraying. The automatic sprayer is very convenient and easy to carry. It is particularly good for truck crops and small bush fruits.

The tank of this sprayer should be made of brass. This is highly desirable, because if it is made of galvanized iron it corrodes very rapidly when used for Bordeaux mixture. The corroding action on the metal makes the life of the sprayer very short. Where brass is used and the tank thoroughly made, these sprayers are very durable. This is an ideal sprayer where a small amount of spraying is to be done.

Barrel Sprayer.—The barrel pump sprayer is of medium capacity, and well suited for the small orchard. It has the advantage of being comparatively cheap and of doing very satisfactory work.

FIG. 58.—A barrel sprayer, mounted on wheels. (Barnes Manufacturing Company.)

There are two ways of mounting the pump in the barrel, namely on the side of the barrel and on the end of the barrel. The side mounting of the pump seems to have a slight advantage over the end mounting in that the sprayer sets low down and is not in the way of low branches. There is also no danger of tipping the barrel over when mounted on the side.

The barrel sprayer usually holds about fifty gallons. It requires two men to operate it. The barrel is either mounted on a sled or on wheels.

Twin-cylinder Hand Sprayer.—The twin-cylinder hand sprayer is decidedly the most satisfactory hand pump. By the use of the two cylinders, a balance of power is obtained, which ensures an even flow to the air chamber, which is not obtainable with a single-cylinder pump.

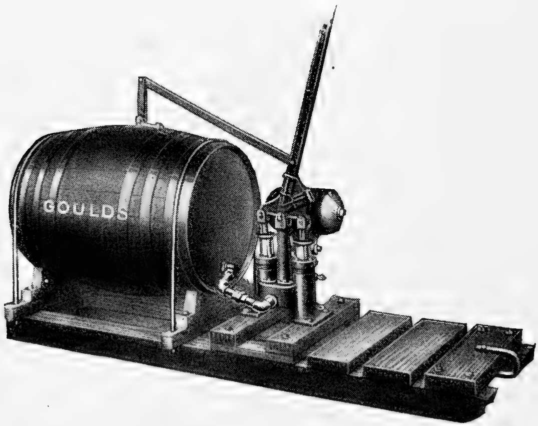


Fig. 59.—Two-cylinder hand sprayer, mounted on a sled. This is an excellent type for a small sprayer. (The Goulds Manufacturing Company.)

The working parts of this pump are usually made of brass. The construction is strong, compact and convenient.

The pump is operated by a handle which is removable, and can be used in either a vertical or a horizontal position.

The double-cylinder pump is a very efficient sprayer. It is used for orchards of considerable size, and a much greater pressure can usually be maintained with this sprayer than with any other hand pump. It is remarkably easy to operate. This pump is usually mounted on a wagon or a sled. The vessel holding the spray material may be either a tank, or a barrel, depending upon the size of the orchard and the inclination of the owner.

Power Sprayers.—The power sprayers vary in size. They range from a two-cylinder pump up to three-cylinder pumps of considerable capacity. The size of the engine varies from $1\frac{1}{2}$ horse power to 4 horse power. The power sprayers are more complicated and require more skill to operate than do any of the hand pumps. In order to successfully operate a power sprayer one must know something about gasoline engines and understand the principles of pumps.

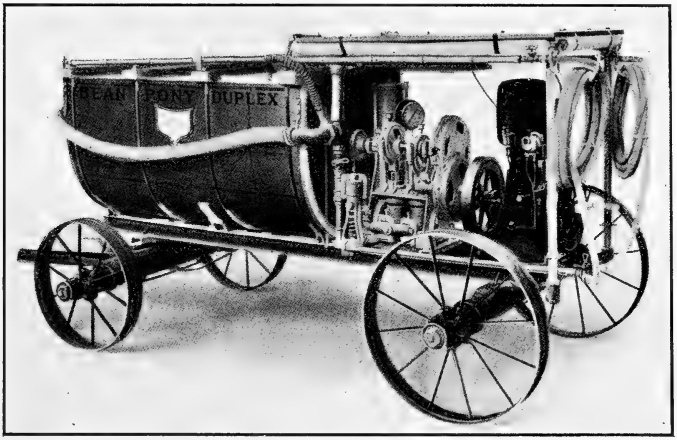


Fig. 60.—A small power sprayer, suitable for the home or the small commercial orchard.

The power sprayers are the most efficient sprayers on the market because they will permit greater pressure and a finer distribution of the spray material. The pressure usually carried in a power outfit varies from 150 to 250 pounds, and the tanks range in size from 125 to 200 gallons.

The power sprayer is usually equipped with a tower which permits a man to reach all parts of an ordinary sized tree. These sprayers are used in the commercial orchard or on the large farm orchard. It requires three men to successfully operate any of the power sprayers.

Spray Machine Parts.—In order to thoroughly understand a spray machine, one must understand some of the parts of which it is made. Some of the most important parts are the cylinders, valves, valve seats, plungers, agitators, supply tanks, and nozzles.

Cylinders.—The cylinders should always be made of brass. Sometimes brass tubing of heavy weight is threaded to fit the cylinder heads. Some firms use brass tubing clamped between the cylinder heads, while still others use a solid cast-iron chamber with a brass liner. A cast-iron cylinder, enamelled with porcelain has been used some, but the greatest difficulty with this cylinder is the unevenness of the enamel, and because of this defect it is not generally satisfactory.

Valves.—There are four kinds of valves found in the spray machine, namely, the ball, poppit, swing check, and steam check. These valves are used in various places in the machine and are used to control the flow of the liquid and to regulate the pressure of the air. Valves are made of rubber, steel or bronze and the bronze valve is the most durable for all kinds of work.

There are many variations in the four kinds of valves, due to minor changes in the construction of some part, but these are too numerous to discuss in detail.

Valve Seat.—The valve seat is the place into which the valve fits. The seats are built to receive the particular type of valve which is used. Many of the valve seats are made of iron, with a secondary seat of leather or rubber to prevent back flow. Occasionally hard-rubber seats are used, but the majority of pumps are equipped with removable brass valve seats, which are the most durable and the most desirable.

Plunger.—The plunger or piston is that part which fits into the cylinder and gives compression. Plungers are fitted with various types of packing. Some of the most common materials used for this purpose are cloth reinforced with rubber, hemp, steam packing, and paraffin canvas. The most desirable packing is one that will last for a considerable period and does not require constant attention to keep it in shape.

Agitators.—An agitator is a device for stirring the material in the tank during spraying. In a small tank or a barrel the swinging paddles are fairly satisfactory, but in the power sprayers the sliding agitator or propeller are preferable. The sliding agitator simply moves back and forth along the bottom of the tank, while the propeller whirls around in the liquid, keeping it churned up all the time. The propeller agitators are much more efficient than any other type because of their higher speed, durability, simplicity, and small size.

Supply Tanks.—Supply tanks vary in shape and in size. The most popular tank, however, is the round-bottom type. This tank is easily kept tight by screwing up a few nuts on the clamp rods. The principal trouble with all tanks is the difficulty of keeping them water-tight, and when selecting one see that there is an easy way of tightening it up so that it can always be kept tight. A wooden tank is preferable to any metal tank.

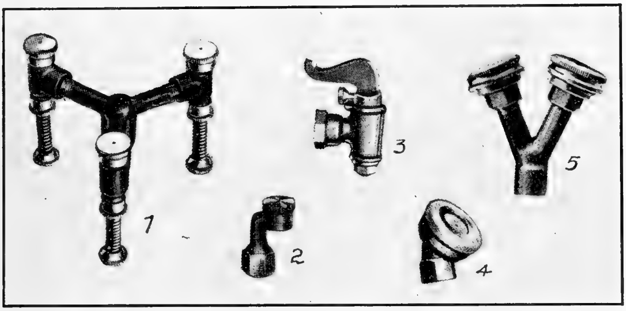


Fig. 61.—Different types of spray nozzles. *1*, three-cluster vermorel; *2*, angle Cyclone; *3*, Bordeaux; *4*, Whirlpool; *5*, Vapo.

Nozzles.—The nozzles used for spraying vary greatly, and several distinct kinds are in use. The nozzle is often the source of considerable trouble, and great care should be used in selecting a good type.

Some of the common types of nozzles are the Bordeaux, Cyclone, Whirlpool, Vermorel, of which there is a one-, two-, three-, and a four-cluster vermorel, the Vapo and several others. The different kinds are used for special purposes and no one general-purpose nozzle is very satisfactory. The vapo nozzle is perhaps one of the most satisfactory types and it has largely taken the place of the vermorel. A small, single vapo nozzle has the capacity of a three-cluster vermorel.

The chief function of a nozzle is to throw a very fine spray, and to distribute it uniformly in all directions. A nozzle clogs up easily and needs cleaning frequently for good work.

Spray Rod.—The spray rod is used to facilitate spraying and to aid in distributing the spray mixture where it is wanted. It affords an easy means of extending the spray. The spray rod is often spoken of as an extension rod. It is made of bamboo and varies in length from 6 to 12 feet. Each rod is lined either with aluminum, brass or iron, but a seamless, aluminum tubing, which is screw threaded into brass connections at either end is preferable. These connections sleeve over the end of the rod, which make the joints very strong. The use of aluminum tubing makes the rod very light and easy to handle. The bamboo extension rods are also fitted with rubber drip guards which can be moved up and down on the rod, and are used to catch all of the moisture that settles on the rod while spraying.

Spray Gun.—The spray gun, which is the most recent development in this line of equipment, promises to replace entirely the spray rod. This gun not only saves labor and money, but is efficient and easy to handle. It can be quickly adjusted throw either a fine or a coarse spray and at a short or a long distance.

SPRAY MATERIALS.

The necessity of spraying is no longer doubted. It has been demonstrated and proved beyond further doubt that unless spraying is done it is almost an impossibility to produce first-class horticultural products. The only question that remains is to determine what is the proper material with which to spray the plants.

Spray materials are divided into two classes, namely, insecticides, which are chemicals used for the killing of insects, and fungicides, which are chemicals used to prevent or destroy plant diseases. The insecticides are divided into stomach poisons and contact poisons, based upon the way in which they kill the insect.

Insecticides and fungicides are used in two ways, either in a dry state as a fine powder or dissolved in water and distributed as a fine spray. If the material is dusted on the plants, it is distributed by the use of a dust gun which forces the powder out by the aid of a fan. If a spray is used, various kinds of spraying machines are employed.

Sprays for the Plants and How to Prepare Them.—*Poisons for Biting Insects.*—There are a number of insecticides which are used for biting insects. These poisons are taken into the stomach of the insects and kill them through their action on the digestive tract. There are two classes of stomach poisons, namely organic poisons, which are usually vegetable compounds, and inorganic compounds, which are of inorganic materials. The vegetable poisons are poisonous to the insects but not to the human system and therefore are safer to use on some plants, as, for instance, cabbage, lettuce, or currants. The poisonous property of these insecticides is usually volatile, that is, when the material is exposed to the air for a few days it loses its poisonous nature. Because of this fact it must be strictly fresh when it is used, and it must be kept air-tight, when it is stored, otherwise it is worthless. The two most important insecticides which belong to this class are the white hellebore and the pyrethrum.

The inorganic insecticides are poisonous to insects as well as to animals, and greater care must be used in their application to the plants. There are many poisons in this class, but the base of all of them is usually some form of arsenic. A few of the most common ones are arsenate of lead, Paris green, and London purple.

These poisons are applied in both the dust form and the spray form. The method which is selected depends upon the plant and the insect which is being treated.

FORMULAS FOR THE STOMACH POISONS.

ARSENATE OF LEAD.

Paste Form.

Arsenate of lead	2 to 5 pounds
Water	50 gallons

Powder Form.

Arsenate of lead	1½ to 3 pounds
Water	50 gallons

This poison is in many respects the most satisfactory of any of the arsenical sprays. It is very adhesive and if properly made will not burn the foliage to any extent. More pounds of the paste form must be used to a given quantity of water than the powder form because of the amount of moisture present in the paste.

PARIS GREEN.

Paris green	½ to 1 pound
Stone lime	2 to 3 pounds
Water	50 gallons

The chief fault with the Paris green is its tendency to burn the foliage. If it is not added to some fungicide, stone lime should be added to the water in order to reduce the amount of burning of the foliage. If Paris green is used in combination with Bordeaux mixture the addition of lime is not necessary. This insecticide is a very active poison.

WHITE HELLEBORE.

When Used as a Spray.

White hellebore	1 ounce
Water	3 gallons

When Used as a Powder.

White hellebore	1 ounce
Air-slaked lime, flour or sifted road dust	5 ounces

PYRETHRUM.

When Used as a spray.

Pyrethrum	1 ounce
Water	2 gallons

When Used as a Powder.

Pyrethrum	1 ounce
Air-slaked lime, flour or sifted road dust	5 ounces

The white hellebore and the pyrethrum lose their poisonous properties quickly when exposed to the air. These insecticides are poisonous to insects but not to higher animals. They are valuable to use on ripening fruit or just before the harvesting of such crops as the lettuce or the cabbage. These poisons must be strictly fresh or they are worthless.

FORMULAS FOR CONTACT POISONS

LIME-SULPHUR WASH.

Stone lime	12 to 15 pounds
Flowers of sulphur	15 pounds
Water	50 gallons

This formula is for the home-made wash. Slake the lime in a small quantity of water. Gradually stir the sulphur into this mixture. Dilute the mixture to 12 gallons and boil for one hour or longer. Remove from the fire and add enough water to make 50 gallons. Strain the wash through a fine-mesh strainer. This spray must be used when the plants are dormant, and it is either applied in the spring before the buds open or in the fall after the leaves drop. The chief disadvantage of this home-made wash is the great quantity of sediment which is hard to remove satisfactorily so that it will not clog up the pump and nozzles.

COMMERCIAL LIME-SULPHUR SOLUTION.

The commercial lime-sulphur is much easier to use because it is free from sediment and requires no preparation other than to dilute it with water. The commercial solutions are thoroughly reliable. They are fairly well standardized now and the standard liquid test is about 33 degrees on the Baumé hydrometer, which is the density of the solution. These solutions when used as insecticides must be diluted and sprayed on the plants when they are in a dormant state. When the solution tests 33 degrees Baumé, one gallon of the mixture should be diluted with 7 or 8 gallons of water. Solutions less dense should be diluted as follows:

TABLE OF DILUTIONS FOR THE DORMANT SPRAY.

Reading on hydrometer, degree Baumé.	Number of gallons of water to one gallon of the lime-sulphur solution for dormant spray.
33	7
32	6½
31	6
30	5½
29	5¼
28	5
27	4¾
26	4½
25	4¼
24	4
23	4
22	3¾
21	3½
20	3

SOAP SOLUTIONS.

Satisfactory insecticides for soft-bodied insects can be made from soap. Fish-oil soap is probably the best, although common laundry soap is very good. The solution is made by cutting up one pound of soap into small pieces and dissolving it by boiling in 4 or 5 gallons of water. This is a good spray for plant lice.

NICOTINE PRODUCTS.

The nicotine products are perhaps the most satisfactory contact insecticides we have for the plant lice. The active principle in these solutions is nicotine sulphate. Some commercial products, namely, the Black Leaf 40 and the Nicofume, are very good. These materials are made from tobacco and are in a very concentrated form. They are usually prepared by diluting the stock solution with 800 to 1000 parts of water.

Tobacco decoction is also used to some extent as an insecticide. This spray is made by boiling 1 pound of tobacco stems in about a gallon of water for one hour. Strain out the refuse material and add enough water to make two gallons. The tobacco products are excellent for controlling the plant lice, and they do no injury to the most tender plants.

KEROSENE EMULSION.

Laundry soap	½ pound
Kerosene	2 gallons
Water	1 gallon

Kerosene emulsion is made by dissolving the soap by boiling it in the full amount of water. Remove the mixture from the fire and add the kerosene. Stir the mixture violently for about fifteen minutes until it becomes a creamy mass that will not separate. This is the stock solution. For use dilute 1 part of the emulsion with 8 to 10 parts of water for hard-bodied insects, and 1 part with 12 to 20 parts of water for soft-bodied insects.

CARBOLIC ACID EMULSION.

Hard soap	1 pound
Crude carbolic acid	1 pint
Hot water	1 gallon

Dissolve the soap in the hot water and add the carbolic acid. Churn the mixture until it becomes creamy and does not separate. This is the stock solution. For use dilute 1 part of the emulsion to 30 parts of water. This spray is used against the different kinds of maggots, the cabbage worms, and other soft-bodied insects.

Sprays for Plant Diseases.—The spray mixtures for the control of plant diseases differ from those used to kill insects. The confusion which results over this question is oftentimes detrimental to the growers.

BORDEAUX MIXTURE.

Copper sulphate	4 pounds
Stone lime	4 pounds
Water	50 gallons

This mixture is known as the standard Bordeaux. Other strengths are made by using a less amount of the copper sulphate and the stone lime. To make Bordeaux mixture dissolve the copper sulphate in several gallons of water and then add enough water to make 25 gallons. Slake the stone lime in about five gallons of water, and add enough water to it to make the 25 gallons. When these solutions are made pour both of them together into a barrel, and the spray material is finished.

Bordeaux mixture should not be made in metal vessels because the copper acts upon the metal and soon destroys it. Wooden vessels are best suited for making this material. Bordeaux mixture should always be made fresh and sprayed on the plant as soon as it is made. It loses much of its value as a fungicide if it is allowed to stand very long before it is used.

Bordeaux mixture is one of the best fungicides we have, and its place in horticulture is firmly established.

SELF-BOILED LIME-SULPHUR MIXTURE.

Stone lime	10 pounds
Flowers of sulphur	10 pounds
Water	50 gallons

Place the lime in a barrel and pour on enough water to start the slaking of the lime. Then add the sulphur after sieving it to remove any lumps and stir the mixture thoroughly, finally adding sufficient water to make a paste. Constant stirring is necessary to prevent caking. After the boiling produced by the slaking of the lime is over, the mixture should be diluted to the 50 gallons and it is then ready to use.

This fungicide is very satisfactory for use on the peach, the American and Japanese plums, and upon some varieties of cherries.

COMMERCIAL LIME-SULPHUR SOLUTION.

The commercial lime-sulphur solution is a good fungicide when diluted to the proper strength. In fact it is universally used on many of our fruits and particularly the apple. This fungicide, however, is not very satisfactory in controlling the rots, but it is good for the apple scab, the flyspeck fungus and some other diseases.

The dilution of this fungicide is based upon the density of the solution, the same as it is for the insecticide, except that the spray must be much weaker as a fungicide than as an insecticide. The table gives the dilution based upon the degree Baumé of the commercial product.

TABLE OF DILUTIONS FOR SUMMER SPRAY.

Reading of hydrometer, degree Baumé.	Number of gallons of water to one gallon of the lime-sulphur solution, for summer spray of apples.
33	40
32	37
31	36
30	34
29	33
28	31
27	29
26	28
25	26
24	24
23	23
22	21
21	20
20	19

Combination Insecticides and Fungicides.—There are insects and diseases which attack certain crops about the same time. Whenever such a condition is found, a combination of both an insecticide and a fungicide can be sprayed on the plants as one spray. By this practice the work of spraying is greatly decreased.

The combinations vary, depending upon the plant and the injury which is being done. A few of the combinations which can be made are as follows:

COMBINATION OF SUMMER SPRAYS.

No. 1.

Commercial lime-sulphur diluted	1 gallon to 40 gallons of water
Arsenate of lead	2 or 3 pounds to 50 gallons
Nicotine sulphate	1 part to 800 parts of the spray

This combination can be made and applied at the same time, if the conditions warrant it. The lime-sulphur is used to control such diseases as the scab of the apple, the arsenate of lead controls the codling moth or other eating insects, and the nicotine controls the plant lice if there are any present. It is a common practice to use the lime sulphur and arsenate of lead combination in most all of the spraying, but the nicotine sulphate should not be used unless there are insects present that require its use.

No. 2.

Bordeaux mixture	4–4–50 formula
Arsenate of lead	2 pounds to 50 gallons
Nicotine sulphate	1 part to 800 parts of the spray

This combination is similar to the first one, except that the Bordeaux mixture is substituted for the lime-sulphur solution. The Bordeaux mixture is preferable to the lime-sulphur solution for certain diseases. The nicotine should not be added unless there are insects present that require it.

No. 3.

Self-boiled lime-sulphur mixture	10–10–50 formula
Arsenate of lead	3 pounds to 50 gallons of the spray

This combination is very satisfactory for spraying some of the American and Japanese varieties of plums.

Fumigation.—In addition to the common spray mixture we recognize fumigation as a means of controlling diseases and insects. Whenever fumigation is employed for the control of disease it is used in a special way. Formaldehyde gas is the common fumigant used. The Maine formula for formalin is:

Formalin	3 pounds
Potassium permanganate	23 ounces

This quantity is sufficient for the fumigation of 1000 cubic feet of space. The fumigation is used to destroy diseases on certain crops when they are placed in storage. The potato and onion are two crops often treated in this way. When fumigation is practised the crops are placed in crates and piled up in rows in a tight room. The gas is generated by pouring the formalin in a flat-bottomed dish and adding the potassium permanganate the last thing before leaving the room. The room should be closed tightly and allowed to remain closed from twenty-four to forty-eight hours.

Seed Treatment.—The diseases of some of our crops are found on the seed. In such crops, the treating of the seed before planting it is very beneficial and greatly increases the yield. The two common materials used for seed treatment are formalin and corrosive sublimate.

The formalin is more generally used and is more adapted to a larger number of seed. The black leg of the cabbage and the smut of the onion are two common diseases which can be partially controlled by treating the seed with this solution.

The scab of the potato is greatly reduced by soaking the potato seed in a formalin solution made by placing 1 pint of formalin in 30 gallons of water. The potato should remain in this solution for about two hours.

Corrosive sublimate is also used for the treatment of potato seed. The corrosive sublimate should be used at the rate of 2 ounces to 16 gallons of water and the potatoes allowed to soak one and one-half hours.

REVIEW QUESTIONS.

1. Name six different kinds of spray machines.
2. Why are the small hand sprayers not as effective as the power machines?
3. How does the bucket sprayer differ from the automatic sprayer?
4. What advantage has the automatic sprayer over the bucket sprayer?
5. How does the barrel sprayer differ from the twin-cylinder hand sprayer?
6. What three kinds of power sprayers are made and upon what is the difference based?
7. Name the four kinds of valves found in a spray machine?
8. What material is best suited for making the valve seat?
9. Describe the most effective agitator.
10. What material is best suited for making a spray tank? Why?
11. Name and describe several kinds of spray nozzles?
12. Why are the nozzles so very important in spraying?
13. What is the spray rod, and what is its function?
14. Name two poisons for biting insects.
15. What is meant by a contact and a stomach insecticide?
16. Why should stone lime be added to Paris green when spraying?
17. When should white hellebore and pyrethrum be used in spraying?
18. Give the formula and tell how lime-sulphur wash is made?
19. On what kind of insects is kerosene emulsion used?
20. How does kerosene emulsion differ from carbolic acid emulsion?
21. Give the formula for Bordeaux mixture and tell how it is made.
22. What is the difference between commercial lime sulphur and self-boiled lime sulphur?
23. What combinations of insecticides and fungicides are possible, and why are they made?
24. What is meant by fumigation and what is controlled by it?
25. Tell how seed potatoes are treated and what is gained by this treatment.

CHAPTER IX.

THE PRUNING OF PLANTS.

THE pruning of plants is an important as well as an interesting operation. It requires knowledge, experience and judgment. Pruning produces a tree that is symmetrical in shape. Plants properly pruned will bear better fruit, because the plant food is used in fewer branches and therefore the plant can grow better fruit.

Plants of different kinds must be pruned differently. Likewise young plants must be pruned in a different manner than old and mature plants. Young trees one year old are pruned differently than five-year-old or twenty-year-old trees. Vines are pruned unlike the bush fruits, and the brambles, such as blackberries and the raspberries, are pruned differently than the peach or the pear tree. So then after analyzing pruning in a brief way we are led to assume that all plants must be pruned in a manner determined by the plant, and also that the methods must be varied as the plant grows older.

Principles of Pruning. — There are certain principles in the pruning of any plant that are identical, because pruning is simply an operation on the plant. It consists of removing a certain amount or a part of the plant body. The nature of animal life is to heal any cut or wound on its body, and it is also the nature of a plant to heal any wound made on it. However, a wound made by removing a limb on a plant is different than the cutting off of a piece of the bark on the trunk which might be similar to an animal wound. Consequently a few principles in removing a branch must be observed. All wounds on a plant are healed by the cell sap carrying food to the wounded part. If this wounded part is in the line of the sap movement the wound is readily healed, but if the wound is not in line with this channel in which the sap flows it will not be healed. Since the only way that the sap is kept flowing in this channel is by the presence of leaves on the trees, it is at once apparent that if a limb is cut off, the leaves are removed and consequently the sap does not pass out into any part of the stub that remains. When a stub is allowed to remian no healing can take place and in a short time disease will enter the tree and finally cause its death.

Time to Prune.—The time for pruning varies over a considerable period and with different plants, and we recognize winter and summer pruning. With most horticulturists pruning is done during the late winter and early spring months. As a rule, pruning late in the spring, just before growth begins, is the ideal time for most plants. Late pruning of this kind serves to remove all winter-killed branches with no chance of more to occur. It also has the advantage of starting the healing process at once and the wound is exposed for a much shorter time.

Protection of Wounds.—All wounded surfaces should be covered with some protective material in order to prevent diseases from gaining an entrance. No artificial material will aid in healing of any wound, but it prevents water and other foreign material from entering.

Small wounds not to exceed one-half to three-quarters of an inch will usually heal over in one year and no covering is necessary. Larger wounds, however, should be protected. White lead paint, which is of the consistency of thick cream, is perhaps the best material to use for wound dressing. Occasionally tar products and grafting waxes are used.

Pruning Tools. — Special pruning tools are necessary if good pruning is to be done. In selecting any tool, see that it is made of the best material and capable of keeping a good cutting edge. Every cut must be made clean and smooth, which can only be done by the best pruning tools.

The pruning saw, the pruning knife, and the pruning shears are all necessary for the different kinds of pruning. In selecting a pruning saw, get one that has the saw teeth only on one edge. The two-edge pruning saw is of no value

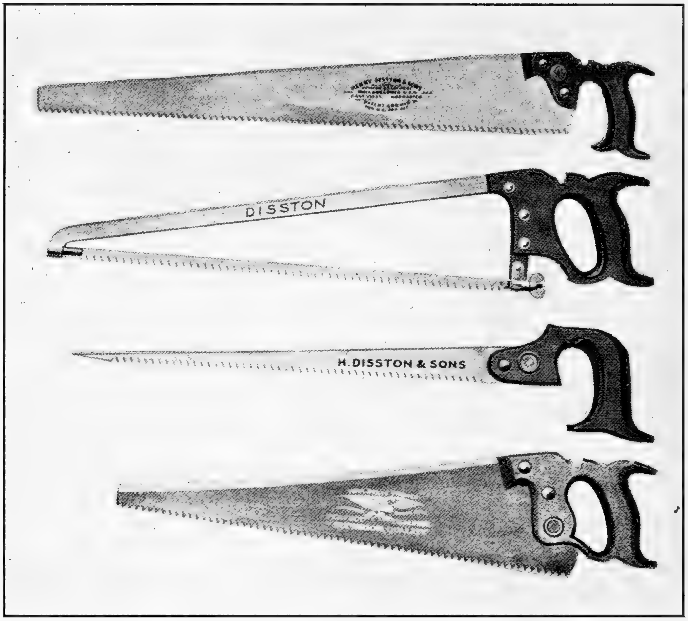


FIG. 62.—Four good types of pruning saws.

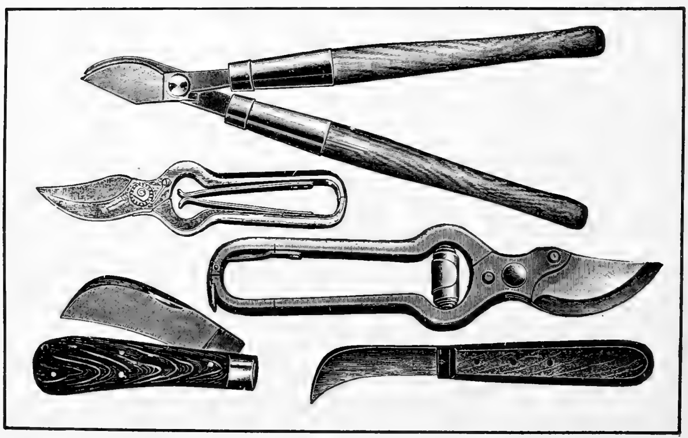


FIG. 63.—Several types of pruning tools.

and should be banished from the country. A small, narrow saw resembling a compass saw, although somewhat longer and slightly thicker, is perhaps the best type. These saws can be purchased at reliable up-to-date stores. Several types of good pruning shears are found on the market, and the ones shown in the illustration are excellent types to use. The pruning knife, however, is indispensable for cutting smaller limbs. This is perhaps the best, too, since a cleaner cut can be made with it than any other pruning tool.

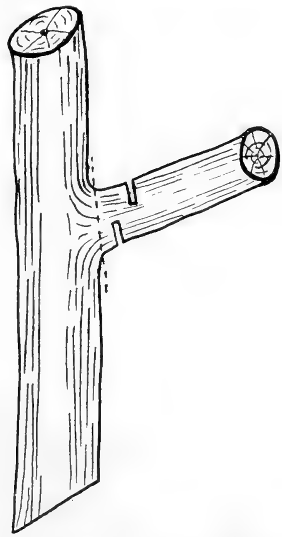


FIG. 64.—Method of cutting off a large limb. Note the two cuts. Dotted line indicates where the last cut should be made after the limb has been removed.

How to Remove Large Branches.—It often happens that in order to obtain the best results in removing large limbs two cuts must be made. The branch should be sawed off about a foot above the point of its origin in order to prevent the splitting down and the tearing off of a large portion of bark. To do this, first cut away a large protion of the branch, which will aid in lessening the weight of the limb. Next make a cut on the under side of the branch about half-way through the limb and then finish the removal of the branch by sawing it through from the top.

The Pruning of Young Trees. — The pruning of a young tree differs greatly from that of a mature tree. The object in the pruning of young trees is to shape their form and to develop a uniform and a symmetrical top.

Young trees are always more vigorous growers than old ones. Greater annual

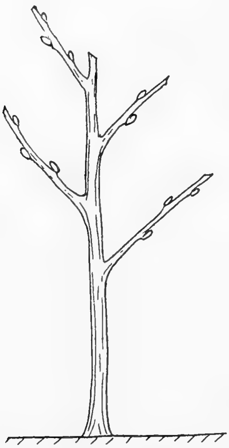


Fig. 65.—The proper distribution of the main branches on a young tree.

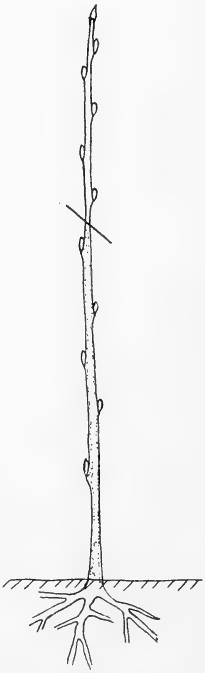


Fig. 66.—Heading back of a one-year-old tree.

growth is always made, and because of this rapid accumulation of wood it becomes necessary to shorten some of the branches and to entirely remove others, in order to prepare a good framework for the tree. Young trees are usually pruned more heavily than old trees. Pruning of a young tree should be done every year for at least five or six years after the tree is planted. In some trees pruning will be necessary for a longer time.

Cause for Pruning.—Under natural conditions of growth many plants grow very thickly and produce so many branches that they crowd each other. The older the plant gets the more the limbs crowd, until the plant reaches a point that the branches become so numerous that much light and air are shut out. In addition to this trouble the plant has so many surplus branches that the root system is not sufficient to continue the growth of so much wood, and at the same time produce fruit. When pruning is practised, these surplus branches are removed which allow the food material to go into the production of fruit and flowers instead of wood.

The pruning of a tree or bush also aids in forming a uniform and symmetrical plant. All of the irregular branches are removed and the others shortened, so that the plant will be uniform.

The thinning out of the branches aids in controlling insects and diseases. Spraying is made much easier and larger crops are produced.

The systematic pruning of plants, especially when grown under artificial conditions, aids in withstanding wind storms, and trees are not blown over as easily as when large, long branches are allowed to remain.

Effects of Pruning.—The regular methods employed in the pruning of a tree or shrub has a tendency to increase growth. Weak plants can oftentimes be made to grow more rapidly by severely pruning the top during the resting period. When such plants are severely pruned all the strength of the roots is used to grow a single upright, vigorous stalk. This acceleration of growth is also seen in the rejuvenation of an old tree. This is particularly true of the peach. By cutting off practically all of the old top of the tree, you cause the roots to send out many vigorous shoots which in a short time makes another head of all new wood. Occasionally other old trees are treated in this manner, as the apple, elm and sometimes the soft maple.

Pruning of certain plants also has a beneficial effect on the production of fruit. The peach serves as a good example, as in this case the plant bears its fruit upon the growth of the previous year and the grower can reduce the crop in proportion to the capacity of the tree. Pruning aids in combating certain diseases, as, for example, the cankers and the blights. The only control for these diseases is the removal of the diseased part by pruning.

Pruning the Top of a Plant.—The pruning of the branches of a plant is the only way of forming a good symmetrical top. The forming of the head of a tree is by far the most important operation in the growing of a plant. This is true not only of the commercial orchard but of the home orchard or the ornamental garden. Shade trees also require some systematic pruning, because their beauty largely depends upon the uniformity of their top both in their dormant as well as in their green stage.

When the top of a plant is pruned, it requires judgment and experience. If a tree is the plant which is to be pruned, the most important consideration is the location of the branches along the trunk, which is to form the framework of the tree. It makes little difference what kind of a tree you are pruning at this early stage, the principal consideration should be the even and equal distribution of the side branches along the trunk. There should be no crotches allowed to remain, and the branches should be distributed uniformly, so that the tree will be well balanced.

In most trees it is desirable to have the main structural branches of the tree composed of from three to five limbs of about equal size. A tree should never be allowed to divide into two limbs which again subdivide because a tree of this type is more likely to split.

If a bush or a bramble is to be pruned, the proper way is to remove a certain number of the canes. These canes should be cut off close to the surface of the ground. The remainder can be headed back if necessary.

Pruning the Roots of a Plant.—The pruning of the roots of any plant is necessary whenever transplanting is done. Root pruning is imperative in order to remove any broken or mutilated roots. All of the irregular roots should be shortened or entirely removed. If any roots are killed the dead portions should be cut away until the living part is reached. The pruning should be done with a sharp knife. A slanting cut should be made and in such a way that the cut surface will be on the underside of the root. When the tree is placed in position the cut surfaces should come in contact with the soil either at the sides or the bottom of the hole.

Summer Pruning.—The pruning of certain plants in the summer is important from several stand-points. This is particularly true of young trees. The energy of a young plant should be directed toward the development of a stout trunk and framework. If an exceptionally good tree is to be formed, careful attention should be given to the pinching off of the undesirable branches, while they are small, and before they have used up very much of the plant food, which should go to other parts of the tree. During the early growth these branches are easily removed and can usually be brushed off very satisfactorily with the hands.

Summer pruning is not only of value to the small trees but is practised to some extent on the larger trees. Under some conditions a tree will refuse to set fruit buds, and throw all its energy into the production of wood. A tree of this kind, if properly handled, can be made to produce fruit by summer pruning. To secure the desired results the pruning should usually be done before the season of growth ends, because earlier pruning starts new growth while late pruning gives no results. In summer pruning a part of the surplus wood is cut out and other branches headed back. This check in the growth of the plant at this time has a tendency to make fruit buds form. The benefit derived from summer pruning depends upon the ability of the pruner to regulate the pruning in such a way as to bring about early maturity.

Winter Pruning.—The pruning of plants during the dormant period is usually spoken of as winter pruning. The dormant season is the time the majority of pruning is done, particularly of all of the woody plants. The winter is a good time to perform this operation for several reasons: The branches are not covered with leaves and are easier to remove. The framework of the tree is visible and the undesirable parts can easily be seen. In addition to these facts the tree is in a period of rest and the removal of a limb, by pruning, is no injury to the plant. Certain plants, like the grapes and maple trees, bleed profusely if not pruned while they are dormant.

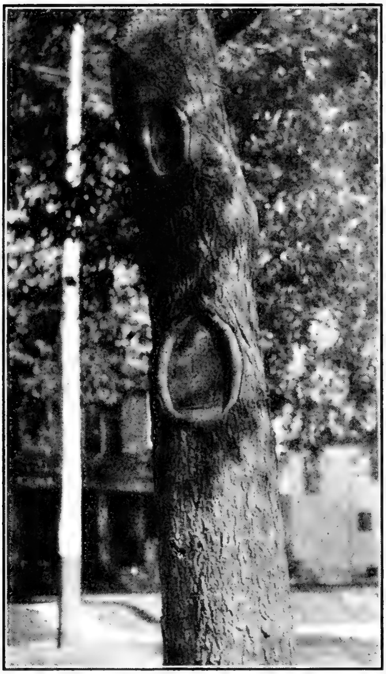


FIG. 67.—The proper way to cut off a large limb. Note how the wounds are healing.

FIG. 68.—A large wound entirely healed over.

Pruning Old Trees.—The object in pruning an old tree is merely to keep the branches thinned out, to remove any water sprouts that may occur and to take out all limbs that are interfering with each other. If the tree has been systematically pruned during its early growth very little pruning will be necessary as the tree gets older. Occasionally large limbs must be cut off for various causes. When this operation is made necessary, care must be taken to make clean, smooth cuts. The wounded part should be covered with some material like white lead paint to protect the open cut. Occasionally grafting wax is used, but this material is expensive and not very satisfactory. Other materials have often been

Fig. 69.—An injured tree repaired with cement.

recommended, but the safest course to follow is to apply those materials which are known to be safe and efficient. The wound dressing should be applied carefully and the careless daubing of the surrounding bark should be avoided.

When pruning old trees the operator should be furnished with good tools, and particularly good pruning saws. These tools must be sharp so that clean, smooth surfaces are made.

REVIEW QUESTIONS.

1. Why do plants require pruning?
2. Tell how a wound on a plant is healed.
3. Discuss the proper time for the pruning of plants.
4. Why are special pruning tools advisable?
5. What is the proper way for removing a large limb?
6. Distinguish between the pruning of a young and an old tree.
7. Discuss the effects of pruning.
8. Discuss the pruning of a top of a plant.
9. Give the differences in the pruning of the branches and the roots of a plant.
10. What is meant by summer pruning?
11. What benefit is derived from summer pruning?
12. How does winter pruning differ from summer pruning?

CHAPTER X.

HARVESTING AND MARKETING.

THE grower is the producer. He is the man who furnishes produce, and this is true with fruits and vegetables as well as all agricultural crops. Most growers are honest, but they are poor business men, and their lack of knowledge concerning business ways often cause many failures. The producer should realize that it is not only necessary to grow the produce well, but it is equally as important to harvest it properly. If the produce is well harvested and properly packed there is a market for it. There is always a demand for fancy or first-class products, but poor and second-class goods are usually a loss to the producer.

Harvesting Produce.—All produce, whether vegetables or fruit, must be carefully harvested. It is essential to gather it at the proper time. The time for picking produce necessarily varies, and it is determined chiefly as to whether it is for local or for distant consumption.

All produce that is harvested should be made presentable. Such crops as the potatoes, radishes, turnips and a few others should be washed before they are sold. Some crops should also be graded in order to make a uniform package.

Many of the horticultural crops should be harvested at a definite time. This is particularly true of such crops as the strawberries, blackberries, tomatoes, melons, sweet corn and many others. If these crops of a perishable nature are allowed to remain too long on the plant they become inferior in quality, and in many cases they are a total loss. Crops of this kind should be harvested as soon as they are ripe and they should never be allowed to become over-ripe, because an over-ripe product is as worthless as a green product.

Harvesting Period.—The period during which all crops should be harvested varies with the crop. Certain crops, as for example the potato, late cabbage, apples, peaches and many others, can be harvested at one time and as soon as the crop is matured. Other crops like the melons, peppers, cucumbers, summer squash and several more can be harvested over a longer period of time. Prompt picking of the individual specimens of the latter class is important. In a few crops like the sweet corn, peas and green beans the harvesting period is short but it extends over several days and two or three pickings are usually necessary in order to gather the entire crop. Such fruits as the blackberries, raspberries and strawberries often require many pickings before the crop is harvested, while other plants like the radishes, beets and carrots must be picked at different times to insure good quality.

The market to a large degree regulates the time at which some crops are harvested. If the price is high, it often pays to harvest a few crops before they are matured, as, for example, the potato. The increase in the price more than offsets the loss in the yield. This early harvesting of the crop is often done in the case of the early cabbage, the lettuce and the spinach. When the price is high and the crop is harvested before it is matured it should not be removed from the plant until the time arrives to sell it. Some immatured crops, as, for example, the potato, will only keep for a short time after they are removed from the plant. Premature harvesting of a few crops is very profitable, but judgment should be exercised when this practice is followed.

Care of Produce between Harvesting and Marketing.—All produce which is perishable must be carried to a cool place as soon as it is picked from the plant. Exposure to the sun should be avoided. When the produce remains in the field for a short time after it is gathered and before it is packed it should be shaded or covered up. The exposure of produce to winds is very detrimental and causes it to wilt and to dry out. Exposure of any kind injures the quality and reduces the price. All vegetables and fruits contain a large percentage of water, which gives the crispness and freshness to them. The amount of water present usually determines the value of the produce. Therefore any means which can be used to hold this water in the fruit or the vegetable will not only improve its quality but will increase the price which it will bring when it is placed upon the market.

Certain crops must be washed and graded before they are packed. Whenever washing is necessary, handle the produce carefully and do not scratch or tear the skin. Any injury to the skin gives an opportunity for mould and bacteria to get into the injured part and the product will rot. The marring of the skin in any way also detracts from the looks of the package. Some crops like the radishes and the carrots must not only be washed but they must be graded and tied in bunches before they are sent to the market. The harvesting, grading, washing and packing should be done without delay and as soon as the crop is taken from either the plant or the soil.

Grading Produce.—All of our fruits and vegetables should be graded. The chief reason for grading is the poor impression a mixed lot of produce gives to the buyer. A few large apples or potatoes in a barrel do not add to the value of the package but only emphasize the lack of uniformity of the lot. In grading pick out all of the large specimens as well as the small ones and make the carrier contain produce of one size. This method of grading makes the package uniform, attracts the eye and pleases the buyer. It is not always the large specimens that bring the best price, but rather the uniform appearance of the package that is of the greatest value.

Kinds of Packages.—The style of package varies greatly and is determined by the product to be packed. Fruit is usually packed in either boxes or barrels. The size of the boxes vary, but they usually hold approximately one bushel of fruit. Box apples are generally fancy fruit. In the eastern fruit-growing sections the barrel is the usual package for apples while in the western regions the box is the most popular. The barrel holds about three bushels and is very convenient for storage and for shipment.

Vegetables are packed in many different styles of vessels and many high-class products are placed in special baskets or cartons. A few crops as, for example, the cabbage is marketed in ventilated barrels, which are made by cutting out a part of several staves of the barrel so that air can circulate through the produce. Sometimes cabbage is packed in crates made of slats, which will hold about one hundred heads.

Celery is shipped in small flat boxes. These boxes are called celery crates and vary slightly in size, depending upon the locality.

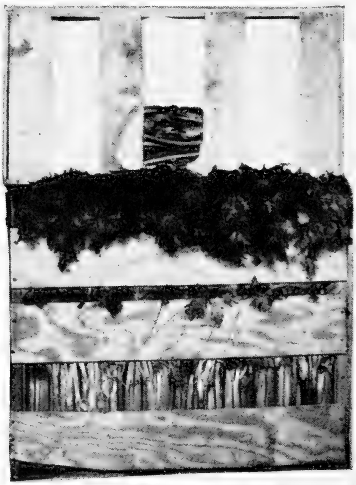


Fig. 70.—A good type of celery crate, well packed.

Tomatoes are packed in baskets, which fit into special crates. When the tomatoes are packed in crates they are usually intended for long-distant shipment. For local trade, however, the half-bushel split market basket is the most popular.

Potatoes are usually marketed in gunny sacks, but sometimes they are delivered to the local trade in bushel baskets.

This variation in packages is due largely to the locality in which the product is grown and also as to whether it is a short or a long distant shipment. Occasionally special markets will demand a certain kind of a carrier, and the grower must then use that kind of a package.

It makes very little difference as to the kind of a package the grower markets his produce in if each container is filled with a uniform product of the best quality. However, standardization of packages is fast becoming important.

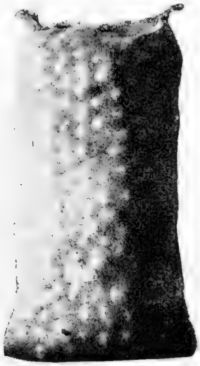


FIG. 71.—The onion shipped in a loose woven sack.

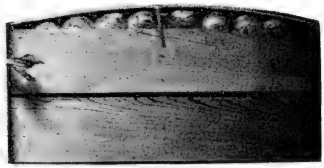


FIG. 72.—Showing the bulge on an orange box which is necessary for good packing.

FIG. 73.—Radishes and spinach packed in the Delaware basket.

Preparing Produce for Local and Distant Market.—The time at which fruit and vegetables are picked is determined largely by the market. If the produce is sold in a local market it is not harvested as soon as when it is sold in a distant market. It is always preferable to allow the produce to ripen upon the plant, because the quality is greatly improved. Produce can only be allowed to ripen upon the plant when a local market is used. In such cases the product is gathered one afternoon and sold early the next morning. By this method all produce is fresh and of good quality.

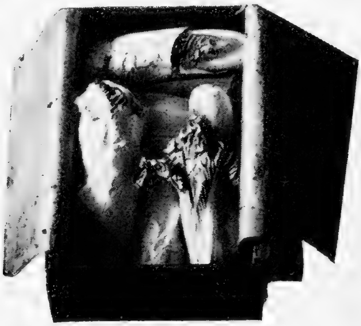


Fig. 74.—Celery cabbage wrapped separately and packed in uniform crates.

The condition is very different if we are shipping to a distant market. Ripe fruits or vegetables soon rot. The tissue is soft and the produce will not stand handling. Juices from one fruit often leak out and ruin an entire crate. Therefore

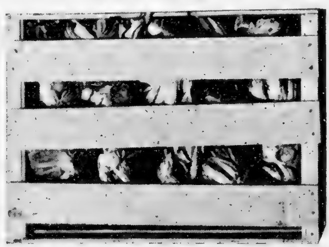


Fig. 75.—Cauliflower packed in a ventilated crate.

great care must be exercised in selecting and in harvesting produce for distant shipment. In almost every case the produce must of necessity be picked when it is partially matured and still green. This lack of maturity makes the quality inferior, but it is the only way in which some products can be shipped. If the fruits are green, they are hard and firm and will stand transit. During shipment or shortly afterward, the produce will ripen and will be ready for sale upon arriving at their destination, provided they have been properly selected at the time of harvesting. The tomato, melon and peach are some crops that are always picked green if they are to be shipped to a distant market.

Packing for Local and for Distant Market.—The packing of produce for a local trade differs from the packing for a long distant shipment. The products for home trade can oftentimes be marketed in a great variety of vessels. Grading is perhaps more important for the local trade than is the kind of a package and too often the proper grading of an article is overlooked for home consumption. Usually the home trade consumes the produce at once and no means of shipment is necessary. The produce can be delivered to the consumer in any vessel that is convenient as, for example, market baskets, bushel baskets, barrels and boxes.

When long distant shipments are made the kind of a package becomes a very important problem. The grower must realize that he is dealing with men in a different section, and that his produce must arrive at its destination in good condition. The packages must be uniform and not of varying sizes and shapes or there would be no means of ascertaining the value of his shipment. Each package must contain a definite quantity. The quality of the package must be uniform. In some cases each fruit must be wrapped separately as, for example, the tomato and the melon. Some crops like the celery must be tied up in bunches of a definite size. Lettuce is often packed in chopped ice, so that it will not wilt but will arrive at its destination in good condition. Strawberries are packed in special boxes which resemble large ice-boxes. A number of crates are placed in one of these large boxes and ice is packed in several compartments so that the berries will be cold and remain firm.

Quality of the Package.—Inferior or mixed packages should never be made. A thing worth doing is worth doing well and attempted deception in a package is bound to react upon the grower. Label your packages so that every buyer knows what he is purchasing. The quality of the package should be plainly stated. The package should be labelled fancy No. 1 or No. 2, so that the buyer is not deceived. Always make the package uniform in contents, no matter what the grade might be.

People in general have recognized that quality and not quantity in produce is what they want. Often a small lot of well selected and fancy produce will sell for more than a wagon load of rubbish.

The home-grown product will oftentimes bring more than that shipped from regions where the crop is grown in great acreages. Occasionally the prices of the home-grown product is often several times that of the shipped product. This great difference in price is due largely to the quality, but the public is willing to pay for it. I have one case in mind with the tomato. A grower has consistently received considerably more for his home grown fruit than was paid for the shipped product. This increase in price was due to the superior quality. There are numerous other cases, which could be mentioned to prove the value of quality.

Transportation.—Produce is shipped in two ways, either by express or by fast freight in refrigeration cars. If the distance is short express is perhaps the better, but when long distances are covered it becomes necessary to ship by fast freight and to have the produce packed in ice-cooled cars. Long distance shipments require car load lots.

These cars are practically large ice-boxes. The produce is cooled, if possible, before it is placed in the cars, but this cooling is not always necessary. After the produce is loaded and packed the cars are iced and tightly closed up. By handling the produce in this manner it arrives in excellent condition, and oftentimes fruits and vegetables are shipped thousands of miles, arriving on the market in a fresh state.

Perhaps no greater impetus has been given to horticulture than the invention of the iced or the refrigerator car. Before this means of transportation came into use, long distance shipments of perishable produce were impossible. Only short hauls could be made, and many times the express rate was so high that the shipping of produce was prohibitive. Improved transportation has opened up great areas, for the production of fruit and vegetables. Before refrigeration cars came into general use this area was only cheap farm lands. Fast freight with iced cars has made it possible to have fresh fruit and vegetables on all markets the entire year, and at prices which are not prohibitive for the general public.

REVIEW QUESTIONS.

1. Why is it important to harvest all produce carefully?
2. Why does the harvesting period vary? Give several examples.
3. What factors tend to cause the harvesting period to change?
4. What care is necessary to preserve the highest quality in produce after it is gathered?
5. Discuss the value of grading produce.
6. Why is it necessary to have a variety of packages for shipping produce?
7. Why must produce for the home market be handled differently from that for a distant market?
8. Discuss the packing of produce for the local and for the distant market.
9. How does the quality of the package increase its value?
10. Discuss the two ways of shipping produce.

CHAPTER XI.

WINTER PROTECTION OF PLANTS.

The winter care of plants is important. The death of a large number of our favorite flowers and shrubs is due to neglect. A plant, like an animal, needs protection even though it is partially hardy. Oftentimes abnormal seasons will kill many of our plants, if no protection is given to them. A strong wind will not only break down the plants but will cause the branches and the twigs to dry out to such a degree that the plant cannot recover in the spring. A sudden burst of warm weather during the winter months is very destructive to many kinds of vegetation. These warm spells often cause the buds to start growth, which is later killed by more cold weather. If the plants are properly cared for and protected in some manner this injury is prevented. Alternate freezing and thawing is injurious to plant life and it should be prevented whenever it is possible. All of our plants should be held in a dormant state during the cold weather and the closer we maintain this condition the greater success we will have in the wintering of our plants.

Fall Preparation of a Plant.—There are only a few people who realize that the winter protection of a plant should begin during the late summer. In order to have the plant ripen up its wood, preparatory to going into the winter, the water supply must be reduced. When a plant is allowed to grow rapidly until late in the season, the plant tissue is filled with new cells, the cells are gorged with water, and much of the tissue is soft and green. A plant entering the winter in such a condition is sure to be injured and sometimes die.

The chief object then, in the fall preparation of a plant, is to check the growth, or at least to retard it to such a degree that the plant tissue will harden and the wood will ripen. The leaves should fall naturally and the leaf scars be perfectly formed.

There are several ways of making the plant ripen up its wood. The principal method is to check its growth in the late summer by the lack of water. The supply of water is reduced by either stopping the cultivation of the soil, or by planting some quick growing crop. The late growing plants will rob the soil of its moisture and thereby take it away from the plant you intend to winter over. In orchards the trees are ripened by planting a cover crop, such as rye or clover, late in the summer. This cover crop is allowed to grow the remainder of the season. These quick growing crops rapidly exhaust the soil of its moisture and permit the green wood of the trees to ripen up before going into winter.

Winter Killing of a Plant.—Some of the horticultural plants are often killed by exposure to the cold weather. Such a condition is called winter killing. In some cases only a part of a plant is winter-killed, while in others the entire plant is killed. Winter killing of plants is not due to any disease or any insect, but it is due only to exposure. Authorities differ as to what is the direct cause of winter killing. It is thought, however, by many horticulturists that the death of the plant is caused by the loss of water from the branches of unprotected plants together with severe weather. Transpiration, as well as evaporation of the water in a woody plant, takes place in the winter as well as in the summer. If this loss of water becomes excessive, due to an abnormal winter, many plants are killed. Strong winds or prolonged warm weather during the dormant season is sure to cause much winter killing, unless the plant is protected in some way. Winter killing is also caused when the plants are not properly hardened before going into the winter.

Perhaps there is no better way of preventing winter killing than to protect a plant from extreme exposure. The plant can be protected from exposure either by building wind breaks, or by covering the individual plants with material of various kinds such as rye straw, burlap and manure.

The Winter Care of Herbaceous Plants.—Plants whose tops die down on the approach of cold weather while their roots remain alive in the soil over winter are called hardy herbaceous plants. Such plants as the peony, rhubarb and asparagus are examples of the hardy herbaceous plants. These plants need special care if the roots are going to remain alive and produce the greatest yields the following spring.

The roots of such plants are comparatively shallow. The depth varies from 6 inches to possibly a foot. This depth is not below the frost line and consequently the roots are frozen. Since the roots of such plants are large and fleshy it is very important to keep these parts frozen when once they are in that condition. The alternate freezing and thawing of such parts is injurious to the plants and reduces their vitality. The freezing itself is not injurious but the roots must not be allowed to thaw out until spring.

The chief way of preventing the alternate freezing and thawing of the roots is to cover the soil over the roots with fresh horse manure that has plenty of litter in it. The manure should consist largely of straw with a small percentage of the solid matter. It should be placed over the roots after the ground has frozen slightly and should cover the soil to a depth of from 8 to 10 inches. The manure in addition to serving as a protection for the roots adds plant food to the soil which increases the growth of the plant the following spring.

The Winter Care of Woody Plants.—Woody plants include all those plants whose tops do not die down during the winter. Our common trees and shrubs are good examples. Many of the woody plants are able to withstand the cold weather under natural conditions. Occasionally when cultivation is prolonged too late in the season, many plants are injured and sometimes killed. Occasionally some tender trees as, for example, the peach must be protected in certain regions to prevent them from being frozen back. Likewise many bushes and brambles must be given some protection in exposed locations.

The branches of the brambles and the low growing bushes are called canes. The canes as a rule have a soft substance in their center called pith. The pith in such canes prevents them from being solid and in some cases seem to render the plants less hardy. Common examples of plants with a pithy center are the raspberries, blackberries and roses.

Winter protection for plants of this kind is often necessary. Sometimes the plantation is shielded by a board fence or a natural wind break of trees. In other cases strawy manure

FIG. 76.—Protecting a small bush by a straw mulch.

is piled up through the canes and covered over the ground. Many times each plant is given a protection of its own. This latter method is used frequently on the roses.

FIG. 77.—Baby rambler roses entirely covered with straw for the winter.

The rose having several forms offers a good example for discussion. The canes of upright growing bushes should first be firmly tied together with a cord. Some fibrous material, preferably long rye straw, is secured and is packed about the canes and tied firmly around the bush. Occasionally a strip

Fig. 78.—Climbing roses which have been taken from their supports and heavily mulched with straw for the winter.

of burlap or a gunny sack is tied over the straw as an additional protection to the plant. Other types of roses like

Fig. 79.—A good way to protect tender trees.

the climbing varieties are often taken down from their supports and laid on the ground. After they are placed in an orderly manner on the ground they are covered up with straw to a depth of two or three feet. This treatment keeps the plant in a dormant state until late in the season and prevents alternate freezing and thawing of the roots and the branches. If the rose bushes are small and planted in beds all of the plants in the bed can be covered up with straw. The straw should be placed over the plants rather loosely and not packed firmly around them except along the edges of the bed.

Mulching the Soil.—The mulching of the ground is a great benefit to all plants. Not all plants need the mulch as a protection, but many are greatly benefited in growth by having this treatment. Plants like the rhubarb and the asparagus, while not requiring a mulch, profit from it. These plants usually require no mulch as a protection but the growth the following spring is more rapid and the plants are of better quality if the ground is mulched with manure during the winter. The plant food which is found in the manure gradually washes out and is deposited in the soil. The water soaking through the manure gives an available supply of plant food early in the spring for the new growth. The mulching of the soil also prevents the freezing of the ground to such a great depth, and this often is an advantage to the plant. When a soil is covered with a mulch it helps to hold the snow and the rain and stores up more moisture in the ground. Likewise it prevents the loss of water by retarding the evaporation from the surface.

Several materials are used for mulches. Straw, leaves, coarse manure, prairie grass and hay are among the chief materials selected for this purpose. The horse manure, including the litter, is the best, and it should be used whenever it is possible to secure it.

The methods of placing the mulching material around the plants differ slightly. Where the plant is small and stands alone the mulch is piled around the plant for a distance of 2 or 3 feet. The depth of the mulch varies and is determined by the nature of the material. If leaves are used for mulching they can be placed 2 or 3 feet deep. Usually some means of holding the leaves in place and in preventing them from blowing away will be necessary. The depth to which manure is placed around the plants depends upon its composition. When two-thirds of the manure is litter, a greater amount can be piled around the plant, than when it consists largely of solid matter. A conservative amount of the ordinary horse manure to mulch the ground around a plant is about 1 foot. The mulch should not be piled against the plant but it should begin about 3 or 4 inches away from it. When the mulching material is piled up against the plant it often induces mice to harbor near it and these rodents sometimes eat the bark and cause the death of the plant.

The beds of herbaceous perennial plants should be mulched every fall. Plants like the peonies, rhubarb, asparagus, strawberries and many others respond wonderfully to such treatment. Herbaceous perennial plants are usually set in beds and placed rather closely together. Because of this method of growing, it is better to cover the entire bed with the mulch. Fresh horse manure which is composed largely of straw is the best kind of a mulch. The mulch should be spread on the ground before severe cold weather arrives. From 6 to 8 inches of the mulch is the proper amount to use. The material should be distributed uniformly over the bed.

Spring Treatment of Mulched Plants.—The spring treatment of plants which have been mulched, differs according to the plant. The mulch around woody plants such as small ornamental trees and bushes, like the roses, should not be removed. By the time spring arrives the mulch will have settled down and will hardly be noticeable. Two methods of treatment are employed in such cases. If the plants are not too small the mulch is usually left undisturbed and more added each year as the old material rots and gradually disappears by becoming a part of the soil. If the plants are larger and the mulch has been extended to the limit of the drip of the branches, it is usually spaded under and incorporated with the soil to make more plant food.

For herbaceous plants a somewhat different treatment is required. In such plants as the strawberries, rhubarb, asparagus and peonies the mulch is gently raked from the crown of the plants early in the spring, just as the new growth is starting. The material used for the mulch should not be removed from the bed, but should be allowed to remain between the rows, and either spaded under or permitted to decay of its own accord on the bed.

Winter Care of Bulbs and Roots.—The bulbs and the fleshy-rooted plants require a treatment similar to that of the herbaceous plants. The bulb and the fleshy root is a vegetative part of a plant in a dormant state. A large amount of water is present in both, as well as plenty of plant food for the future use of the growing plant. The secret for their preservation is to prevent them from losing this stored up water, and drying up.

The fleshy roots of some plants and many of the bulbs are hardy and will not be killed by freezing. For this class of plants greater success will be attained, if they are planted out in the open ground during August and September and allowed to remain out of doors. The depth to which the bulbs and the fleshy-rooted plants should be set varies, and ranges from 4 to 8 inches for the common ones. When freezing weather arrives the beds should be mulched with coarse horse manure. The manure should be removed as soon as the plants begin to grow in the spring.

The treatment of the fleshy-rooted plants that are not hardy is more exact and is attended with less success. Plants like the canna which have thick, fleshy roots are also filled with water. Such roots will die if they are frozen. It is necessary therefore to dig them up and to store them over winter. These roots must not only be kept in the proper conditions by preventing the loss of water but they must also be stored in a cool place so that no growth will take place. To succeed in the storing of such roots the storage place must not be too damp or the roots will decay, yet it must have sufficient moisture to prevent them from drying out. The varying and the irregular conditions found in the ordinary houses makes it an extremely precarious place to successfully store fleshy-rooted plants. Perhaps the most ideal place for the storage of such plants would be in a cellar that is built underground which could be held at a temperature of about 35° F. With this temperature and with good ventilation the moisture conditions will usually be ideal.

When storing these plants first try to secure the best storage facilities. Then dig up the roots after the tops have been killed by frost, leaving some soil attached to them. The roots should be placed side by side on shelves built in the storage house. If the proper conditions are maintained the roots will come out of storage in the spring in excellent shape.

Where only a few roots are kept over winter usually fair results can be had by collecting the roots and packing them in sand in one corner of the cellar. They should be kept as cool as possible and if they are found to be drying out during the winter the sand should be sprinkled with water.

REVIEW QUESTIONS.

1. What is winter killing of plants? How is it caused?
2. How does fall preparation of plants prevent winter killing?
3. Why is winter protection of some plants necessary?
4. How does the winter care of the herbaceous plants differ from that of the woody plants?
5. Why is alternate freezing and thawing of the ground injurious to roots?
6. What part of a plant is called the cane?
7. What two ways are plants protected from wind?
8. Describe the method of wrapping woody plants.
9. What is meant by mulching?
10. What materials are used for mulching?
11. What determines the depth of the mulch?
12. How does the mulching of herbaceous plants differ from that of woody plants?
13. Describe the spring treatment of mulched plants.
14. How does the winter care of bulbs differ from that of fleshy-rooted plants?
15. Describe the method of storing fleshy roots over winter.

CHAPTER XII.

THE STRAWBERRY.

THE strawberry is one of our best native fruits. It was found growing wild on our mountains and in our valleys by the earliest settlers. The native sorts have been improved both by American as well as by European growers. Many of our first good varieties are said to have been sent to America from Europe, where they were first developed from our native plants.

Propagation.—The strawberry is propagated by runners. The runner is an off-shoot from the parent plant. This off-shoot soon takes root at its tip and in a short time a new plant is developed. When the young plant is large enough the connection between it and the mother plant is cut and the young plant is set in a new location. If the young plant is not removed from the parent, the runner will perish as soon as the new plant is large enough to nourish itself.

The strawberry should not be propagated from seed unless new varieties are wanted. The great variation in plants grown from seeds is not desirable for a bearing patch, because the grower is sure to get many types of fruit, which will ripen at different times and be generally inferior in every respect. When a good variety does appear from seed it should be planted separately and propagated by runners.

Renewal of the Bed.—The strawberry bed is rarely ever profitable after three years and it should then be renewed. The renewal of the bed should begin soon after the picking season is over. The old plants should be cut off, allowed to dry, raked up with any remaining mulch which is on the bed and all burned. If the refuse material is raked to the center of the rows and piled in small wind rows and burned on a windy day, very little, if any damage will be done to the plants. The old plants in the center of the rows should now either be plowed out or spaded under, leaving the young plants to make the new bed for the next year. This method of renewal can be employed once and sometimes twice on the same piece of ground. However, better results will be had if the young plants are taken from the old patch and set out in another location for the new bed. The old bed can then be plowed up and planted to some other crop.

Soil.—The strawberry has a wide adaptation to soils. It will grow well on most any type. A sandy loam with a porous subsoil which insures good drainage is perhaps the best type to select when it is available.

The soil for the strawberry should be well supplied with organic matter which is in a well decomposed state. New lands which have been recently cleared of timber produces large and profitable crops of strawberries. Such lands abound in leaf mould and are rich in organic matter and in humus.

The varieties differ considerably in their soil requirement. Some are well adapted to soils in certain localities, while other varieties in the same section are failures and decidedly unprofitable. Certain other varieties are very cosmopolitan with regard to the soil and enjoy a wide popularity. These varieties have given good satisfaction in many localities, therefore they should usually be selected by the amateur.

A thorough preparation of the soil before planting saves much future disappointment. The grower should not be satisfied with the cultivation which is given to ordinary farm crops because additional preparation is always profitable. The soil should be pulverized and reduced to a fine state of division if the strawberry is to succeed. In preparing the land plow moderately deep, say about 8 inches. If the land is in grass fall plowing is desirable. A cultivated crop such as corn should be planted the first year to insure good cultivation of the soil. This procedure will help eradicate the white grub which is often present in sod land and which is very destructive to the strawberry plant.

The soil should be retentive of moisture but not wet. Where excess water is present drainage is necessary. The berries draw heavily upon the soil water in the maturing of the crop and plenty of moisture in the soil at ripening time is highly advantageous for success in the growing of the strawberry. Many times artificial watering is very profitable during the ripening period.

Planting.—The strawberry can either be planted in the spring or in the fall. Spring planting is usually more desirable because the ground can be prepared in the fall and is then ready for setting the plants out early. The latter part of March or the first of April is the most preferable time to reset the plants. The exact date must necessarily vary in the different sections. When the plants are set in the spring they have the advantage of a full season's growth and become more thoroughly mature. In some sections the planting is done later in the season, just after the berries have been harvested. This method is satisfactory if the soil is well prepared. The young plants are usually taken from the old patch and transplanted to their new location. However, it is usually necessary to water and to shade the plants at this time of the year unless the weather is cool and plenty of moisture is available.

The plants must not be set too deeply. The crowns should not be covered up, although the plant should be set as deep as it is possible without injuring the crowns. The plants are set with either a dibble, a trowel, or a spade. The roots should be spread out slightly and the soil pressed firmly about them. The watering of the plants after setting them out will be of great value.

System of Planting.—There are four systems of planting in common use: The hill system, the single hedge row system, the double hedge row system and the matted row system.

Hill System.—The hill system is the growing of the plants singly in rows. Each plant is allowed to grow independently and no runners are permitted to form. In this method the entire strength of the plant is given over to the production of fruit, and the plants produce excellent large berries. This way of planting is very profitable when the grower is catering to a fancy market.

The distance apart the plants are set depends upon whether hand or horse cultivation is practised. Where hand cultivation is followed the plants are set 12 to 16 inches apart in the rows and the rows 18 to 24 inches apart. If horse cultivation is used the rows must be 30 inches apart and the plants 12 to 14 inches apart in the rows.

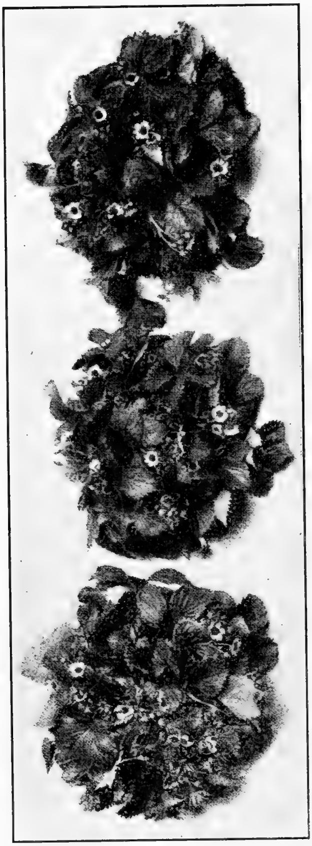


Fig. 80.—The hill system. In this system all of the runners are pinched off. (After R. M. Kellogg.)

Fig. 81.—Single hedge system. This system is formed by permitting enough runners to set to make a continuous row of plants. (After R. M. Kellogg.)

Single Hedge Row System.—The single hedge row system differs from the hill system in that the runners are permitted to grow sufficiently to fill up the space between the original plants. As a rule each mother plant is allowed to produce two runners, one on each side of the parent plant. If more runners appear they are removed. The plants in the rows should be set from 18 to 20 inches apart, and the rows from 30 to 36 inches apart.

Double Hedge Row System.—In the double hedge row system the mother plant is allowed to develop from four to six plants around her. Should more runners appear they are removed. The grower should see that the plants are evenly distributed over the ground. The original plants should be set from 18 to 24 inches in the rows and the rows should be at least 36 inches apart.

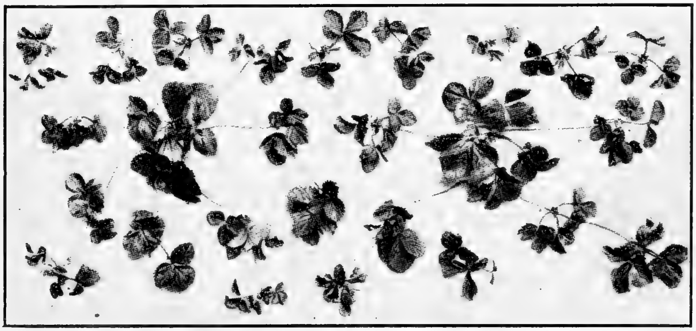


Fig. 82.—Matted row system. The plants are allowed to grow unmolested until they completely cover the ground. (After R. M. Kellogg.)

Matted Row System.—This system of planting is widely used. When the plants are grown by this method they require less labor and usually produce larger yields. When growing the plants by this system, all of the runners are allowed to develop and to form a dense mat of plants. Many growers permit the runners to set plants until the row is from 18 to 24 inches wide, but this always produces many small, inferior berries.

Cultivation.—The value of cultivation is not fully realized by many growers. The strawberry plants should be cultivated frequently and thoroughly from the time the berries are picked until frost. Newly set patches must be well cultivated the first year if a good crop is to be expected the next year. The ordinary cultivating tools are used. The weeds should be kept down and the runners cut off as they appear when they are out of place.

The first season is the most critical time in the growth of the strawberry. Tillage is very important in bringing the plants through this crisis. The cultivation is valuable in keeping a dust mulch on the soil and in preventing the loss of water by evaporation.

Fig. 83.—A pot-grown strawberry plant.

Mulching.—In most of the northern States and in many of the southern sections the strawberries should be mulched. The best mulching materials are strawy manure with very little solid matter, clean straw or hay free from weed seeds. Occasionally other mulching materials such as leaves, pine needles, marsh hay or cotton-seed hulls are used. The mulch should be applied after the ground is frozen. If it is put on too early the plants often start into growth too soon. Considering all materials, the clean straw is perhaps the best for mulching.

Fig. 84.—A well-mulched strawberry bed.

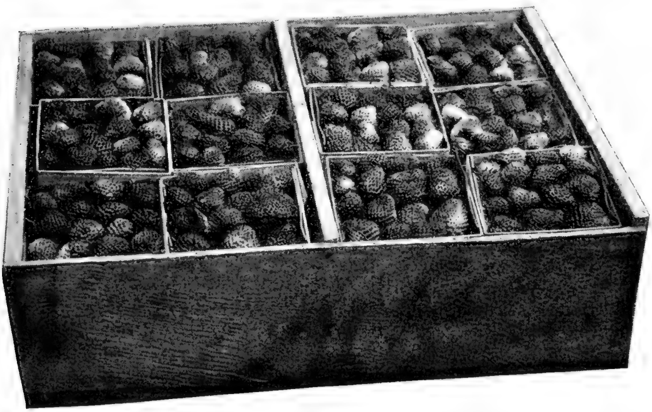


Fig. 85.—A well-graded crate of strawberries packed in square pint boxes. (After Thompson, United States Department of Agriculture.)

Harvesting.—The time of picking the strawberry depends upon the distance they are to be shipped. When they are grown for home consumption or for the local market they should not be picked until they are thoroughly ripe, but not soft. If they are grown for a distant market they should be

Fig. 86.—Crate of strawberries in octagon quart boxes. (After Thompson, United States Department of Agriculture.)

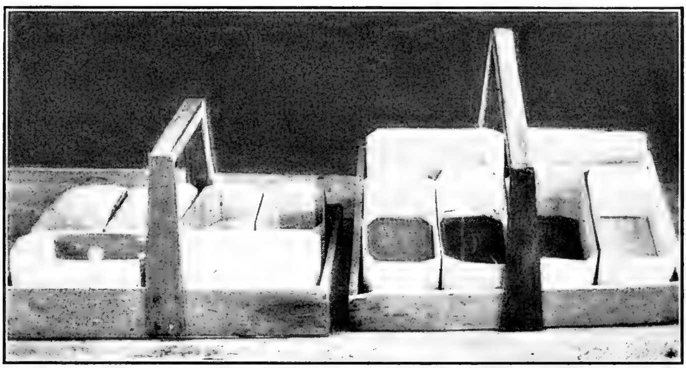


Fig. 87.—A six-basket carrier used for picking strawberries. (After W. H. Wicks, Arkansas Bulletin No. 122.)

picked when they are about three-fourths ripe. The berries should not be picked before they are colored and they should have a short stem attached to them.

The berries should be picked carefully and they should never be bruised or crushed in any way.

Packing.—Strawberries should be carefully graded and sorted before they are packed. Each package should be

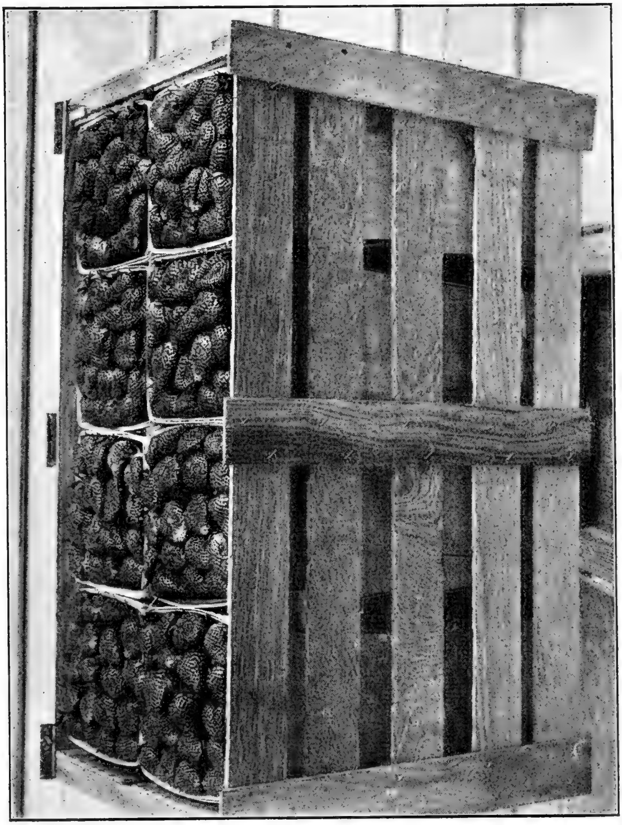
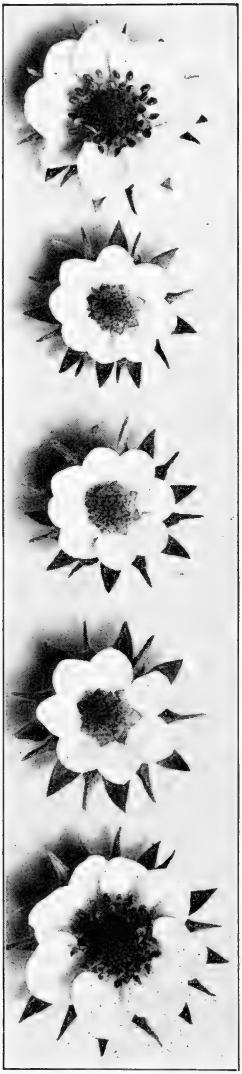


Fig. 88.—Well-graded strawberries in American quart boxes, packed in a ventilated crate. (After Thompson, United States Department of Agriculture.)

uniform and contain berries of one size. Occasionally the fruit is graded in the field, but the most satisfactory method is to have all of the berries graded and packed in a packing shed, and by experienced packers.

The berries should be placed in the shade when they are



picked. As soon as the fruit is placed in crates they should be sent directly to the refrigerator, because the heat quickly injures the fruit.

The strawberry is marketed in many styles of boxes and crates. They vary in size and in shape. The capacity of the boxes ranges from scant pints to full quarts, but there is a growing tendency to a standard full size quart box. The American type of box is most generally used. The octagon box is objectionable because of its shape and the raised bottom. The boxes are packed in crates of varying sizes and range from 24 to 32 quarts. In some sections a larger crate is sometimes used, but it is not so very satisfactory.

Varieties.—There has been a remarkable development in strawberries since the first variety gained prominence. There are a great many varieties that can be grown with success in all localities, and the grower should collect evidence on the behavior of different kinds in his region before determining upon any special variety. Some sorts will grow well on one class of soil while others will be a failure on that same soil, and only local experience can determine the best variety for a given section.

The grower must also remember that the strawberry is divided into two classes based upon the kind of flowers

Fig. 89.—Pistillate or female and staminate or male flowers of the strawberry plant. (Cruickshank, Ohio State University.)

that it produces. One class of plants is known as the pistillate or imperfect varieties while the other class is the staminate or the perfect type. The imperfect varieties have flowers with only pistils and will not produce fruit unless fertilized with other varieties that have stamens, while the perfect varieties have stamens as well as pistils, and are capable of producing fruit alone. Unless the male and the female parts are both present there can be no fruit. In selecting a variety it is necessary either to select a variety that has perfect flowers or to alternate the rows of plants that have imperfect flowers with those that have the perfect flowers. Where the rows are alternated the varieties must both bloom at the same time in order to have the fruit set. The amateur should usually confine his selection to the perfect flowered varieties. Usually two or three varieties are better to grow than only one, even if all of them are perfect flowered sorts.

The following list of varieties comprises a few of the most cosmopolitan sorts: Early Varieties—August Luther, Excelsior, Crescent and Warfield. Medium Early Varieties—Dunlap, Glen Mary and Bubach. Late Varieties—Gandy, Sample, and Brandywine.

DISEASES OF THE STRAWBERRY.

The strawberry is notably free from disease. It is rarely ever necessary to spray the plants, provided the proper cultural methods are followed. There are, however, several diseases which might become troublesome.

Leaf Spot.—The leaf spot is the most commonly known disease of the strawberry. This disease makes its appearance in the form of small, discolored spots on the leaves. These spots appear most abundantly at the flowering period. The spots are first reddish or purplish, but as they grow older the centers become a whitish color and the death of the tissue is the result. The spots are scattered irregularly over the leaves, and when they are abundant several may join together to make one large spot.

Certain varieties are more or less free from this disease, while others are very susceptible to it. The best means of control is to select disease resistant varieties so far as possible. Only the most healthy plants should be set and all spotted leaves should be pinched off. A thorough spraying with Bordeaux mixture may be given before the flowers open. If the disease becomes quite serious some relief may be had by mowing off the leaves and burning over the bed, which should be done just after the fruiting season.

Mildew.—The mildew of the strawberry is similar to that on any other plant. The disease covers the berries and the leaves with a whitish growth of webby material. It usually causes the leaves to curl up and die. Spraying with Bordeaux mixture or dusting the plants with flowers of sulphur will usually control the mildew.

INSECTS OF THE STRAWBERRY.

Since the strawberry plants are grown for two or three years on the same land, are low growing, and set closely in rows, the control of the insects is based more particularly upon rotation of the crops, clean culture, fall plowing and similar practices rather than on spraying. The one crop method of producing strawberries greatly simplifies the insect problem. There are a number of insects that feed upon the different parts of the strawberry plant, but many of them never become serious and little attention is ever paid to them.

Strawberry Leaf Roller.—The leaf roller is perhaps the most serious insect pest. It is a small greenish-brown caterpillar which folds two halves of the leaf together and feeds within the enclosed leaf. When the insects are abundant the foliage is destroyed, the fruit fails to mature and the plant is greatly weakened.

The leaf roller can usually be controlled by spraying the plants with arsenate of lead at the rate of 2 pounds to 50 gallons of water. The application of the insecticide must be timely and applied within a week after the first appearance of the moths or just before the young caterpillars begin to fold the leaves.

Strawberry Weevil.—In many parts of the country the weevil when abundant destroys from 50 to 60 per cent. of the crop each year. The insect is intermittent in its attack and will be numerous for several years then suddenly disappear and will cause no more trouble for some time, finally reappearing again.

The adult insects hibernate over winter under rubbish near the strawberry bed. In the spring they appear and after feeding for a short time lay their eggs in the unopened flower buds. In about a week the little grubs hatch and begin at once to eat the buds thus destroying them entirely. When the insects are numerous they often feed upon the foliage.

The best means of control for this insect is by practising clean culture.

In addition to the insects mentioned there are several more, but they rarely ever become troublesome.

SPRAYING OUTLINE FOR THE STRAWBERRY.

Number of spray.	Time to spray.	Spray materials.
First	When growth begins	4–4–50 Bordeaux mixture.
Second	After picking of fruit	4–4–50 Bordeaux mixture. Also cut and burn all leaves on some windy day before spraying.

At the first appearance of the leaf roller spray with 2 pounds arsenate of lead to 50 gallons of water. This spray should be repeated every week if necessary until the fruit is about half-grown.

REVIEW QUESTIONS.

1. Where were the first good varieties of strawberries developed? Why?
2. Why should the strawberry be propagated by runners instead of seed?
3. Why is an old strawberry bed unprofitable? What is meant by renewal?
4. Is the soil for the strawberry important? What determines the best type of soil to select?
5. When is the best time to plant the strawberry? Why?
6. What regulates the depth to which a plant can be set?
7. Name the four systems of planting the strawberry.
8. What is the difference between the single and the double hedge row system; the hill and the matted row system?
9. What system is the most economical? Why?

10. When should the cultivation of the strawberry begin?

11. What is the value of mulching a strawberry bed and when should the mulch be placed on the plants?

12. What determines the selection of varieties of strawberries?

13. Is the strawberry seriously affected with insects and diseases?

14. How does the leaf spot differ from the mildew? What is the remedy for each?

15. What is one of the best means for controlling the insects affecting the strawberry?

16. Give the spray outline for the strawberry.

CHAPTER XIII.

BUSH FRUITS.

THE currant and the gooseberry are the two most important bush fruits. The gooseberry is not so well known as the currant, but it deserves more attention from the American grower. In England the reverse is true and the gooseberry is very widely planted, and many varieties with very large fruit have been developed. The currant and the gooseberry are called bush fruits because the plants are low growing and are inclined to be bushy. The bush fruits should find a place in every garden because of their reliability. They rarely ever fail and are consistent bearers. These fruits are highly prized by many people for the making of jellies and jams. The bush fruits take up much less space in proportion to the amount of fruit produced than most any other fruit. They are easily grown, are compact in habit and can be set in places too small for tree fruits. The currant and the gooseberry make a fitting border around the garden. They can be planted so as to screen some objectionable fence and at the same time produce an abundance of fresh fruit. The currant and the gooseberry are the hardiest of our common fruits, and they are very easy to protect in an unfavorable climate. They are of easy culture.

Currant.—There are two common types of the currant, namely, the red and the black fruited sorts. These types are based upon the growth of the plant and the color of the fruit.

The red currant is supposed to have its origin in northern Europe and in the northern part of America. The origin of this plant is accountable for its hardiness. This species has both red and white colored fruits. The red fruited varieties are the most popular, although the white currants are grown in some sections.

The black currant commonly grown in the garden has its origin in northern Europe. The fruit as well as the plant of this species has a peculiar odor which is objectionable to some people. The demand for the fruit of the black currant is not as great as that of the red, but in some markets it is prized highly and brings a good price.

Gooseberry.—The gooseberry is closely related to the currant. It is very hardy and very productive. There are two classes of gooseberries under cultivation, namely, the American and the European types. The color of the cultivated sorts ranges from a pale green to a deep red when fruit is ripe.

The cultivated American gooseberry has been developed from one of our native species. Besides the cultivated sorts there are several wild varieties. The fruit of the wild sort is used in communities where the plant is found growing. The greatest objection to the fruit of the wild plants is the large number of sharp prickles found on it.

The cultivated European gooseberries have their origin in Europe. These gooseberries are not grown to any extent in America, because the plants are very susceptible to the mildew. The gooseberry, however, is a more popular fruit in Europe than it is in America, and many of the English gooseberries are very large, some specimens weighing from 3 to 5 ounces.

Propagation.—The bush fruits are propagated by hard-wood cuttings, by layers and by division of the plant. While the plants can be reproduced from seed this practice is never recommended, because the plants that are grown from seed are never true to name or to type. If a new variety is wanted, however, seed must be planted, but this is a very uncertain undertaking, especially for the amateur.

The currant is more generally propagated by hard-wood cuttings. The cuttings are taken from wood of the previous summer's growth and cut into pieces about 8 inches in length. The cut should be smooth and just below a bud, because it is usually too immature to produce good cuttings. The end of the new growth should be removed. The cuttings should be made in the fall, usually during the latter part of September and in October. A convenient number should be tied in a bunch and placed in damp sand in a cool cellar to callous over. The cuttings can be stored in the open ground if the ground in which they are stored does not freeze. The cuttings are not always taken in the fall. Occasionally they are cut in the spring and planted at once in the nursery row, but this practice usually does not produce as good plants as the stored and calloused cuttings do.

The gooseberry is not propagated as easily from hard-wood cuttings as the currant. The varieties, however, which have small, slender wood can scarcely be propagated by stem cuttings. For this reason the gooseberry is usually propagated by layering. Layering is normally performed during the month of June. If the branches are covered with soil at this time, usually each twig will be found to be rooted by autumn. The rooted twigs should be taken up early in the spring, cut apart and planted out in the nursery row. After they are set in the nursery they are handled in the same manner as the hard-wood cuttings.

For the home garden where several additional plants are wanted, the parent plant can oftentimes be taken up in the fall and separated into two or more parts and each piece set in a new location.

Soil.—The currant and the gooseberry will grow in almost any soil. The soil should have a good depth and be supplied with plant food. A well-drained, sandy loam with plenty of humus will give excellent results. A clay loam that is properly handled will also grow good currants and excellent gooseberries. The bush fruits do their best on high lands and are almost worthless on low land. A northern slope is preferred because it is cool and the bush fruits thrive under cool conditions. The currants and the gooseberries do well when they are planted on the north side of a building or between the rows in an orchard, because they are partially shaded. In the crowded city and in the suburban garden these fruits usually do better than almost any other fruit, expecially if the bushes are properly pruned and well-thinned out. The gooseberries do the best on a fairly stiff clay while the currants seem to prefer the lighter soil for their best development. In certain regions where the soil gets very hot and dry during the summer, it is often advisable to mulch the ground with coarse litter or straw in order to keep the temperature down and to hold the moisture in the soil.

The bush fruits are heavy feeders and they should be supplied with a large amount of plant food. The plant food can be furnished by either cultivating the soil or by mulching it heavily with good horse manure. The mulch in addition to adding plant food serves to keep the weeds down.

Cultivation.—In the majority of fruit gardens, cultivation is preferable. However, in certain sections particularly in the middle west the bush fruits seem to thrive best without cultivation, and with a mulch. The tillage when practical should be shallow because the currant and the gooseberry are shallow-rooted plants. The plants when grown under a mulch do comparatively well without tillage, and the bush fruits can be grown along the borders of the garden and in other out-of-the-way places. However, more satisfactory results are usually obtained if a certain amount of tillage is given each year. It should be stopped soon enough so the plant can mature its wood before winter. Without a doubt some cover crop such as crimson clover would be valuable, especially on a commercial plantation, if cultivation is practised. The cover crop, if it is adopted, should be planted about the same time as recommended for the other fruits, namely, the latter part of July or the first part of August.

Planting.—The bush fruits may be planted in the fall or in the spring. In many sections, except the extreme north, fall planting is preferable. Where the weather conditions are favorable and the soil is well prepared there seems to be little difference between fall and spring planting. Good results have been secured with both methods where the conditions were suitable. The advocates of fall planting claim that since the growth of these plants starts early in the spring, there is more of a check to the growth of a plant if it is set in the spring than if it is transplanted in the fall. This assumption is very sound in many instances, because the wood ripens up early in the autumn, therefore fall planting is preferred by most growers.

The distance to plant the bush fruit is determined by the method of cultivation. In most cases the plants are set 4 feet apart in the rows and the rows 6 feet apart. These distances permit of horse cultivation and during the first few years the plants can be cultivated in both directions. As the plants grow larger they are cultivated only in one direction. When the plants are set in the fruit garden and where only a few are grown, they can be planted closer together. The usual distance under these conditions is 4 feet apart each way.

The plants can be either one or two years old when they are set in their permanent places, but the two-year-old plants are usually preferred. The plants that are propagated by cuttings or by layers give the most satisfactory results for a permanent patch.

Pruning.—The currant and the gooseberry are two of the most important bush fruits. They are much alike in their habits of growth and the pruning of each plant is practically the same.

When starting the young plant the first year it should be pruned to a single whip containing six or seven good buds. The second year select five or six good branches to form the framework of the bush. Prune any irregular branches back to make a uniform top.

When the plant comes into bearing, less pruning is necessary, but a certain amount should be given regularly every year. The wood that is two or three years old produces the greatest quantity and the most superior fruit. The older branches produce fruit, but the quantity is less and the quality is inferior. The aim, then of the pruner should be to remove all branches over three years of age, and to thin out the bush in order to admit the sunlight and to permit good circulation of air. Head in all those branches that make a long or an irregular growth.

Fig. 90.—Gooseberry before pruning. (West Virginia Agricultural Bulletin No. 149.)

Fig. 91.—Gooseberry after pruning. (West Virginia Agricultural Bulletin No. 149.)

Harvesting.—The bush fruits usually give a good harvest. A strong, healthy currant plant should yield from three to six pounds of high-grade fruit, and many plants greatly exceed this yield. The currants should be picked when they are dry. They can hang on the vines for several weeks after they are ripe and improve in quality all of the time. They should be picked by pinching or cutting off the clusters. The berries should not be pulled from the bunches.

The gooseberry usually outyields the currant. The fruit of the gooseberries like the currants can remain on the bushes after it is ripe and improve in quality.

The greatest disadvantage to the harvesting of the gooseberry is the thorns. However, the thorns can largely be avoided if the branches are lifted up with one hand and the berries picked from the under side with the other hand. The thornless varieties have not as yet proved to be of any great value.

The currants and the gooseberries are long lived. They will bear fruit for many years, but it is better to set out new plants every eight or ten years. As the bushes get older the fruit becomes smaller and gets poorer in quality. The plants are propagated so easily and they cost so little that it is doubtful whether it is ever profitable to attempt to rejuvenate a neglected patch. The plants come into bearing very early and will perhaps bear fruit as soon if not sooner than rejuvenated plants and the quality will be more superior.

Varieties.—There are only a few well-defined American varieties of the bush fruits but there are many European types. The lack of interest, until very recently, in the commercial cultivation of these fruits, probably accounts for the scarcity of the varieties as compared with some of our other fruits. In Europe the bush fruits are cultivated extensively and there are many good varieties.

The most popular varieties of the red currants are the Cherry, Fray, Perfection, Versailliaise and the Victoria. In certain regions other varieties are grown, but they are not so widely planted. The Wilder is one of the newer varieties and is gaining in popularity each year.

The white varieties of currants should be more generally planted, especially in the home garden. They are considered equally as good in quality and they are prolific bearers. The White Grape and the White Imperial are the most common varieties.

The black European currants are not grown to any extent in this country. The disagreeable odor of the plant and the peculiar flavor of the fruit are objectionable to many people. This currant has some advantages and a few plants should be grown. The Black Naples is the most widely planted variety.

The important American varieties of gooseberries are even less in number than the currants. The Downing, the Pearl, and the Houghton are perhaps the most popular of the American sorts. These varieties are thrifty growers, very productive and are comparatively free from disease. They are excellent for cooking and for making jelly, but they are not equal in quality to the English varieties for eating out of the hand. The English varieties have been developed to a much greater degree than the American types. There are over one thousand well-developed English sorts of which some are suited to the American gardens. Of the English types the Columbus, Chatauqua, Industry and the Triumph are best suited to the American garden. The English types are usually less vigorous and less productive than the native varieties.

DISEASES OF THE BUSH FRUITS.

The diseases and the insects affecting the bush fruits are similar, and many that are found on the one plant are also common on the other.

Leaf Spot.—The leaf spot is a disease that affects the leaves, and it is found on both the currant and the gooseberry. It is easily recognized because of the large well-defined spots, with pale centers, which are surrounded by a brownish border. Spraying with the standard 4–4–50 Bordeaux mixture is effective in controlling this disease. The spraying should begin just as the buds are opening, and repeated at intervals of two weeks until four or five sprays have been given.

Anthracnose.—The anthracnose attacks all parts of the currant and the gooseberry. The anthracnose only becomes serious at certain times, but cases are reported where great damage has resulted from this trouble. The first symptom of this disease is the appearance of small dark brown spots on the leaves. These spots later change to yellow and the leaves fall off. Upon the canes, the stems, and the fruit the disease appears as small sunken spots. Spraying with the standard 4–4–50 Bordeaux mixture will control this disease. The first spraying should be given just as the buds begin to swell in the spring. Following up this successive sprayings should be given every two weeks until four or five have been applied.

Powdery Mildew.—The powdery mildew is found growing on both the currant and the gooseberry. This disease appears on all parts of the plant. The affected parts look as though they had been sprinkled with flour or some other white material. The powdery mildew, like all other mildews is a superficial fungus, and upon close examination you will find small white threads matted in a dense mass over the affected parts. If the disease is allowed to progress without any restraint, the berries become deformed, irregular and of poor quality. They often crack open and later rot. The damage caused by this disease is considerable, and it retards the cultivation of these fruits in many sections. According to the work done at the Geneva Experiment Station the spraying with potassium sulphide at the rate of 1 ounce to 2 gallons of water is effective in reducing the loss due to this disease. The spraying should begin just as the buds are opening and continued at intervals of two weeks until seven or eight sprays have been given.

INSECTS OF THE BUSH FRUITS.

Currant Worms.—The worms that are found eating the foliage of the currants and the gooseberries include several species. The native species as well as the imported worms are found preying upon these plants. The injury due to these insects is somewhat distinct for the various species, although all of them eat the leaves and cause considerable damage. The adults of some of the so-called currant worms are moths and some are flies, but in all cases it is the larvæ of the species attacking the plant that eat the foliage. The habits and the life histories of the various currant worms differ, but in general all of them can be controlled by the same methods.

If the plants are sprayed with 2 pounds of arsenate of lead to 50 gallons of water, these insects can be easily killed. If arsenate of lead is not available, $\frac{1}{2}$ pound of Paris green to 50 gallons of water is effective in destroying the worms. The spraying should begin as soon as the insects are seen. Usually one spraying is sufficient, although in some cases additional sprayings are necessary. If the insect attacks the plant later in the season, when the fruit is reaching maturity, spray them with fresh hellebore or fresh pyrethrum at the rate of 4 ounces to 2 gallons of water. Dusting the plants with the dry material diluted, 1 pound of the poison to 5 pounds of air-slaked lime or flour, is also good. Where the pyrethrum or the hellebore is used, there is no danger from poisoning by the eating of the fruit.

Aphis.—The aphis is known as the plant louse. It is frequently found on the currant, and occasionally on the gooseberry. It is yellowish green in color and is usually found on the under side of the leaves. The plant lice usually become abundant during the latter part of the spring, and they often cover the entire under surface of the leaves, causing them to curl up. The younger leaves near the tips of the branch are the ones which are most often attacked.

The spraying with kerosene emulsion or with Black Leaf 40 will control this insect. The spraying to be effective must be done with great care and the spray material must come in contact with every insect. This is often difficult, since the insects are in the curled leaves, and hard to reach. The spray must necessarily be directed upward so as to reach the under side of the leaves.

Fruit Worms.—The currant and the gooseberry are subject to attack by certain insects that bore into their fruit. Ordinarily these insects are not serious, but occasionally the entire crop is damaged by them. The gooseberry fruit worm is perhaps the most serious and is the larva of a small grayish moth. The female lays her eggs on the fruit and after hatching the larvæ enter the fruit and feed on the pulp. Occasionally one worm will enter several berries and join all of them by a web. In the small home garden hand picking is perhaps as effective a remedy as can be suggested. This is not practical on a large scale, and some other method still remains to be worked out.

SPRAYING OUTLINE FOR THE CURRANTS AND THE GOOSEBERRIES.

No. of spray.	Time of spray.	Spray materials.
First	Before buds swell in spring	Commercial lime sulphur diluted 1 gallon to 8 gallons of water.
Second	Just as leaves are expanding	Commercial lime sulphur, 1 gallon to 35 gallons of water, or 4–4–50 Bordeaux plus 2 pounds arsenate of lead to 50 gallons of spray.
Third	When fruit is one-fourth grown	Same as second.
Fourth	Near ripening season if worms are troublesome on the fruit	Fresh hellebore or pyrethrum, 4 ounces to 2 gallons of water, or dusted on at the rate of 1 pound to 5 pounds of flour or air slaked lime.

If the aphis or plant louse appears, spray the plants with Black Leaf 40 at the rate of 1 part to 500 parts of water. Any wilted foliage should be cut out and destroyed because this usually indicates the borer.

REVIEW QUESTIONS.

1. Name the bush fruits and tell why they are so called.
2. Differentiate between the several kinds of currants.
3. How does the currant differ from the gooseberry?
4. Discuss the propagation of the bush fruits.
5. Why is it more desirable to propagate the bush fruits by cuttings instead of by seed?

6. Why should the gooseberry be propagated by layering instead of by cuttings?
7. What soil is preferable for the currant and the gooseberry?
8. When is it profitable to cultivate and to mulch the bush fruits?
9. Why is cultivation to be preferred over mulching?
10. What are the proper distances to plant the bush fruits?
11. What determines the distance the plants are set?
12. Discuss the harvesting of the bush fruits.
13. Why should the plantation be renewed every ten to twelve years?
14. Discuss the varieties and name the most important ones.
15. Discuss the insects and the plant diseases that attack the plants.
16. Give the spray outline for the bush fruits.

CHAPTER XIV.

THE BRAMBLES.

THE brambles include the blackberry, the dewberry, the red raspberry, the black raspberry and the loganberry. The blackberry and the raspberry are the most important brambles, and these are found growing in many sections of the country. They are both commercially profitable over a large area. The dewberry is more limited in its growth than either the blackberry or the raspberry. It is grown in many places, however, but it does not rank very high as a commercial fruit. The loganberry is a new bramble. It has come into prominence very recently. The area over which it can be grown is somewhat limited. The loganberry reaches its highest development in the northwestern part of the United States. It is a very important fruit in Washington and Oregon and it is shipped to many parts of the country from that region.

The brambles are special favorites of most growers because they give quick returns. They are easily grown and the yields are usually large. Some one of the brambles should find a place in either the small suburban home garden or the farm garden. Where the garden is large enough, a few plants of each bramble should be grown.

In many sections of the country the brambles, and especially the blackberry, raspberry and dewberry, grow wild. These wild sorts are good but they are usually inferior to the cultivated varieties. Whenever brambles are desired for the garden it is always well to select those cultivated varieties that have proved to be profitable. It is rarely ever satisfactory to collect the wild sorts for the garden. The fully ripened fruit of the cultivated sorts is much superior in quality to that of the wild sorts. The habit of growth of the cultivated plants surpasses the wild varieties and there is always a loss when the wild plants are grown in place of some of the cultivated and the named varieties.

Blackberry and Dewberry.—The fruit of the blackberry and the dewberry is similar, but the growth of the plants is different. The dewberry is not as important as the blackberry. It claims admission into the garden principally because it ripens its fruit earlier, and this lengthens the blackberry season. Another advantage claimed for the dewberry is that it is a trailing plant and it can be more easily mulched and protected in severe climates. The dewberry is sometimes spoken of as the trailing blackberry.

The cultivation of the blackberry began about 1850 and it has gradually spread to many regions since that date. The general culture of the blackberry has probably been delayed because of the many wild forms which are abundant in nearly every section of the country. The superiority of the cultivated varieties with regard to the size and the quality of the berries has greaty increased the commercial plantings. As the public becomes better educated to the value of the cultivated varieties of blackberries the industry is bound to increase more rapidly.

Raspberry.—There are three kind of raspberries. This division is based on the color of the fruit, and we have the red raspberry, the black raspberry, and the yellow or light colored raspberry. The red raspberry and the black raspberry are the types which are most often grown. The yellow raspberry is cultivated only to a limited extent and more as a novelty than as a staple variety.

The origin of the raspberry is somewhat uncertain. There seems to be, however, some varieties of European and some of American origin.

The red raspberry group includes not only the native red raspberry but the European red varieties as well. This group also embraces an intermediate plant that bears a purple fruit and is frequently spoken of as purple cane raspberry. The yellow-fruited raspberry is also included in the red group. The red raspberry has a more slender and a more open habit of growth than the black raspberry. The canes are often stiff and bear stiff prickles. The red

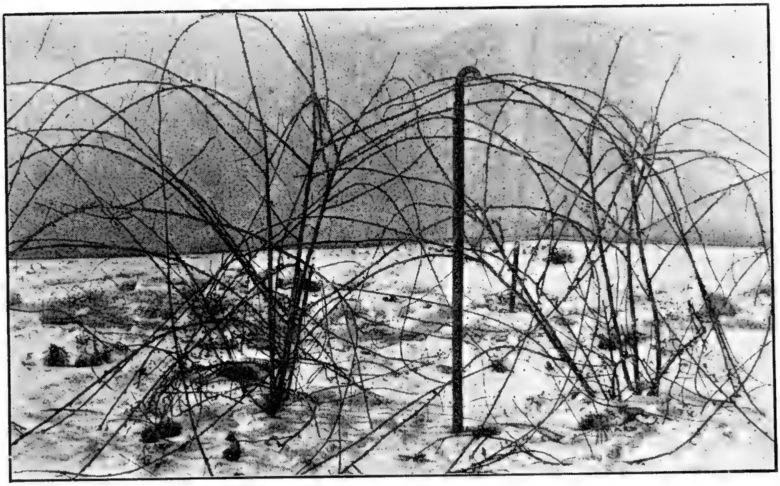


FIG. 92.—Black raspberry before pruning. (West Virginia Agricultural Bull. No. 149.)

FIG. 93.—Black raspberry after pruning. (West Virginia Agricultural Bull. No. 149.)

raspberry is somewhat more hardy than the black raspberry and it can be grown considerably farther north.

The black raspberry is distinct from the red raspberry both in its habit of growth and in its fruit. The habit of growth of the plant as well as the quality of the fruit are such that it has gained an important place as a commercial product. The black raspberry industry can be more profitably and more successfully pursued in regions remote from large commercial centers, because the fruit can be evaporated and sold in a dry state. The red raspberry, however, cannot be handled in this way and must be sold in a fresh state. This limits the production of the red raspberry group to regions where large centers of population exists such as around cities.

Loganberry.—The loganberry is a hybrid between the red antwerp raspberry and a native blackberry of California, produced by Judge J. H. Logan, of Santa Cruz, California. It is a plant well adapted to the northwestern States of Washington and Oregon as well as parts of California. It is not grown to any extent in other regions. The loganberry is remarkable for its productiveness, hardiness and freedom from insects and diseases. The fruit is very large, often reaching $1\frac{1}{2}$ inches in length. It is shaped much like the blackberry and is of a dull crimson-red color. The plant is a rank, coarse grower and produces long viny canes. The loganberry has a flavor intermediate between that of the blackberry and the raspberry. It ships well if picked before it is too ripe. It is prized by many people for canning, preserving and jelly making.

Propagation.—The brambles are propagated by suckers, root cuttings and tip layering. Each method of propagation is satisfactory, but the growth of some of the different varieties makes one method better than some others. There is a great tendency for some of the brambles to throw up young plants from their roots. These young plants are called suckers. The suckers are cut from the parent plant with a part of the root to which it is attached and set in a new place. In a short time the new plant will soon make a fine, large specimen. When the propagating material is scarce, new plants can be produced by cutting the roots into pieces about 3 inches long. These small pieces of roots are called root cuttings. Each root cutting should be planted 3 or 4 inches deep. The root from which the cutting is made should be from $\frac{1}{4}$ to $\frac{3}{8}$ of an inch in diameter. Certain of the brambles can be propagated by layering. The dewberry and some of the blackberry-dewberry hybrids, as well as the raspberries will root readily at the tip of the canes. This method of propagation is called tip layering. Tip layering is performed by either allowing the cane to bend down and touch the ground naturally or to fasten it down by some artificial means. When the tip of the cane comes in contact with the soil it soon takes root and in a short time a new plant is developed.

Soil.—The brambles thrive on nearly any type of soil provided suitable moisture conditions prevail. A sandy or clay loam is perhaps the most preferable when it can be secured. The brambles yield the largest returns when they are grown upon a moderately deep, rich soil with plenty of available plant food.

The soil for the brambles should be well prepared the season previous to the setting of the plants. Some cultivated crop, such as potatoes, beans or cow peas, should be planted on the soil the previous year, so that the ground will be well cultivated. This procedure will ensure the thorough rotting of any sod or organic matter and will help to destroy any cut worms or other injurious insects which often cause great damage to the young plants. The soil should be plowed to a depth of 8 to 10 inches when the brambles are planted. After plowing the ground it should be thoroughly harrowed and worked down until the soil of the plant bed is fine and uniform. The subsoil should be such as to give ample drainage. The brambles cannot thrive with their roots growing in a cold, damp subsoil.

Fertilizer.—The brambles respond differently to the use of fertilizers. Barnyard manure applied in limited quantities is perhaps the best fertilizer for the brambles in general. The manure not only adds plant food and humus but it also improves the physical condition of the soil.

According to some work done at the New Jersey Agricultural Experiment Station, the barnyard manure is not as profitable as the complete commercial fertilizer for the red raspberries. There might be considerable variation in different sections in regard to the value of commercial fertilizers. In all probability a combination of both the barnyard manure and a complete commercial fertilizer will give more uniform results over a greater range of territory. For the home garden the barnyard manure should be used, especially by the amateur. Occasionally there is some danger attending the use of the commercial fertilizer and unless the grower is thoroughly familiar with the handling of the product some damage might result to the plants.

Planting.—The brambles are usually planted in the spring. A larger number of the plants will grow if they are set as early as the land can be properly prepared. When early spring planting is impossible the plants can be set in the fall especially in those regions where there is no danger from drying winds during the winter.

The plants should be set a little deeper than they formerly stood in the nursery row. If the crowns project above the ground the canes are easily broken off. The top should be cut back to 6 or 8 inches in length as soon as the planting is finished.

The distance to plant the brambles depends upon the purpose of the crop. If the soil is fertile and the crop is for commercial purposes they must be set farther apart than if the plants are grown in the garden for home consumption.

The brambles are usually set 3 feet apart in the rows, and the rows 6 to 8 feet apart for commercial planting in the Eastern States. In other regions where the plants grow very large, as they frequently do on the Pacific coast, they should be set 4 or 5 feet apart in the rows and the rows not any closer than 8 feet. In the home garden where only a few plants of each bramble are grown, and where hand labor and greater attention is given to them, the plants can be set closer together. Under such conditions the rows should never be less than 4 feet apart nor the plants less than 2 feet apart in the rows. The character of the soil and the space available will determine the distance in most cases especially in the home garden.

Systems of Training.—The systems of training vary with the conditions in the different sections of the country. In some regions the canes are topped, that is, the tips of the

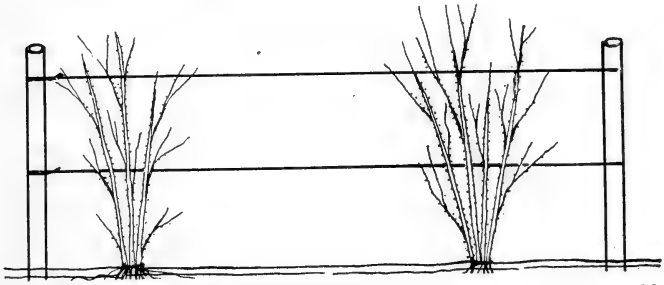


FIG. 94.—A common form of trellis for canes of the upright types of brambles.

branches are pinched off with the fingers when they have reached a height of $2\frac{1}{2}$ or 3 feet. All canes do not reach the desired height at the same time, and the patch must be pruned several times. The pinching off of the tip causes the canes to branch and they are better able to stand erect

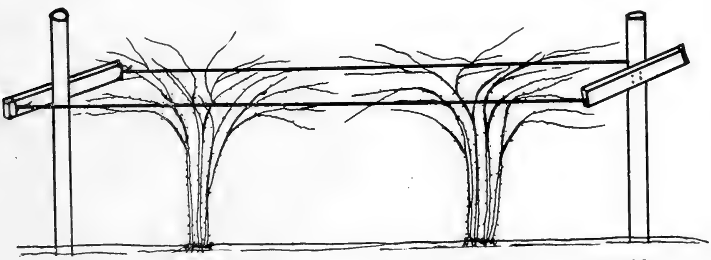


FIG. 95.—A form of trellis for canes of the trailing types of brambles.

under heavy crops of berries. In some cases when pinching off is practised the canes will stand erect without supports. If supports are needed wires can be stretched along rows of posts close to the brambles. A trellis of this kind is made by setting posts at intervals of from 15 to 25 feet.

A wire is stretched along the posts about $2\frac{1}{2}$ feet above the ground and the canes are tied to the wire. A modification of this trellis is made by nailing a cross-piece, 18 inches long, to the post near the top. Two wires are then stretched along the posts and fastened to the cross-bars. The brambles are now allowed to grow between the wires, which forms a support on either side of them.

Brambles of the upright growing type, as some of the blackberries, are supported by tying the canes to a trellis made by stretching two or three wires along several posts set at intervals of from 15 to 20 feet. The trailing types of brambles are sometimes allowed to run along the wires of the trellis similar to that of the grapevine. Either two or three wires can be fastened to the posts. The number of wires is determined by the type of the bramble. If the brambles are planted in hills, which is occasionally done, posts can be set at each plant and the canes fastened to the post.

Pruning.—The blackberries and the raspberries are sufficiently alike to make the pruning of each practically the same.

Both the blackberry and the raspberry have a great tendency to sucker. These suckers not only grow about the parent plant but also between the rows. A certain percentage of all these suckers should be removed as soon as they appear, and especially those which grow between the rows.

As soon as the berries are picked, the old canes which have just borne the fruit, should be cut off close to the ground and burned. This practice allows the young canes more room in which to develop and at the same time destroys any diseases or insects that are present.

In some sections the plants are topped, that is, the tips of the canes are pinched off with the fingers when the canes have reached a height of $2\frac{1}{2}$ or 3 feet. This pinching back of the canes causes them to branch and they are better able to support their fruit without breaking over.

The canes should be thinned out in the row, so that only four or five are grown in one clump. This practice is conducive to good healthy plants and also produces the best quality of fruit.

Winter Protection.—The brambles require some winter protection in the northern and central western States which are subject to cold drying winds. Although some of the brambles, particularly the blackberries, can withstand very cold weather, some protection is usually advisable. The plants are first taken from their trellis or support and laid on the ground. It is then a relatively easy matter to cover up the canes with soil. If the soil is not sufficient to thoroughly protect the plants, hay, straw or coarse manure can be added later in the winter. As soon as the cold weather is over the materials are removed and the plants fastened to the supports. The strawy material which has been removed will form a mulch for the ground during the growing season and in this way will serve two purposes. A mulch is of great value in retarding the evaporation of water from the soil. It also has the advantage of keeping the weeds down and, to a limited extent, of preventing a rank growth of suckers. Where the plants are mulched the material should not be removed from the canes until all danger of severe weather is past.

Harvesting.—The fruit of the brambles is usually hand-picked. This method of harvesting is necessary because of the soft nature of the fruit. The keeping qualities of the fruit of any variety depends largely upon the care exercised in the picking and the handling. If the berries are bruised or injured in any way the fruit is quickly destroyed by moulds.

The time for picking the fruit depends upon the season of maturity and the variety. Some varieties may be picked soon after the berries turn black, while others color up before they are ripe. The berries should not be picked until they become sweet, but should still be firm enough to market well.

The fruit of the brambles is marketed in either pint or quart boxes, like that of the strawberry. Perhaps the shallow pint boxes are preferable to the quarts because the weight of the berries is sometimes sufficient to mash the lower ones. The boxes are packed in crates which vary in size from 16 to 24 boxes to the crate.

The fruit should be kept in a shady place in the field, and taken to the refrigerator as soon as possible after it is picked.

Varieties.—The brambles vary so in their ability to withstand cold that they are usually divided into three groups, the hardy, the half-hardy and the tender sorts. The hardy varieties should be selected for planting in the northern regions where severe weather prevails. In such districts the plants should be mulched to prevent them from winter killing. The half-hardy varieties grow and succeed in the middle States or in a region farther south than where the northern varieties are grown. The tender varieties have originated for the most part in the southwest, and are pecularly adapted to the semi-arid conditions that prevail in those sections. These varieties are somewhat drought resistant and mature their fruits before the season becomes too warm.

The Pacific coast region grows a large number of varieties. Some of these are common in the east and some are adapted to other sections of the United States. There are many brambles grown in the Pacific coast region that are not adapted to any other section of the country. This is possible because of the wide variation in the climate as well as in the rainfall.

There can be no authentic list of varieties that will succeed in all regions. The grower must first decide whether his local conditions will permit the growing of the tender, half-hardy or hardy types. It is not profitable to select varieties which are not perfectly hardy. An inquiry among the growers in his immediate vicinity as to the best variety to select is recommended. The grower should as far as possible select those varieties which are best suited to his particular section.

DISEASES OF THE BRAMBLES.

There are several diseases and insects found on both the blackberry and the raspberry. However, by the use of the proper preventatives these troubles can be held in check and good yields obtained.

Leaf Spot.—The leaf spot is a disease found upon the leaves of the blackberry and the raspberry. The disease appears as small spots on the leaves. The central region of the spots is white while the border is of a reddish color. This disease is exceedingly common and widespread. No treatment has yet been demonstrated to be of sufficient value to be recommended. It is not often very serious.

Anthracnose.—The anthracnose is a very serious disease of both the blackberry and the raspberry. It has caused great loss in several States. The disease attacks chiefly the young canes, but is also found upon the leaves. The disease appears as small purplish spots which later become grayish white in the centers. As the spots increase in size, they coalesce, making irregular blotches varying from $\frac{1}{8}$ to $\frac{1}{2}$ inch in length. The affected leaves refuse to grow and finally dry up and fall off. The anthracnose is not very destructive if rotation of crops is practised. In addition to rotation, the infected canes should be cut out and burned. Spraying with standard 4–4–50 Bordeaux mixture will aid in preventing the spread of the disease.

Cane Blight.—The cane blight is sometimes very injurious in certain regions. The injury occurs to the fruiting canes, the foliage of which wilts and dies. This disease often enters the canes through slits made in pruning. The disease is largely distributed through nursery stock and by workmen. The cane blight should be prevented as much as possible by planting only healthy plants and all diseased canes should be immediately burned. It is never advisable to replant on ground that has been previously infected.

INSECTS OF THE BRAMBLES.

Raspberry-cane Borer.—The raspberry-cane borer sometimes becomes troublesome. The adult insect is a beetle about $\frac{1}{2}$ inch in length. It has a slender body which is black in color except the prothorax, which is yellow. Occasionally two or three black spots are found on the wings. The beetles appear in the early summer and the females girdle the young tip in two places, causing it to wither and die. Between the two girdled portions the female deposits her eggs, which soon hatch and the larvæ burrow downward.

By fall they have reached the root, where they remain over winter. This insect is held in control by cutting off the tip of the canes below the girdled point and burning them. Spraying is not effective against this kind of an insect.

SPRAYING OUTLINE FOR THE BRAMBLES.

When the new canes are 8 to 10 inches high begin spraying with 4–4–50 Bordeaux mixture and repeat at intervals of every two or three weeks throughout the growing season. If worms or slugs appear and destroy the foliage by eating it, add 2 pounds of arsenate of lead to 50 gallons of spray. After the fruiting season has passed, thoroughly inspect the canes, cut out and burn all those which are irregular in growth, weak or infected with galls, tree cricket eggs or stem borers.

REVIEW QUESTIONS.

1. Name the plants that are included under the brambles.
2. Tell the difference between the blackberry and the dewberry.
3. What is the origin of the raspberry? How is the raspberry group divided?
4. What is the difference between the red raspberry and the black raspberry?
5. Why is the black raspberry grown over a greater area than the red raspberry?
6. Give the origin of the loganberry? Where is its native home?
7. Discuss the three ways in which the brambles are propagated.
8. Which method of propagation is most commonly employed?
9. Discuss the preparation of the soil for the brambles.
10. What advantage has barnyard manure over commercial fertilizer?
11. What is the most desirable way to fertilize the brambles in the home garden? Why?
12. Discuss the planting of the brambles.
13. What determines the distance the plants are set?
14. Why are the brambles set closer together in the home garden than in the commercial plantation?
15. Discuss the several ways of training the brambles.
16. Discuss a good way to protect brambles during cold weather.
17. Why is it necessary to give the brambles winter protection?
18. What is the determining factor in selecting a variety of one of the brambles?
19. Name and describe the important diseases and insects.
20. Give the spray outline for the brambles.

CHAPTER XV.

THE GRAPE.

America has about twenty species of native wild grapes. A few of this number have been fully tested under cultivation. There is practically no part of North America without some native species. In many sections these wild species are important fruits and are the parents of many of our commercial varieties.

The two great classes of grapes grown in this country are the American species or the labrusca grapes, of which the Concord, the Delaware and the Niagara are common examples, and the European or vinifera varieties, such as the Malaga, Tokay and Thompson Seedless, which are confined to the warmer Pacific coast region. The grapes grown east of the Rocky Mountains are practically all improved native species, but west of the mountains along the Pacific coast the European species are the grapes which are largely grown.

The grape is of very easy culture and brings almost certain reward for the care and the attention which is given to it.

Propagation.—The grape is propagated by seed, hard-wood cuttings, layering and in some regions by grafting. Grafting is most often done in California, where the European varieties are worked on the American roots, in order to avoid the loss due to an insect known as the phylloxera.

The grapes propagated by seed are used either as stocks on which to graft known sorts or to obtain new varieties. The seed should be sown, as soon as it is gathered, in rich soil, to a depth of ½ of an inch, and protected by a mulch during the winter. Where the seed is grown in a haphazard way there is very little chance of ever producing fruit of any value. The intelligent hybridizing or the crossing of two staple varieties of known worth is a much better way of securing new varieties of value.

The propagation by hard-wood cuttings is the most practical and the most widely used method. The hard-wood cuttings of the grape are made in several ways, namely, as one-eye, two-eye, three-eye, heel and mallet cuttings. The two- and the three-eye cuttings are most often employed.

Fig. 96.—Two- and three-eye rooted cuttings of the grape.

The one-eye cutting is only used when the cutting wood is scarce and a large number of cuttings are made. The heel and the mallet cuttings are only used in special cases. A few varieties will grow better when a small piece of the parent branch is attached, as in the heel and the mallet cutting.

The length of the straight stem hard-wood cutting varies according to the variety and the amount of available cutting wood. When it is possible the cutting should be about 8 inches long. Shorter cuttings should only be used when absolutely necessary.

The cuttings should be handled as described in the chapter on the Propagation of Plants.

FIG. 97.—Rooted heel cuttings of the grape.

The grapes of all varieties are easily propagated by layering. This method of propagation is neither adapted to the rapid multiplication of the plant nor is it very well suited to the commercial propagation of the grape. It is, however, an excellent means for increasing the grape for home use where only a few well-developed and strong plants are needed.

There are several methods of layering commonly employed: The serpentine and the trench layer are perhaps the most practical. Layering is especially valuable for the amateur, because very little knowledge of the growth of a plant is necessary to have good success with layering. The essential step in layering is to break or twist the cane at several points and then cover it up with soil to a depth of several inches. If serpentine layering is the method selected the cane is covered at several places, leaving a corresponding space not covered. Several plants will grow from this parent cane and the young plants can be removed when they have a well-developed root system.

Soil.—The grape does the best if grown on a good sandy loam. A clay loam is also satisfactory in many cases if it is well drained. The soil should be fertile but not excessively rich. It should be loose and easily worked. The presence of lime in a soil seems to be beneficial.

The subsoil should be open and somewhat loose in texture. The character of the subsoil is important. The roots are easily injured by excessive heat and draught as well as by standing water, and if the texture of the subsoil is such that the roots cannot penetrate it the vine will usually suffer. This is particularly true if the subsoil is comparatively close to the surface.

The soils underlaid with a hard pan or those which are inclined to wash badly, as well as poorly drained ones, should always be avoided when selecting a location for the grape.

The soil should be thoroughly prepared by plowing and harrowing it before planting the grape. Where conditions warrant it the soil will be greatly improved by incorporating well-rotted manure with it before planting the vines.

The soil with reference to the general location is important. The situation for the grape should be one which is protected from cold winds. A warm sunny exposure with a free circulation of air is very desirable. A southern slope generally offers the best location. Other slopes and level land are used extensively for growing the grape, but the fruit is usually a little longer in ripening. Excellent fruit is often grown on northern slopes if they have the modifying influences of some large body of water.

Planting.—The most economical way of planting the grape is to furrow out the land one way and mark it the other. The vines are then set at the intersection of the furrow and the mark. For home planting a hole large enough to receive the roots without crowding them can be made with the ordinary spade or any other digging implement.

When planting the vines it is always well to select a cloudy day and to have the soil in a damp condition but not wet. The vines suffer less from exposure when they are planted under these conditions. The top of the vines should be cut off so that only three or four buds remain before they are planted. The roots should be cut back to a uniform length, say about 10 to 12 inches. On light soils it is very important to have the plants set deep, and on such soils 12 to 15 inches is not too deep. The fertile top soil should be worked about the roots, but the plants should not be covered more than 2 or 3 inches deeper than they stood in the nursery row at the time of planting. Gradually add the remainder of the soil until the plants are to the required depth.

It is not advisable to plant deep on heavy soils and 6 to 8 inches is about the right depth.

The distance apart the plants should be set depends somewhat upon the vigor of the plant and the variety which is selected. The method of training and pruning as well as the soil also regulates the distance. The strong growing varieties are sometimes set 10 feet apart each way, but occasionally some growers will set the plants 7 or 8 feet in the rows and the rows 8 to 10 feet apart. The stronger growing varieties, like the Niagara and the Concord, will have to be set at a greater distance than a weaker growing variety like the Delaware.

Only strong one-year-old vines produced from layers or from cuttings should be planted. Two-year-old vines often times do not grow well, while older vines are of very little value.

It is more economical and in every way more profitable to pay a good price for the best vines than to use inferior ones which cost nothing.

The vines of each variety should be planted together and as soon as the planting is completed a record should be made which will show the location of all the vines of each variety.

Cultivation.—The cultivation of the grape should begin soon after the vines are planted. The tillage should be shallow enough so as not to strike the roots. The vineyard should be kept free from weeds. During the first two years some hoed crop can be grown between the rows which will be a benefit to the plants by shading them. After a year or two the vines will need all of the room. The narrow strips left along the rows should be cleaned out with the hoe. A one-horse cultivator will usually be the most economical for cultivating between the rows.

The cultivation should stop when the fruit begins to weigh down the vines. As soon as the crop has been harvested, the cultivator should be run down the middle of the rows and the ground sown to some cover crop. Crimson clover or cow peas seem to serve this purpose well, although rye, buck-wheat and hairy vetch are sometimes used.

Pruning.—The pruning and the training of the grape to a definite system usually go together. It is necessary to follow a uniform method of pruning in order to train the vine to a certain system. It requires judgment as well as knowledge of the vine. When the vines are in a vigorous condition the pruning and the training becomes almost optional with the grower, although there is no doubt that certain varieties of grapes do the best when trained to a certain system.

In pruning the grape the relationship of the wood to fruit bearing should be thoroughly understood. The pruner must keep in mind that the fruit of any year is borne near the base of shoots of the same year, which spring either from the canes of the preceding year or from older wood.

Since each shoot bears from two to three clusters of fruit, only two or three buds should be left on the cane of the previous year's growth. Usually two or more canes are selected on one or two of the main stems. Good pruning, then, means removing all wood except canes sufficient to furnish the shoots necessary for the desired number of clusters.

The time for the pruning of the grapes varies somewhat with the growers and the localities, but it usually extends from the dropping of the leaves in the fall to a time just before the swelling of the buds in the spring.

Systems of Training.—The training and the pruning of the grape are closely allied. In discussing training it is necessary to use certain terms characteristic of the grape and a brief definition of these terms should logically find a place here. The terms commonly used are (1) shoot, which is a green or immature growth less than one year old; (2) cane, which is a matured shoot; (3) arm, which is an old cane three or more years old; (4) branch, which is a division of an arm; (5) stem, which is the part that supports the entire vine.

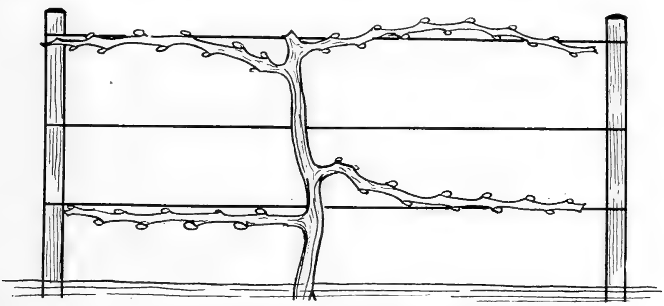


Fig. 98.—Single-stem Kniffen system of training the grape.

In the training of a vine a support is necessary. This support is called an arbor or a trellis. The best trellis is one that permits the vine to grow without crowding and also holds it in such a position so that all parts can be easily reached when spraying and gathering the fruit. The trellis should not be too expensive. There are many different styles of support and each has its advantages as well as its disadvantages. The support adapted will depend upon the variety of grape which is grown and also whether it is for commercial or home planting.

Stakes.—The cheapest and the most simple method of training the grape is by setting a stake at each vine and tying it to the stake. This method affords an opportunity for cultivating the soil in both directions and is preferred by some growers. The weaker growing varieties are usually trained by this method. The stakes should be 2 or 3 inches square or 2 or 3 inches in diameter and at least 5 or 6 feet in length. The most durable wood should be used. Occasionally when the vines are trained to stakes it is necessary to use two of them for the stronger growing varieties.

Trellises.—A good trellis can be made by the use of several good posts and some wire. The posts should be of the most durable wood and about 7 or 8 feet in length; 2 or 3 feet of the post should be set in the ground, leaving the trellis about 5 feet in height. The posts at the ends of the rows should be heavier than those in the center, because the greatest strain comes on the end posts. The posts should alternate between the vines and not set directly in front of any one. They should be set twice the distance between the vines. After the posts are set, galvanized iron wire should be stretched along the row and the wire should be securely fastened to each post with a staple. Galvanized iron wire no smaller than No. 12 should be used. Three wires are usually much better than two. The lower wire should be about 15 to 20 inches above the ground. The other wires should be spaced about 12 to 14 inches apart.

When the wires are fastened to the side of the posts it is called a vertical trellis. Several methods of training the grape may be used on the vertical trellis. The two most common systems are the horizontal arm and the fan system. When the fan system is adopted it is much the same as that practised when the vines are trained on stakes. This method is virtually a renewal system because the vine is practically renewed each year. Two or three shoots are grown near the ground each year, and these are tied to wires, the ends being cut off when the young canes are 4 or 5 feet long.

The canes are then trained to the wires in a fan shape. The side canes on the branches are shortened to spurs of two or three buds. Only three or four of the side canes should be allowed to grow on the branches. All of the other canes should be removed.

The arm system of training consists in allowing a single stem to grow to the desired height. The end of the stem is then cut off and the two upper canes are trained horizontally along one of the wires and forms the arms. All other canes should be removed so soon as they start growth.

There are two ways of fastening the arms to the supports: Some growers prefer to cut the stem short and train the arm to the first wire. The future branches can then grow up and be fastened to the upper wires. Some other growers prefer to have the stem long so it will reach the top wire and the future branches will hang down. Either system can be used according to the choice of the grower.

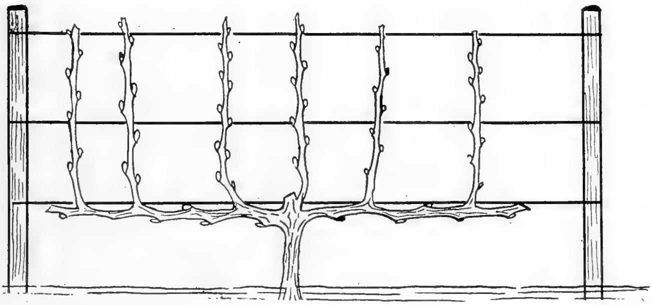


Fig. 99.—Upright renewal system of training the grape.

The Overhead System.—The overhead system is only adapted for small areas of grapes around the home. It is nothing more than the common grape arbor. In many sections it is fast disappearing and is being replaced by the other methods of training. However, there are certain places where the grape can be satisfactorily trained by this method. The overhead system is supported by a trellis made by placing posts in the ground 8 to 10 feet apart. The posts are usually 8 or 9 feet long and set in the ground 2 or 3 feet. The posts are set in two rows and each post opposite the other. A 2 x 4 is then nailed across the top of two posts. When this frame is completed strips 1 x 2 inches are nailed along the sides and over the top of the frame. These strips should be at least 2 feet apart.

Harvesting and Packing.—The grape should not be picked until it is fully ripe for use in the home or for making wine. There are many varieties which become highly colored sometime before they are fully matured, but they are not ripe. If the grape is picked so soon as it colors up the fruit will be sour and inferior in quality. When the grape is ripe and in the best condition to pick the stem will begin to shrivel slightly or will soften a little so that it can be easily bent.

The grape should never be gathered when the vines are wet with dew or rain. The stems should always be cut and the bunch should never be pulled or broken off. The bunches should be laid either in shallow trays or in baskets when they are carried to the packing house. The packing of grapes will be made much easier if the grapes are allowed to lie for a couple of hours until the stems become slightly wilted. The bunches should be placed in the baskets with their stems down. Each bunch should be packed firmly in the carrier or the fruit will move about and be greatly injured before it reaches the market.

A package should never contain more than one variety of grapes. Neither should mixed nor inferior fruit be included in any pack, because it reduces the value of the good fruit.

The grape ripens during the latter part of the summer when it is still warm. Therefore grapes cannot be kept for any length of time unless they are immediately placed in cold storage. Even under the best conditions the grape can only be held for a limited time. It is usually better to dispose of the crop when it is harvested than it is to attempt to hold it.

Varieties.—The selection of varieties is a most difficult undertaking. Their behavior and requirements are varied according to the soil and the climate, so that it would be folly to offer a list for any given section. There are, however, several varieties that do well over a considerably large area and might be listed for the aid of some. The Concord, Worden and the Moore, which are dark grapes, and the Niagara, which is a white grape, succeed in many parts of the North.

The Delaware is perhaps the finest quality grape, but it must be given special care, and some skill is necessary in growing it. It usually takes an experienced grower to succeed with this variety, although the amateur sometimes has good success with it.

The Catawba is one of the oldest and the best known of our native varieties. It is a late grape and does not succeed over so great a range of territory as the other varieties enumerated. A few other varieties worth mentioning are the Brighton, Diamond and Woodruff.

DISEASES OF THE GRAPE.

The grape is subject to several diseases and insects. In some sections these maladies become so troublesome that grapes are not often grown. Luckily, if proper spraying is done many of these troubles can be controlled.

Black Rot.—The black rot is probably the most serious trouble to the grape-growing industry. This disease is of American origin and well distributed over the grape-growing regions of the United States. The black rot not only attacks the fruit, but it is found on the leaves, stems and young canes. The berries are the most seriously affected, although the disease, as a rule, first appears on the leaves as circular, sharply defined, brown spots. The berries are usually attacked when they are about one-third grown. The disease appears as small purplish-brown spots on the fruit and gradually spread over the whole surface of the berry. The affected fruit becomes dark in color in a short time and later shrinks up, but in most cases hangs on the stem for some time after it is attacked. The berries rarely ever shell off.

The general experience of growers with the common varieties of the dark colored grapes would indicate that all of them are susceptible to this disease. Some of the light colored varieties seem to be practically immune. There is, however, a great difference in resistance of the different varieties, which is probably determined by their environmental condition. The Scuppernong variety seems to be the least affected by this disease and is considered practically immune.

Clean culture and thorough spraying will control this disease to a large degree. The 4–4–50 Bordeaux mixture is the most effective, and the first application should be given about the time the young shoots are a foot long. The spraying should be continued throughout the summer at intervals

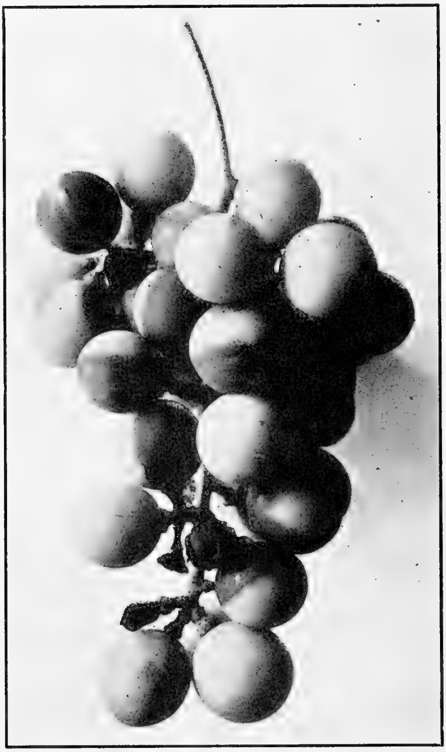


FIG. 100.—Black rot of the Niagara grape. (After Reddick, Cornell Bulletin No. 293.)

of two or three weeks until five or six sprayings have been given. The number of sprayings that will be required will depend largely upon the weather conditions. In regions where the rain fall is abundant more spraying will be necessary.

Powdery Mildew.—The powdery mildew is also a native of the United States. It is widely disseminated and now covers all of Europe. It is also known in every part of the United States. This disease attacks all parts of the plant, first appearing as white circular spots upon both the upper and the lower surfaces of the young leaves. These spots gradually enlarge and may finally cover the entire surface of the leaf. The affected leaves are retarded in growth and the blossoms which are attacked fail to set fruit. The affected fruit ceases to grow and either falls off or fails to ripen.

The powdery mildew is strictly superficial and it is easily rubbed off of the affected parts with the hand. Damp, rainy weather favors its development, while dry windy weather has a tendency to check it. The American varieties of grapes are less susceptible to the powdery mildew than the European sorts.

There are two methods of controlling the mildew, namely, dusting and spraying. In regions where the wind is light, the dusting with flowers of sulphur on every part of the plant is effective. Several applications of sulphur should be given. The first application should be applied at the time the blossoms begin to open. If signs of the mildew are observed later, additional applications should be made at once. Spraying with a 4–4–50 Bordeaux mixture is effective. If the vines have been sprayed for the black rot this spray will be effective in controlling the mildew.

Downy Mildew.—The downy mildew somewhat resembles the powdery mildew. It is widely distributed on both the cultivated and the wild species of grapes. All parts of the plant are affected, namely, the young shoots, the leaves and the fruit. The injury is somewhat similar to that of the powdery mildew. The same methods of control as recommended for the powdery mildew are effective in controlling the downy mildew, but perhaps Bordeaux mixture should be given the preference.

INSECTS OF THE GRAPE.

Grape Phylloxera.—The grape phylloxera is an insect native to the United States, and at times has severely threatened the grape industry in the Pacific coast regions. This insect is a small plant louse, and its life history is very complicated, involving four different forms of aphids. The four forms may be briefly enumerated as (1) the root form, (2) the leaf gall form, (3) the winged form and (4) the sexual form. The root form is the most destructive, and the gall form is also very injurious.

The principal means of control lies in the selection of resistant vines. Since the most destructive form of this insect is found on the roots, which are protected in such a way that no spray can be used, it becomes necessary to employ some other means of control. Carbon bisulphide, which is a volatile gas, heavier than air, has been extensively used. This material is the most effective on light soils but does not lend itself to very successful use on heavy clay soils. It is also relatively expensive. Carbon bisulphide may be applied at any time other than during the blooming and the ripening season. Two applications usually give the best results. To apply the material pour one-half of an ounce into a hole about 1 foot in depth and not closer than 1 foot from the vine.

If water is available for irrigation it offers one of the best means of control for this insect, which is done by flooding the ground to a depth of about 6 inches and allowing the water to remain on the soil for about ten days. The best results are obtained by applying the water so soon as the vines cease active growth in the fall.

Flea Beetle.—The flea beetle is a little insect which often becomes serious on the grape. It is a bluish-green beetle, and the chief damage it does is to eat the buds about the time they begin to swell in the spring. If the beetles are very abundant they often destroy all of the buds, which greatly retard the leafing out and in severe cases of infestation sometimes kill the vine. The larvæ of the insect hatch from the eggs about the time the leaves are expanding and at once attacks them, eating out irregular holes.

Where systematic spraying with arsenate of lead is practised very little damage results from the flea beetle.

Grape Leaf Hopper.—The leaf hopper is often very injurious in many sections where grapes are grown. These insects feed upon the under side of the leaves, and they often become very abundant. Their injury causes small white spots to appear on the leaves. These spots are made by the insect sucking out the chlorophyll from the plant. As the amount of injury increases, the leaves turn yellow and the fruit is reduced in size and in quality. The adult insect is about $\frac{1}{8}$th inch in length. The wings are marked with red and yellow. The nymphes are a light yellowish green in color. They feed in the same way as the adults. The insects come in the early spring and feed on whatever foliage is available until the grape leaves appear.

Various devices and methods of control are in vogue. Owing to the jumping habit of the insect several patent arrangements have been introduced. The use of sticky fly paper is also effective. A device made by stretching cloth on wooden frames against which the hoppers strike is sometimes used. The cloth is painted with a sticky material made by mixing 1 quart of melted resin with 1 pint of castor oil, and as the insects strike the cloth covered with this material they stick fast and are killed. Spraying the vines with 1 pound of whale oil soap to 10 gallons of water is also used. A 10 per cent. kerosene emulsion is effective and often employed. Several applications of an insecticide are usually necessary. If the vineyard is thoroughly cleaned up every year many of the hibernating insects are killed and therefore less damage results.

Grape Berry Moth.—The grape berry moth is a small moth with a wing expanse of about $\frac{1}{2}$ inch. Wormy grapes are largely due to the larvæ of this moth. The injury done by the first and the second brood is somewhat different. The first generation larvæ web the cluster of grapes together either before the blossoms open or soon after the grapes set. The later brood, however, bores into the green fruit, causing purplish spots to mark the entrance of the insect. It is obvious that if the first brood is large greater damage will be done, since each worm practically destroys a bunch of grapes, while the later brood destroys only the berry.

Spraying with arsenate of lead at the rate of 2 pounds to 50 gallons of water is effective in destroying this insect. Where the vines are sprayed with Bordeaux mixture the lead can be added to it and both sprayed on at the same time. A little soap sticker added to the solution will cause it to adhere better to the berries. The first spraying should be given just before the blossoms open, the second just as the grapes finish blooming and the third during the early part of July. Picking and destroying all of the infested berries will aid materially in combating this insect.

Grape Curculio.—The injury of the grape curculio closely resembles that of the grape berry moth. The grape curculio also causes wormy grapes, but the damage is somewhat different from that of grape berry moth. The adults are small weevils which pass the winter in or near the vineyards. They usually hibernate under trash or rubbish, and appear in the spring about the time the grapes bloom. The insects feed on the foliage until the grapes are about one-fourth grown. The adult then cuts a very characteristic crescent-shaped hole in the grape, under the flap of which the egg is laid. The larvæ soon hatch and bore into the pulp, where it feeds until it reaches maturity.

Spraying the vines with arsenate of lead at the rate of 2 pounds to 50 gallons of water while the grapes are small will kill many of the adults. If this procedure is followed out very little damage will result from this insect.

SPRAYING OUTLINE FOR THE GRAPE.

Number of spray.	Time to spray.	Spray materials.
First	When shoots are 8 to 10 inches long	4–4–50 Bordeaux.
Second	Just before blooming	4–4–50 Bordeaux plus 2 pounds arsenate of lead to 50 gallons of the spray.
Third	Just after blossoms fall	Same as second.
Fourth	Two weeks after third	4–4–50 Bordeaux.

If additional sprayings are necessary use Bordeaux mixture.

REVIEW QUESTIONS.

1. Name the two classes of grapes, and give the sections of the country where each is grown.
2. Discuss the propagation of the grape.
3. What determines the length of a grape cutting?
4. In your opinion which is the most important method of propagating the grape? Why?
5. Why is the nature of the subsoil important in grape culture?
6. What kind of a soil does the grape prefer?
7. Is there any relation between the soil and the general location of a vineyard?
8. Discuss the most economical way of planting the grape.
9. What determines the distance apart the grape must be planted?
10. When should the cultivation of the grape begin? Why?
11. What is meant by training of the grape?
12. Differentiate between staking and trellising.
13. Which method is the most economical? Why?
14. What advantage has the stake over the other systems of training?
15. Describe the making of a trellis.
16. Where is the overhead system of value and why is it not commercially profitable?
17. Why is it unprofitable to pick grapes before they are fully ripe?
18. When is the proper time to pick grapes? Why?
19. Why is it unprofitable to store grapes?
20. What determines the proper selection of varieties?
21. Name and describe the black rot of the grape. How is it controlled?
22. What is the difference between powdery mildew and downy mildew?
23. Why is the grape phylloxera so destructive?
24. How does the injury from the grape-berry moth differ from that of the curculio?
25. Give the spray outline for the grape.

CHAPTER XVI.

THE POME FRUITS.

THE apple, pear and quince are classed as pome or pomaceous fruits. The flesh in the pome fruits consists of the thickened calyx tube, which becomes consolidated with the ovary or core and the edible part of the pome is the developed calyx.

APPLE.

The apple is divided into several groups according to the several well-defined characters of the different varieties. Each group is usually named after the most important apple in that group, as, for example, the Ben Davis group includes the Ben Davis, the Gano and the Black Ben Davis as well as several more varieties of that type. Other groups are the Fameuse group, the Duchess of Oldenburg group, etc., and each includes a number of varieties which are similar to each other.

Propagation. — The apple is commonly propagated by budding, by root grafting and by crown grafting. The root grafting and the budding are the most common methods of propagation. The root grafting is performed upon seedling roots during the winter. The grafted roots are then tied in bundles of convenient size and are stored in sand and placed in a cool cellar. When spring arrives and the soil can be plowed the grafts are planted in the nursery row about 1 foot apart in the rows and the rows about 3 feet apart. The tongue and whip graft is the method commonly employed in doing the root grafting.

The budding of the apple is becoming the most popular form of propagation during recent years. This form of propagation is employed upon the one-year-old seedling plants in the nursery row. The budding is performed during the late summer, usually in July, August and September.

The shield bud is commonly used, and it is inserted into the stock from 2 to 4 inches above the ground. After the bud begins to grow the old top of the tree is cut off and the budded variety is allowed to grow and to produce the new tree.

Soil.—The apple does the best on a deep open clay loam. The soil should be well drained, either naturally or artificially. However, the apple is very cosmopolitan and can be grown successfully on almost any soil if it is well provided with available plant food. The soil for the apple should, however, be retentive of moisture and be rich in plant food, because it is impossible to raise good fruit on poor soil. Sufficient moisture can generally be secured by mulching the ground with either manure or straw if water is the limiting factor. Occasionally, the newer soils in some regions are too rich in plant food, and such soils sometimes cause the apple to grow too rank and it does not set fruit.

The subsoil should not be too near the surface, especially if it is very hard and retentive of moisture. A subsoil of this nature prevents good drainage and restricts the growth of the roots. Where such a subsoil exists, and the trees must be planted in such a location, it is well to break up the hard pan by exploding a medium charge of dynamite in each hole. This procedure will loosen up the soil so that the roots can penetrate it to a greater depth. It also provides better drainage.

Planting.—The soil for planting the apple should be well prepared. The preparation should be equal to that which is required for corn. The work of planting the trees will be greatly facilitated if the land is furrowed out both ways with a large plow and the trees set at the intersections. In the setting of a tree the hole should be made large enough to take in all of the roots without the crowding of any of them. The roots should be spread out evenly on the bottom of the hole. The fine top soil should be carefully worked among them so as not to leave any air spaces between or under the roots. The soil should be pressed firmly about the roots, and if it is in the proper condition for planting it cannot be firmed too much.

The time of planting the trees varies with the locality. In the north, spring planting should always be done, because if the trees are set in the fall they are especially liable to winter injury, and in some cases are killed. In the north it usually becomes necessary to dig the trees from the nursery row, and either heel them in by digging a hole in a well-drained place and covering up the trees, both root and branch with soil, or by packing them in a cool, moist cellar. The covering up of the trees with soil is called heeling in. Only specially constructed cellars are adapted to the storing of the trees over winter, and heeling them in out of doors will usually give better results.

In other more favorable localities, as, for example, in the central and the southern sections, where there is very little danger that the trees will be injured in the nursery row, they are taken directly from the nursery and set out in their permanent location in the spring. Where the trees are heeled in for the winter they should be set out just as soon in the spring as the ground can be prepared and the danger of severe freezing is past.

Spring planting seems to be preferable in most of the fruit-growing sections, principally because the tree soon starts into growth after it is planted. This early growth of the tree after it is set in the orchard is a decided advantage to it. The timely establishment of a tree in the soil prevents it from being exposed to the unfavorable elements of the weather and the chances are greater for its success.

The fall planting of trees is practised in some fruit-growing regions. This method can be followed in those sections in which the winters do not get too severe and where there is plenty of moisture in the soil at planting time. In regions where the weather is severe the trees are sometimes laid on the ground and covered with some kind of a mulch. This procedure is expensive, it makes considerable additional labor, and it is not generally recommended. Fall planting has one advantage where it can be practised, in that the work can be done at a time of the year when general farm work is not so pressing. Usually more individual attention is given to the trees if they are planted in the fall.

The depth to which a tree should be planted depends upon the kind of a tree, the nature of the soil and the locality. In the most favorable locations a tree should be set about 4 inches deeper than it grew in the nursery row. In very dry and very light soils a tree can be set perhaps as deep as 10 inches. On slopes of hills a tree must be set at least 5 or 6 inches deeper than it stood in the nursery because of the slope of the land. However, where a good site with fertile rich soil is selected, deep planting is not very desirable, and usually 4 inches deeper than the tree grew in the nursery row is preferable.

Distance Apart to Plant.—The distance the apple should be planted depends upon the variety, the climate and the soil. In localities where the conditions are favorable for growing the apple it should be set farther apart than where the conditions are unfavorable. Likewise the wide spreading varieties should be set farther apart than the compact, upright growing kinds. The short-lived classes can be set closer than the longer-lived varieties. In the favorable apple-growing regions of the east the distance varies from 30 to 40 feet apart, while in some of the Pacific coast regions where the apple does not grow so large the trees are set from 25 to 30 feet apart.

System of Planting.—There are several methods of planting trees, but the three most common systems are the square, the quincunx and the hexagonal. The lay of the land and the size of the orchard determines somewhat the system which is adapted. It is always important to have the rows run straight both ways, since the orchard looks better and it can be cared for more easily. In the laying out of an orchard the first thing is to establish a base line which should be determined by a surveyor when it is possible. All work should proceed from this base line.

The square system is most often used chiefly from lack of knowledge of the others. It consists in planting trees at each corner of a square. This system does not require so many trees to the acre; it has the advantage of being easily laid out, it permits easy cultivation and it allows for systematic thinning should the trees become crowded later in life.

The quincunx system allows the planting of many more trees to the acre than the square system. This system is like the square with the addition of a tree in the center of each square. This plan introduces the use of fillers and provides for a well-laid out orchard when the fillers are removed.

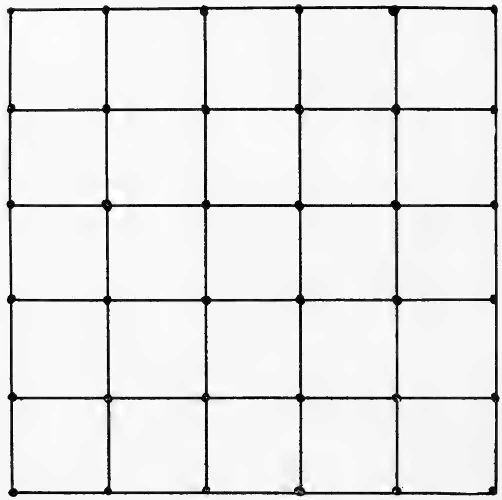


FIG. 101.—Square system of planting an orchard. Placing the trees 30 by 30 feet apart gives 49 trees to the acre.

The hexagonal system uses about 15 per cent. more trees than the square system. In this system each tree stands in the center of a hexagon formed by six trees, all equal distance from each other. It has the advantage of distributing the trees more evenly over the ground than any other system, but the cultivation of the trees is more difficult. This method does not provide any logical way of thinning out of any trees later in the life of the orchard.

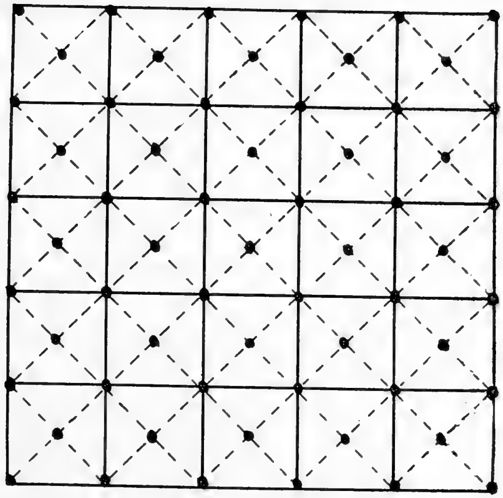


FIG. 102.—Quincunx system of planting an orchard. Placing the trees 30 by 30 feet apart gives 85 trees to the acre.

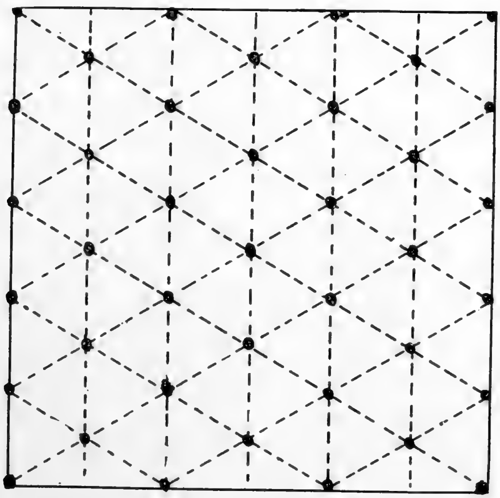


FIG. 103.—Hexagonal system of planting an orchard. Placing the trees 30 by 30 feet apart gives 55 trees to the acre.

Cultivation.—Young trees should be well cultivated during the early part of the growing season, but this operation should be stopped during the late summer or early fall so the trees will ripen up their wood before winter.

Occasionally some crop like the potato, squash, cabbage or tomato can be planted between the trees, which not only produces an income from the land but at the same time necessitates good and thorough cultivation of the ground. The practice of intercropping is not always recommended. Sometimes the orchard is badly neglected, unless intercropping is practised, and it is better for the trees to have a cultivated crop growing between them than to have the soil filled with weeds.

After the trees begin to bear it is sometimes advisable to seed the land down with clover, which should be plowed under every two or three years and the soil cultivated the year the sod is turned under. Occasionally the orchard is seeded down with blue grass. Under some conditions this practice is permissible, as, for example, on steep slopes. In sodded orchards the trees should be heavily mulched by placing straw or manure 1 foot or more deep around them to the limit of the drip of the branches. Occasionally such orchards become sod-bound and must be cultivated.

Mulching.—The advantage of a mulch around a tree is not generally appreciated. A mulch will check evaporation and will prevent the running off of the water. It permits the water to soak into the soil and helps to equalize the soil moisture throughout the growing season. In dry locations it is of the greatest assistance and its use makes success possible with many varieties of apples. A mulch is especially desirable on hilly land where cultivation is impossible. It is likewise valuable to mulch trees on sandy soil and on southern exposures. If the trees are set in sod and cultivation is impossible a mulch is always desirable.

The mulch not only regulates the moisture supply of the soil but it is of great value because it continuously adds plant food to the growing tree. The plant food is supplied by the gradual decay of the mulching material. When the conditions warrant it a tree will do the best if the mulching material is spaded under and incorporated with the soil.

Pruning.—The apple bears its fruit on short branches called spurs. The removal of wood bearing these spurs naturally reduces the yield of fruit. Pruning, therefore, offers a means for thinning the fruit, and a profitable way of securing good quality.

The apple should be headed low and the lower limbs should be started 18 to 24 inches from the ground. This is done by pruning the growing tree heavily and topping it at the point where the head is to be formed. When a number of branches start, remove all of them except three or four of the largest to form the framework of the trees, since this is an ideal number. These should be distributed along the trunk of the tree and not come from one point. Never allow two branches to form a fork in a tree. The branches forming the framework of the tree should be cut back to about 1 foot in length the first year and all other branches entirely removed. Continue to cut back all branches each year until a uniform and symmetrical head is formed.

As the tree grows older and after bearing begins, less pruning is needed and thinning out of the surplus wood is usually sufficient. If systematic pruning has been done during the early stages no severe pruning will be needed after the tree is mature.

Harvesting.—The apple should be harvested carefully. Too early picking sacrifices both color and quality, while too late picking results in loss of keeping qualities and sometimes a loss from wind. The best time, then, for picking the apple is when it is well grown and fully colored, but still hard and firm. This condition is known as the hard ripe stage. The seeds are colored brown and the stem of the fruit separates readily from the spur.

The apple should be picked carefully and the fruit should not be pinched in picking. The fruit should never be removed from the tree by a straight pull as this tends to either pull the stem out or break off the fruit spur. It should be carefully picked and handled and never thrown carelessly into the picking vessel or from one receptacle to another. The bruising of the flesh or injuring of the skin should be avoided.

The fruit should be placed in the shade of a tree as soon as it is picked and sent to the packing house in a short time.

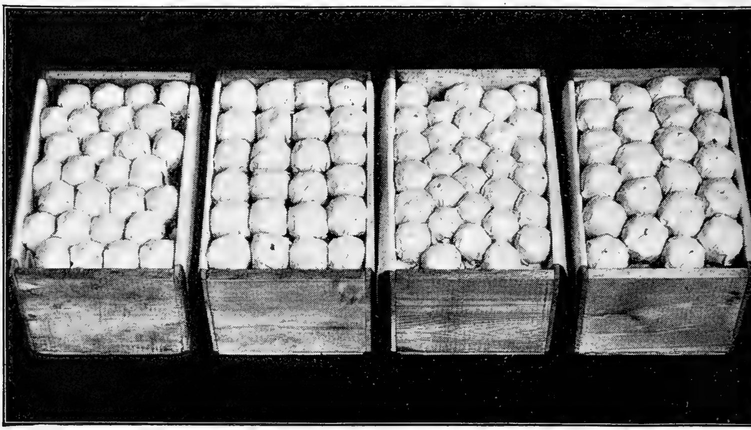


Fig. 104.—A quality pack of applies. (Wilkinson.)

Packing.—The apple is either packed in the bushel box or the barrel. The apple box is used the most extensively in the northwestern fruit-growing districts, although the eastern regions are using the box to a limited extent. The barrel is the most popular vessel in the central west and in the eastern fruit-growing regions. The apple barrel holds about three bushels. The distance to the market regulates to a certain degree the vessel which is used. As a rule the box is used where only very fancy fruit is packed, and higher prices must be obtained for it, because of the extra cost in packing and shipping.

Every package should be clean, uniform in size and color, true to the grade throughout and have sufficient compression to avoid looseness in transit. Each package should be properly labelled, which should contain the varietal name and the name and address of either the individual or the company packing the fruit.

The fruit should be carefully graded, both as to uniformity and color. All poorly colored or off-type apples should be discarded from the good pack. Any bruised fruit or apples which have their stems pulled out should not be included, because they will not keep and only aid in destroying the value of the pack.

As soon as the apple is packed, they should be precooled and stored in a cold-storage plant. For home use a cool cellar is often satisfactory. However, in any event the apples must not be exposed to heat and sun, because this causes them to ripen up quickly and deteriorate in a short time.

Varieties.—There are a great number of varieties of apples. Each region is adapted to the growing of certain well-defined groups of apples. The varieties that are found to be the most profitable by experienced growers are usually the popular sorts in the various districts. There is no way of knowing exactly what variety will do the best in any one locality, and therefore the variety should be selected according to the experience of some progressive grower in each region.

The selection of varieties will depend upon whether they are for home or for commercial use. If they are wanted for the home a larger number of varieties can be selected, covering a longer ripening period. If the varieties are for commercial planting, it is always advisable to select only four or five good standard sorts. The selection of only a few varieties for commercial planting is necessary, because the grower wants to have his crop ripen up at the same time and also to have a sufficient quantity of one kind to be profitable. All buyers of fruit demand a quantity of a few varieties and consequently they will not buy a few bushels of a number of varieties.

Some varieties are very cosmopolitan and can be adjusted to many different regions, while other varieties are adapted only to limited areas and they cannot be grown out of these well-defined places. The Ben Davis, Baldwin, Duchess of Oldenburg and several others can be grown over a great area, while the Yellow Newton and some other varieties can only be grown in certain regions.

Some of the most profitable varieties are the Baldwin, Ben Davis, Gano, Winesap, Greening, Grimes, Jonathan, Missouri Pippin, Spy, Duchess of Oldenburg, Tolman Sweet, Wealthy and a few others.

DISEASES OF THE APPLE.

The apple is subject to attack by several insects as well as several diseases, and these troubles cause great loss yearly. However, most of them can easily be controlled if the proper treatment is given.

The most common disease which is found in almost every apple-growing district is the so-called rot. There are three kinds of rot, namely, the black rot, the brown rot and the bitter rot.

Black Rot.—The black rot not only affects the fruit, but it also produces cankers on the branches and the limbs of the tree. The cankers serve as a continual source of infection to the fruit. They also weaken the tree and finally cause its death. This fungous disease is first detected by a small brownish spot on the fruit, which spreads rapidly when favorable conditions exist until the whole fruit is involved. This rot attacks the fruit on the trees as well as in storage.

Brown Rot.—The brown rot is sometimes known as fruit mould or ripe rot, and it is found not only on the apple, but it is abundant on the peach and the plum. This disease spreads very rapidly in damp, muggy weather and it is very disastrous. The disease first appears as a small, dark brown spot. This spot increases in extent until the whole fruit is affected. This fungus not only causes considerable damage to the fruit on the tree, but it also affects the fruit in shipment and on the market. The spores or fruiting bodies sometimes lodge on the fruit, where they germinate and grow during transit and the crop reaches the market in a poor condition.

Bitter Rot.—The bitter rot is so named because the affected tissue has a bitter taste. The bitterness varies from an exceedingly bitter quality to that which can scarcely be identified. It is also called dry rot. This disease is easily recognized by characteristic black, circular and sharply margined spots, varying in size from $\frac{1}{4}$ inch or more in diameter. The spots become somewhat depressed by the shrinkage of the affected tissue, and finally become leathery or corky in texture.

The rot can all be effectively controlled by the use of 4–4–50 Bordeaux mixture, applied to the plant at intervals varying with the season and the weather. In sections where the fruit is severely attacked by the rots, spraying will have to be done more often, especially in seasons of considerable rainfall. If the first spray has been with Bordeaux mixture, one or two additional sprayings given during the latter part of July and the early part of August will be effective in controlling the rots. The number of sprays must be determined by the individual and the section of the country in which he is located.

Apple Scab.—The scab is one of the worst foes of the apple, and it is quite generally distributed over the country, in the sections where apples and pears are grown. The loss due to this disease is not easily estimated. The fungus is more or less superficial, and unless the fruit is badly infected it sometimes reaches the market, but is sold at greatly reduced prices. This disease is commonly found on the fruit and the leaves, but it also attacks the leaf stalks, the flowers and the smaller twigs. The spots are usually more abundant on the lower surface of the leaves. The disease appears as small, irregular, almost circular spots on the fruit, giving the characteristic familiar scabby appearance. In extreme cases of infestation the fruit becomes puckered up and takes on all kinds of abnormal and irregular shapes. There are probably no varieties of apples or pears which are entirely free from the scab.

Bordeaux mixture or lime sulphur solution are both effective in controlling this disease. The strength of Bordeaux mixture which should be used is determined by the susceptibility of the variety to the spray injury. The strength varies from a 2–4–50 to a 5–5–50 mixture. If a variety is very susceptible to Bordeaux mixture, use lime sulphur, diluted 1 gallon of the concentrated commercial lime sulphur solution to 35 gallons of water.

Fly Speck or Sooty Blotch.—The fly speck or sooty blotch is found on the apple in many sections. At first it was thought the fly speck and sooty blotch were two separate and distinct diseases, but further study has revealed the fact that the fly speck and the sooty blotch are stages of the same fungus. This disease is occasionally found on the pear. Fly speck disease is quite superficial, and it appears as

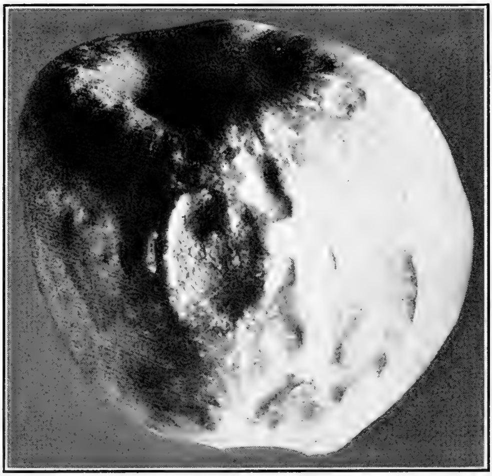


Fig. 105.—The apple blotch.

a number of small black specks, quite regular in outline. Each individual spot is about the size of a small pin head, and in the earlier stage it is still much smaller. A mass of the fungus gives the fruit the appearance of being covered with soot. So far as injuring the fruit is concerned none occurs, but the discolored fruit is hard to sell, and consequently reduces the profits. Spraying for the scab will be effective in controlling the fly speck.

Fire Blight.—The fire blight is one of the most serious diseases of the apple. It also is very injurious to the pear.

It is a contagious disease of bacterial origin. The fire blight is caused by very small organisms called bacteria. They are rod-shaped and motile. They multiply by simply dividing and they increase very rapidly. Immense numbers of bacteria are produced in a remarkably short time and they soon completely fill the infected parts. The bacteria live almost entirely in the sappy portion of the bark.

The blight does not attack the fruit, but confines its ravages to the limbs and the trunk of the tree. The disease is first visible on the tips of the younger twigs, which become dried up and later turn black. It spreads rapidly and often wipes out entire orchards in a short time, when it is not fought vigorously.

The disease is called fire blight because of the characteristic appearance of the foliage. It is also known as twig blight because it is usually first detected on the younger twigs. The disease gains entrance in various ways, as for example, through wounds left from pruning, and through insects visiting blooms during pollination. However, any abrasion or wound on the bark of a tree gives a point of vantage for the entrance of the bacteria. There is only one known method of control for this trouble, and that is to cut out all cankers on the limbs and destroy them by burning. All infested twigs should be cut off and destroyed as soon as they appear. When the infected wood is removed see that the pruning tools are thoroughly sterilized by dipping them in a solution of corrosive sublimate after each cut. Spraying is of no avail in controlling the fire blight.

INSECTS OF THE APPLE.

Codling Moth.—The larvæ of this insect cause wormy apples and it is one of the worst foes of the plant. The adult is a small, pale gray moth with brownish spots near the end of the forewings. Surrounding these spots on the wings is an irregular, golden band. The larva of the moth is the common apple worm, which is found feeding in the core of the apple. It is pinkish in color and lives in the apple about twenty days, eating the fruit and growing to a length of about $\frac{5}{8}$ of an inch. When the larva is full grown it crawls out and seeks a place in which to spin its cocoon.

The moth passes the winter in the larval stage in a small silken cocoon, either under pieces of bark or in some other convenient place which affords protection, in or near apple trees. These larvæ change to pupa and the moths emerge in the spring. Soon after the emergence of the moth, egg laying begins.

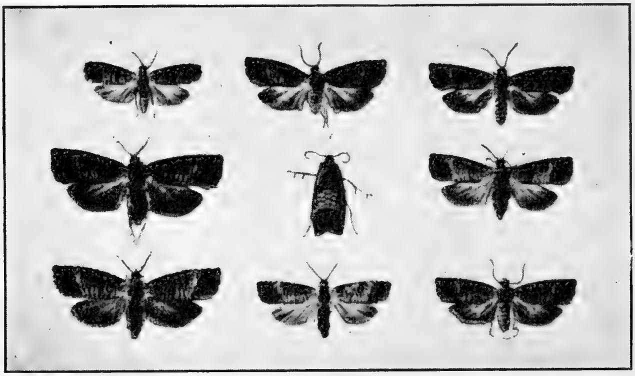


FIG. 106.—Codling moth, natural size. (Slingerland.)

In order to control the codling moth the life history must be known. The growers, in the different sections, must know the time the moths begin to lay their eggs so that adequate and effective control methods can be used. After the worm is once inside of the apple it is proof against any remedy. The poison must necessarily be applied to the fruit before the larva enters it, if it is to be of any value.

There are two and in some sections a partial third brood of the codling moth, and remedial measures must be used against every brood.

Since the larvæ eat the fruit, it is necessary to use some stomach poison. The poison almost universally employed against this insect is the arsenate of lead. Three sprays are usually necessary. The first one should be given just as the petals are falling, the second one about two weeks after the first and the third later in the summer, the time ranging from July 1 to August 10, depending upon the locality. The strength of the poisoned solution is 2 pounds of arsenate of lead to 50 gallons of water.

San José Scale.—The San José scale is a destructive insect in several of the fruit-growing sections. It is found on many of the economic plants as well as on many of the ornamentals. The apple seems to be its preference as a food plant, but it is found on the pear, quince, gooseberry, osage orange

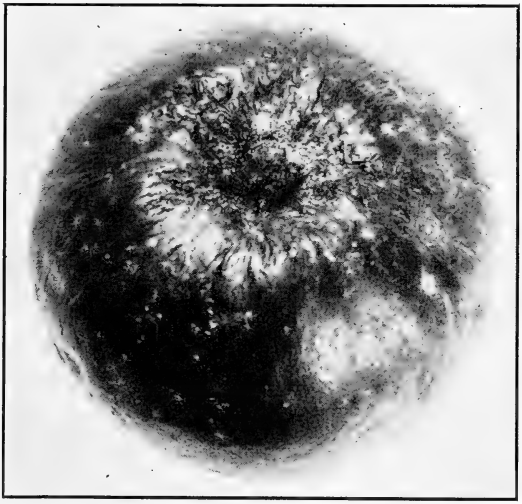


Fig. 107.—San José scale and scab on the fruit of the apple.

as well as on other plants. The ease with which it is distributed on nursery stock and its great power of reproduction make its extermination in any locality practically impossible. Probably no other scale insect has ever been as injurious to plants as the San José. The San José scale attacks all parts of the plant. Its presence can usually be detected by the reddish discolorations on the back of leaves and on the skin of fruits.

The insect is orange yellow in color and is covered with a grayish waxy secretion called the scale. The female lives under this covering and gives birth to living young instead of laying eggs. Owing to the great rapidity with which the scale multiplies very thorough treatment is imperative. At the close of a growing season, all stages of the scale can be found on an infested tree. The mortality of the older and the younger scales is always great and the

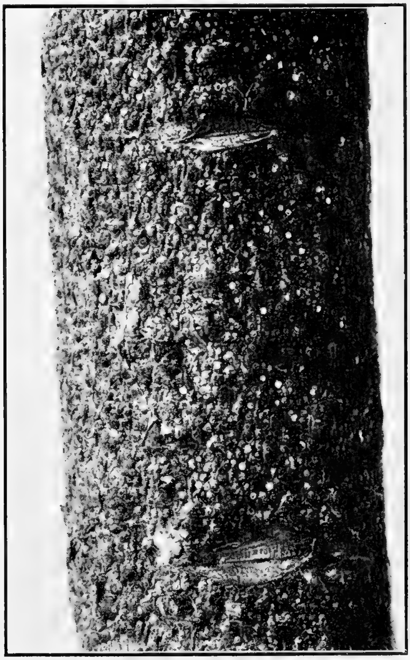


FIG. 108.—San José scale on the apple. (From Illinois Circular, No. 180.)

half-grown insects are the individuals that usually survive the winter in the best shape and carry on the reproduction the following year.

The San José scale has a number of natural enemies, but owing to its great ability to reproduce so rapidly it does great damage in spite of its natural parasites.

Each grower should become familiar with the appearance of the San José scale, and should learn to detect its presence so that remedial measures can be adopted. The lime sulphur wash is the best-known remedy, and perhaps the most effective, although kerosene emulsion as well as several other oil sprays will kill the insect. The best time to spray for the San José is in the spring, just before the buds swell. Commercial lime sulphur diluted 1 gallon to 8 or 10 gallons of water is the proper strength of the spray. Every part of the tree should be thoroughly coated with the spray material. If the infestation is very bad, spraying in the fall will aid materially in reducing the damage done by the insect.

Canker Worm.—The canker worm has for a long time been an enemy of the apple, as well as many of the shade trees. The canker worms are among the most common of the loopers, or measuring worms, and they are the larvæ of two nearly related species of moths, very similar in both habits and appearance. They defoliate the trees early in the spring.

The two canker worms are known as the fall canker worm and the spring canker worm. These insects are so named because of the time at which the eggs are laid. The spring form lays its eggs in the spring, and the fall worm lays its eggs in the fall.

The worms do considerable damage in sections where they occur and they seem to be very widely distributed. In fact, the worms have been reported as being found in all sections of the United States, except along the Atlantic coast, south of New Jersey. These worms are reported to be somewhat injurious in the Mississippi Valley.

The adult of both the spring and the fall canker worm is a moth. The females of both are wingless, while the males of both are winged. The larvæ of both species are quite similar and vary from $\frac{3}{4}$ to 1 inch in length. They are dark, greenish-olive or black in color with white stripes along the sides.

The canker worms can be controlled by spraying with 2 pounds of arsenate of lead to 50 gallons of water, just before the blossoms open and by repeating the same spray just after the petals have fallen. If spraying is not advisable, the females may be prevented from crawling up the trees, by circling the trunks with a band of sticky substance, such as tanglefoot or some other material.

Tent Caterpillar.—The tent caterpillar is common in almost every garden, and it is found in many commercial orchards. It is detected by the webs of the insect adorning the apple as well as the cherry and other fruit trees. This insect takes its name from these webs which are made at the intersection of the limbs. At first the webs are quite small, but they gradually increase in size as the larvæ grow, and in time form a shelter for the insects resembling a tent.

The adult insect is a moth, reddish brown in color and having two parallel white bands extending obliquely across the forewings. Soon after the mating of the sexes, the females lay about two hundred eggs in an egg mass, which is covered with a light brown, frothy glue. The little caterpillars hatch just as the leaf buds are expanding in the spring. The worms from a single egg mass coöperate in spinning the tent, which furnishes them shelter at night and during cold weather. When the caterpillar attains its growth it wanders off, where it spins a cocoon, and about three weeks later the adult moth emerges. This insect would, in all probability, be more injurious than it is, if it were not for the numerous parasites which attack it, thus reducing its numbers.

One of the best means of control is to cut out and destroy the webs or tents as soon as they are detected. If a cold, damp day is selected, practically all of the caterpillars will be in the nest and they can easily be burned or sprayed with pure kerosene. Spraying with arsenate of lead, the same as for the codling moth, is also effective in killing the worms.

In general the above insects include all that are of any consequence, especially the most common forms. There are, however, several other lesser important ones, but in general all of them can be controlled by spraying.

SPRAYING OUTLINE FOR THE APPLE.

Number of spray.	Time to spray.	Spray materials.
First	Just before the buds swell in the spring	Commercial lime sulphur diluted 1 to 8.
Second	Just as buds show pink	Commercial lime sulphur diluted 1 to 35 plus 2 pounds arsenate of lead to 50 gallons of spray.
Third	Just as petals are falling	Same as second spray.
Fourth	Three weeks after third spray	Same as second spray.
Fifth	About July 15 to August 1	4-4-50 Bordeaux mixture plus 2 pounds arsenate of lead to 50 gallons of water, or commercial lime sulphur 1 gallon to 35 gallons of water plus 2 pounds arsenate of lead to 50 gallons of spray.

PEAR.

The pear has been commercially important for many years. It has been grown in this country since the time of the earliest settlers and within recent years large plantings have been made over the Eastern and Central States as well as in the northern regions. The pear has reached great importance in California and a large acreage is planted in that region.

The pear has been developed from the wild pear of Europe and Asia. In its native state the fruit is hard and inferior, but under cultivation it has become edible and delicious.

Propagation.—The pear is propagated in the same way as the apple, that is, root grafted in the winter, budded in the summer or crown grafted in the field. In some regions the pear is dwarfed and this is accomplished by grafting the pear on quince roots. This method of propagating the pear causes the tree to grow smaller and produces the dwarf pear. The dwarf trees have no particular advantage over the standard ones. However, the fruit can usually be harvested with greater ease on the smaller tree and a greater number of trees can be planted to an acre. Dwarf pear trees usually fruit when quite young, sometimes when they are only three years old. The dwarf tree must be pruned systematically every year, in order to keep it in a compact form and to prevent it from becoming too straggly. They usually require more severe pruning than the standard trees.

Soil.—The pear requires a rich, well-drained soil. It, however, thrives on a variety of soils, but it does the best on a rather porous clay subsoil. Usually the pear can be grown with a considerable degree of success in almost any soil in which the apple thrives. The pear is usually short-lived on a loose soil of open texture.

Cultivation.—The cultivation of the soil is sometimes dangerous in the growing of the pear. It has been learned that fire blight is especially troublesome when the tree makes too rapid a growth and it is the practice of many growers to keep the land in sod to prevent too much new wood from being formed. However, the pear orchard must not be allowed to become too firmly sod-bound, so that the trees cannot make a reasonable growth. In case the trees do become sod-bound, it is advisable to plow the orchard and to cultivate it during the early part of the season and again seed it down to grass. Nitrogenous cover crops should usually be avoided and the most attention given to the use of potash and of phosphoric acid fertilizers.

Planting.—The planting of the pear is very similar to that of the apple. The chief point of difference between the two fruits is the distance apart the trees are set. The pear, as a rule, is a more upright growing tree than the apple and the trees can be planted closer together. The standard pears are generally planted 15 by 30 feet, that is the rows are 30 feet apart and the trees 15 feet apart in the rows. The trees when they are planted this distance are allowed to grow until they interfere with each other, and then each alternate tree in the row is cut out. In other sections the trees are planted 20 feet apart each way and this method is satisfactory where the proper varieties are selected. The dwarf trees are planted 10 by 10 feet apart, but usually 15 by 15 feet is a better distance. The greater distance provides more room for driving through the grounds, for spraying and for gathering the fruit. In selecting the trees for planting see that they are young, thrifty and free from disease. A one-year-old tree from the bud or a two-year-old root grafted tree is preferable.

The systems for planting a pear orchard are the same as those for the apple, and the only point of difference is the distance the individual trees are set.

The time of planting the pear varies, but in sections south of the forty-first parallel of latitude fall planting is probably the best, but in the territory north of this line spring planting is recommended.

Pruning.—The pear resembles the apple in many ways in the growth of the tree. What has been said of the apple applies equally well to the pear.

A low-headed pear tree is as desirable as a low-headed apple. The number of branches which make up the framework is usually five or six, because the pear tree rarely ever attains the size of the apple tree. The branches which form the framework should be distributed along the trunk of the tree, and never be allowed to form a fork.

The young pear tree should be pruned back similar to that of the apple. Each main branch should be cut off so that it will be from 10 to 12 inches long. The operation of shortening the branches should continue each year until the tree comes into bearing after which time very little pruning is necessary.

Mature and bearing trees should be thinned out from time to time and all water sprouts removed as soon as they are formed.

Harvesting.—The harvesting of the pear is somewhat similar to that of the apple. The pear is usually picked before it is entirely ripe and allowed to ripen off of the tree. This early picking is made necessary where the pear is shipped away and also because the pear soon deteriorates after it ripens. As a rule, the proper time to pick is when the first pears begin to turn a light yellow, although some varieties are picked when no sign of color is apparent. The fruit should be picked carefully with the stem attached.

Marketing.—The pear is packed and marketed in several styles of vessels. As a rule, the barrel is largely used although frequently the bushel, peck and sometimes the half-peck baskets are used. In some sections the bushel box, similar to that of the apple is used. In certain regions each pear is wrapped separately in soft tissue paper. The pear is generally packed for the market directly from the tree. The market demands a pear of medium size, and one of an attractive appearance.

Varieties.—The selection of varieties varies with the section and the use of the fruit. The pears have a wide range in their season of ripening, so that if the proper attention is given to the selection of varieties the grower may have fruit for his table or for the market from midsummer until early March. Many varieties are tender skinned and unfit for a commercial purpose but are highly prized for the home.

A few varieties recommended for planting may be enumerated as follows: Clapp Favorite, Bartlett, Bosc, Winter Nelis, Sheldon, Anjou, Kieffer and Lawrence for commercial planting, while the Bloodgood, Brandywine, Flemish Beauty, White Doyenne, Seckel and Angouleme should be added to the first list for use in the home orchard.

DISEASES OF THE PEAR.

The pear, like many other fruits, has several diseases and insects which are only found on this plant. In addition to these special forms there are many more which are common to the apple and some of the other fruits.

Pear Blight.—The pear blight has been known in this country for more than a century. The blight is perhaps the most serious disease of the pear. It is also found on the apple, where it becomes very dangerous on certain varieties. The blight is more commonly seen during the early part of the growing season. It usually appears in the form of a twig blight throughout the blooming period. The blight may continue to extend down the twig until the branch is entirely killed by its progress. However, under favorable conditions for the growth of the host plant, the blight may never extend more than a few inches from the tip of the branch.

The pear blight is the result of the work of bacteria. The bacillus multiplies very rapidly under favorable conditions. The nectar in the flowers offers a very good medium on which to develop. From this source it is usually carried

FIG. 109.—Fire blight of the pear on the twig. (After Whetzel and Stewart, Cornell Agricultural Experiment Station.)

from one plant to another by insects visiting the different flowers.

The control of the blight is only accomplished by systematic and careful pruning. It may even be eradicated by diligent work. The essential step consists in cutting out the blight in places where it may winter over. Where the blight is thoroughly pruned out during the fall and winter there would probably be no opportunity for infection the following season if care is exercised in preventing it from being carried in from other regions. When pruning, the knife should be disinfected after every cut by immersing it in a solution of bichloride of mercury. This serves to prevent the spread of the disease. Spraying is of no value.

Pear Scab.—The scab found on the pear is closely related to that of the apple and quite generally referred to as a distinct species. The parts affected are the same as those on the apple. However, the scab on the pear seems to be more destructive and causes the fruit to crack open when it is very abundant.

Some varieties of pears are less susceptible to the attack of this disease, and the Bartlett, Kieffer and Le Conte seem to be the least affected.

The same remedies recommended for the control of the scab on the apple are used for the pear.

In addition to the diseases mentioned there are several more which are common to the pear, and are also found on the apple. These are discussed under the apple and can be controlled by the same methods as recommended for the apple.

INSECTS OF THE PEAR.

Many of the insects found on the pear are also common on the apple. Only those insects which particularly affect the pear are discussed. The most injurious insects to the pear are the codling moth, the San José scale, the pear psylla and the pear thrips. The codling moth and the San José scale are discussed under the apple.

Pear Psylla.—The pear psylla is imported from Europe, and it is generally distributed over the country. It varies in abundance from year to year in different localities. Badly infested trees take on a sickly appearance early in the season, the leaves turn a brownish color, dry up and fall off early in the summer. The fruit falls prematurely.

The adult insect resembles a small cicada, and is about $\frac{1}{10}$th inch in length, dark reddish brown in color with a band of black across the abdomen. The psylla is a sucking insect and takes its food by sucking the juices out of the plant. The insects usually collect around the base of the leaf and the fruit stems until these places become crowded, when they can be found feeding on the under side of the leaves.

The control of this insect is made much easier if the orchard is kept clean and free from trash and rubbish. During the fall the rough bark should be scraped from the trunk and larger branches to render them less attractive places as winter quarters.

Many of these insects crawl out from their hiding places during warm days in the late fall and early spring and are very sluggish in their movement. At such times large numbers of the insects can be killed by spraying them with Black Leaf 40 at the rate of 1 pint to 100 gallons of water to which 3 or 4 pounds of soap is added. The insecticide should be applied on days when there is no danger of the liquid freezing. Kerosene emulsion diluted with 10 parts of water or 1 pound of whale oil soap dissolved in 4 to 6 gallons of water is also used effectively against this insect.

Pear Thrips.—The thrips have become very serious in certain pear-growing regions. They seem to be widely distributed, being found in California, in New York and also in England.

The thrips are very small insects, measuring only about $\frac{1}{20}$th inch in length. The adults are dark brown and emerge from the ground about the time the fruit buds are bursting.

The injury done by these insects is very similar to that done by the psylla. They are found attacking the same parts of the plant and feeding in the same manner. This insect is also found on the peach, apricot and plum, but the pear suffers the greatest injury.

The pear thrips may be satisfactorily controlled by proper methods of cultivation and spraying. The ground should be plowed to a depth of 8 to 10 inches during the fall and in some cases harrowed and again cross-plowed. Two sprayings with Black Leaf 40 should be given in the spring. The first spray should be applied just as the buds begin to open

Fig. 110.—The pear showing injury to the blossom clusters due to the work of the thrips. (After Parrott, New York Agricultural Experiment Station.)

and the second just after the petals fall. Black leaf 40 at the rate of 1 pint to 100 gallons of water to which has been added 5 pounds of soap is the proper spray material.

OUTLINE FOR SPRAYING THE PEAR.

Number of spray.	Time to spray.	Spray materials.
First	Just before the buds swell in spring	Commercial lime sulphur diluted 1 to 8.
Second	Just as the buds show pink	Commercial lime sulphur diluted 1 to 35 plus 2 pounds of arsenate of lead to 50 gallons of the spray.
Third	Just as petals are falling	Same as second spray.
Fourth	Three weeks after the third spray	Same as second spray.
Fifth	About July 15 to August 1	4–4–50 Bordeaux mixture plus 2 pounds arsenate of lead to 50 gallons of spray or commercial lime sulphur 1 gallon to 35 gallons of water, plus 2 pounds arsenate of lead to 50 gallons of spray.

QUINCE.

The quince is the least important of the pome fruits. It is a native of Asia and Southeastern Europe. It is valued chiefly for the making of jellies and preserves. The tree is small and irregular in growth and varies from 10 to 15 feet in height.

Propagation.—The quince is very easily propagated either by layering or by cuttings. Layering is performed by bending the young shoots down in the spring and burying them so that a few of the terminal buds are exposed above the ground. By autumn the branch will be rooted and can be removed from the parent tree and set into a new location. The quince is also extensively propagated by hard-wood cuttings, both for raising stocks as well as producing trees for fruiting.

Soil.—The soil for the quince should be deep and rich. One that will raise good corn and potatoes is well suited for the quince. A clay loam is to be preferred over a sandy loam. Good drainage is essential and a porous subsoil is desirable. An application of manure to the soil in the spring has been found to be beneficial.

Cultivation.—The ground should be well cultivated during the growing season. If the cultivation of the soil is neglected, the trees will sometimes be dwarfed, stunted and entirely unproductive. The cultivation should stop about the middle of the summer so the tree will ripen up its wood. This is very important because the quince is attacked by fire blight, and when the tree is allowed to grow too long in the fall it has the tendency to encourage this disease.

Pruning.—Very little pruning is required. The aim should be to keep off the suckers which start from the roots and trunk of the tree. In the pruning of a young tree it can either be trained to one stem or trimmed so the plant will resemble a bush. In the latter case three or four main branches are allowed to grow. Where the plant is pruned to one stem and forms a little tree instead of a bush usually better and cleaner fruit will be produced.

Varieties.—There are only a very few commercial varieties of quinces, and these are generally known and widely distributed. The Orange, Champion, Rea and Meech seem to be the most popular, and are the varieties that are usually grown.

Insects and Diseases.—The quince is attacked by practically the same insects and diseases that are found on the apple and the pear. There are no troubles which are specifically attached to only the quince as there are in the case of the pear. The quince, however, seems to be particularly susceptible to the attack of the pear blight and leaf rust.

OUTLINE FOR SPRAYING THE QUINCE.

Number of spray.	Time to spray.	Spray materials.
First	Before buds swell in the spring	Commercial lime sulphur 1 to 8.
Second	Just as the buds begin to swell	4–4–50 Bordeaux mixture.
Third	Two weeks after the second spray	4–4–50 Bordeaux mixture plus 2 pounds arsenate of lead to 50 gallons if curculio is present.
Fourth	Just as the blossoms are falling	Commercial lime sulphur diluted 1 to 35, plus 2 pounds arsenate of lead.
Fifth	About three weeks after the fourth.	Same as fourth spray.

REVIEW QUESTIONS.

1. What is meant by pomaceous fruits?
2. Discuss the two principal ways of propagating the apple. Which one is the most important?
3. What is the most congenial soil for the apple? Why?
4. How does the planting of the apple differ from that of the pear?
5. Illustrate by drawing the three systems of planting an orchard.
6. Which system of planting requires the least number of trees? The greatest number?
7. Why is cultivation of the apple orchard important?
8. Discuss the important points to be considered in pruning the apple.
9. How does spring planting compare with fall planting?
10. What determines the distance in planting the apple?
11. How does cultivation compare with mulching?
12. Discuss the rots of the pome fruits and give the methods of treating them.
13. How do the apple scab and the sooty blotch differ from the rots?
14. What kind of a disease is the fire blight and how can it be controlled?
15. Discuss the codling moth and the San José scale and give the methods of control.
16. On what fruits is the San José scale injurious?
17. Discuss the difference between the tent caterpillar and the canker worm.
18. Does the propagation of the pear differ from that of the apple?
19. Discuss the soil and the cultivation of the pear.
20. How does the planting of the pear differ from that of the apple?
21. Discuss the pruning of the pear.
22. Name three varieties of the apple and pear that are good for the home garden, and three for the commercial orchard.
23. Is the pear scab the same as the apple scab? Discuss.
24. Describe the pear psylla and tell how it is controlled.
25. Discuss the pear thrips and tell how they injure the plant.
26. Give the spray outline for the pear.
27. Discuss the cultivation of the quince.
28. Give the spray outline for the quince.

CHAPTER XVII.

THE STONE FRUITS.

The stone fruits include the cherries, peaches and plums. They are called stone fruits because of the hard stony seed found in the flesh. In general, each fruit has similar requirements, although there are specific differences which are characteristic to each one. Practically all of the stone fruits are very perishable and cannot be kept for any length of time. They are affected by the same insects and diseases.

CHERRY.

The cultivated cherry has probably been produced from the two European species, Prunus avium, the ancestor of the sweet cherries, and Prunus cerasus, the ancestor of the sour cherries.

The sweet cherry trees are characterized by a tall erect growth, by reddish-brown glossy bark which has a tendency to peel in rings. The flowers usually appear with the leaves and are generally born in clusters on lateral spurs. The fruit is either red, yellow or black and either spherical, heart-shaped or pointed. The flesh is either soft or firm. The sweet cherries are divided into three groups, namely, the Hearts, the Bigarreaus and the Dukes.

The sour cherry trees are characterized by a low headed and a spreading form of a tree. The flowers are born in clusters from lateral buds, which appear in advance of the leaves. The fruit is round, red, soft and sour. The sour cherries are divided into two groups—the Amarellas and the Morellos.

Propagation.—The cherry is usually propagated by budding. The budding should be done in the nursery row when the trees are yearlings. The stock on which the cherries are budded is very important. The sour cherries are budded mainly upon Mahaleb stock, but sometimes they are worked on the Mazzard stock. The sweet varieties are almost universally budded upon the Mazzard stock.

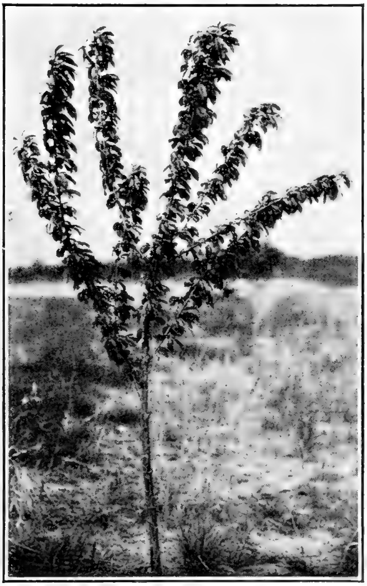


Fig. 111.—Sweet cherry tree, two years old. (Gould, United States Department of Agriculture.)

Where cherries are grown on a large scale it seems to be advisable to select the buds for propagation purposes from bearing trees that have proved their worth. It is a known fact that certain trees bear uniformly every year while others bear sparingly and some scarcely at all. When the buds are taken from non-bearing trees the propagator never knows whether the new tree is going to be of any value, while if the buds are selected from a bearing tree with good fruit the chances seem to be greater for success in producing a good bearing tree.

Soil.—The cherry can be grown on a variety of soils. It probably reaches its highest development on a light, dry, sandy loam or a light clay loam. The sour cherries require plenty of moisture in the soil, but the sweet cherries will grow very successfully on soil too dry for other fruits. The soil should be rich in mineral plant food, but it should not have too much nitrogenous matter in it. A rich, stiff, clay

FIG. 112.—A sour cherry tree, three years old. (Gould, United States Department of Agriculture.)

soil, with plenty of nitrogen in it, produces a tree that is rarely ever productive and is usually short-lived, while a poorly drained soil produces practically a worthless tree. The cherry is a heavy feeder and it should be encouraged in growth while young, but too much wood growth should be discouraged in the old and bearing trees.

The subsoil for the cherry should be porous and well-drained. It should be neither a hard clay nor a dry gravel.

Planting.—Many conditions enter into the planting of the cherry which determines the distance of the trees. The soil, the climate and the rainfall are the most influential factors in deciding this point. The habit of growth of the tree also regulates the distance. The sweet cherry, which is a vigorous grower, should be planted from 30 to 40 feet apart, while the sour cherry, which is not such a vigorous grower, can be set from 20 to 25 feet apart. On a rich soil more room should be provided for each tree than on a poor sandy soil.

The cherry should always be planted alone and never used as a filler in an orchard, and neither should fillers of any other tree be used in a cherry orchard.

The soil should be thoroughly prepared before any planting is started. The surface should be level and all large lumps and stones should be removed from the land. Any system which suits the tastes of the grower can be used in setting the trees.

Either spring or fall planting can be practised. When spring opens early and the winters are mild, with plenty of moisture until late in the season, fall planting may be practised to an advantage. When there is danger of very cold winter weather, early spring planting is the best for the cherry.

The cherry should be set in a hole large enough to receive the roots without crowding them. It should be planted deep enough so the tree will be 2 or 3 inches deeper than it formerly stood in the nursery row. All broken and injured roots should be pruned off, cutting them in such a manner that the cut surface will rest on the bottom of the hole. The hole should be filled about one-half full with top soil and pressed firmly about the roots and the remainder of the soil should be thrown in and all tramped down well. When the planting is finished throw several shovelfulls of loose soil over the top of the ground. The loose soil prevents the loss of water and keeps it from baking and from cracking.

Cultivation.—The cultivation of the soil is essential for the greatest success in cherry culture. The most intensive cultivation should be given to the young trees from the time they are planted until they are four or five years old. Clean culture and good cultivation is probably better for the bearing orchard than is either the grass or the mulch system.

The cultivation of the bearing orchard should start in the spring just as soon as the soil is ready to work. The soil should first be plowed or disked and pulverized by harrowing it until it is firm and smooth. When the soil is prepared in good shape, it should then be harrowed or surface cultivated every two weeks and after every rain until about the middle of July or the first of August. A cover crop should be sown about this time to check the growth of the trees and to ripen up the wood for winter.

The cover crops used for the cherry vary in different sections and for different purposes. If the trees are making a poor and an unsatisfactory growth the cover crops should be a leguminous crop such as Canada peas, crimson clover or hairy vetch. If the growth of the trees is good and plenty of wood is being made then the cover crop should be fall rye or winter wheat. The following spring the cover crop should be plowed under.

Pruning.—The first and the most important pruning of the cherry should be done at the beginning of the second year's growth. The lateral branches should be cut close and the top headed back to about 3 feet from the ground. This procedure will establish a well-balanced, low-headed tree.

Beginning with the third year select from three to five of the best branches for the framework of the tree and remove all of the other branches. The most central branch should be maintained as the leader and should be pruned so that it is 5 or 6 inches longer than the other branches. The remaining branches which make up the framework of the tree should be cut back to 5 or 6 inches in length. The scaffold branches should be selected with relation to each other and should be well distributed.

The fourth and fifth years the pruning should be directed to thinning out of the surplus branches and to establishing a systematical tree. As the tree grows older very little pruning is necessary. Usually after the cherry begins to bear, it requires no pruning.

Harvesting.—The method by which cherries are picked is determined to a limited extent by the way in which they are going to be used. If they are for immediate use in the home they can be picked either with or without the stems. If the fruit is for long distant shipment the stems must be attached to the fruit. If the stems are pulled off the juice will ooze out. In some cherry-growing regions the stems are clipped with small shears.

The time of picking the fruit is determined by the distance of the market and the variety of cherry. For distant shipment the light-colored sorts should be picked as soon as they begin to color, and the dark-colored varieties long before they are dark and juicy. For local consumption the fruit can remain on the tree until it is ripe enough to pick without being too soft. The fruit should be handled carefully so that the skin is not broken or injured, because this gives an entrance to fungi, which will cause the fruit to rot. The cherry should never be poured from one vessel to another, because this bruises and injures the flesh.

Packing.—The fruit should be packed as soon as it is picked. If it is to be shipped any great distance it should be precooled at once and shipped in refrigerator cars.

The cherry is packed in several different styles of packages, which are characteristic of the different sections. The 16-quart crate is perhaps used more than any other style, although in some sections the 24- and the 32-quart crates are used.

A small basket holding from 6 to 8 pounds is used in places, while sweet cherries are often packed in a 10-pound flat box.

Varieties.—There is a comparatively large list of varieties of the cherry, both of the sweet and the sour. Some varieties are valued for home use while others are better suited for commercial planting. The varieties of cherries have not been developed for any definite geographical regions. Many varieties have been described, but only a few of them are profitable.

Among the sweet cherries probably the firm fleshed red and black Bigarreaus are the most profitable. The light-colored Bigarreaus and the Hearts are more susceptible to the fruit rot and the light varieties show bruises and finger marks when placed on the market. Among the sour cherries the Montmorency, the English Morello and the Early Richmond have been the best money makers. The Windsor, Royal Ann, Black Tartarian, Governor Wood and Nepolean are among the best of the sweet cherries.

DISEASES OF THE CHERRY.

The cherry has several diseases and insects that are serious. Most all of the troubles can be controlled by a correct diagnosis of the injury and the proper treatment. Few people realize that all of the so-called rots on the fruits and vegetables are diseases, and in many cases these can be prevented by timely treatment. The rot of the cherry, peach, plum, apple and pear is caused by the presence of a parasitic fungi which destroys the tissue of the fruit.

Brown Rot.—The brown rot is a disease that attacks all of the stone fruits, namely, the cherry, peach, plum and apricot. It is widespread and very destructive to the fruit. The brown rot first appears as a small dark brown spot. This spot increases in size until the whole fruit is infected. While it primarily affects the fruit, it is also known to attack the flowers and the branches, following years of unusual outbreaks of the disease. The decayed fruit either falls to the ground or hangs on the tree, and it is a continual source of infection. This disease not only causes great damage in the orchard, but it also affects the fruit in shipment and on the market.

In order to effectively control the brown rot, preventive measures must begin in the late winter or early spring. All of the mummied fruits on the tree should be destroyed and a general cleaning up given around the tree. The spraying of the trees with a 6–6–50 Bordeaux mixture when they are dormant will aid in killing many spores on the branches. After the trees come out in leaf a weaker solution of Bordeaux mixture sometimes helps to keep the disease in check.

Black Knot.—The black knot is a very striking as well as a most common disease of the cherry and the plum. This disease is very unsightly. It consists of wart-like bodies which cover a considerable area on the twigs and the limbs. It is confined entirely to the woody parts and is usually found on one side of the branch. As the infected part increases in size the bark is broken and the fungus is seen. These knots will have reached full size by early summer. Since the knots are points of infection, and the fungus is local in its habit, it is evident that by the pruning out of the knots the disease can be eradicated. In fact only a few knots are present when the infection begins, and by carefully watching the tree and cutting off and destroying the knots as soon as they appear, little trouble will be experienced with this disease.

Shot-hole Disease.—The name of this disease is significant, referring to the appearance of the leaf, which resembles one that has been shot full of holes with a shotgun. This disease occurs on the cherry and the plum and occasionally on the other stone fruits. Small infected areas appear on the leaves and as the disease advances these diseased spots gradually die, shrink in size and fall out, leaving a small hole in the leaf. A number of these diseased areas occasionally coalesce and make a larger hole. This disease can be held in check by destroying all leaves, which is best done by cultivating the soil and turning the leaves under. If the trees are sprayed with the standard 4–4–50 Bordeaux mixture early in the spring while they are dormant it will aid considerably. Successive sprays should follow, with a dilute alkaline Bordeaux mixture, although on some plants the use of Bordeaux may be accompanied by some injury to the foliage.

INSECTS OF THE CHERRY.

Plant Louse.—The plant louse often becomes troublesome, and especially on the sweet cherries, which are more liable to injury by the louse than the sour varieties. The damage to this plant by the plant lice is similar to that of any other plant. These insects are always more abundant on the under side of the leaves, and this irritation causes them to curl under. Spraying with Black Leaf 40, diluted 1 part to 500 parts of water, or with kerosene emulsion is recommended.

Slug.—The slug is the larvæ of a small black fly. It is about one-fifth of an inch in length. The slug attacks both the cherry and the pear. In reality it is the pear slug which often feeds on the cherry. The adults appear in the spring and lay their eggs in a little slit made for that purpose on the under side of the leaf. The egg hatches into a little worm which soon becomes covered with a brownish, sticky, slimy material. The body of the slug is swollen in front and tapers behind, resembling a tadpole. The larvæ feed upon the upper surface of the leaves, eating only the upper layer and leaving the skeleton of veins and the lower epidermis to turn brown and die. Badly infested trees lose all of their leaves by midsummer. The fruit becomes stunted and fails to mature, and the vitality of the tree is greatly weakened. In severe infestations the trees appear to have been swept by fire.

When only a few trees are attacked by the slugs, the insects may be destroyed by one or two applications of freshly slaked lime dusted on the leaves. On larger tracts arsenate of lead at the rate of 2 pounds to 50 gallons of water should be used.

SPRAYING OUTLINE FOR THE CHERRY.

Number of spray.	Time to spray.	Spray materials.
First	Before buds open in spring	Commercial lime sulphur, 1 part to 8 parts of water.
Second	Just before blossoms open	2–2–50 Bordeaux mixture.
Third	Just after blossoms fall	2–2–50 Bordeaux plus 2 pounds arsenate of lead to 50 gallons of spray.
Fourth	Two weeks after the third	Same as third.

If the black plant lice are present spray with Black Leaf 40, 1 part to 500 parts of water. If slugs appear after the fruit is harvested spray with arsenate of lead at the rate of 2 pounds to 50 gallons of water.

PEACH.

The peach seems to be unknown in the wild state except where circumstances seem to support the opinion that it has escaped from cultivation at an earlier date. In parts of Asia and Persia apparently wild trees have been observed. Persia has for some time been regarded as the source from which this fruit came, but it appeared in Greece soon after the beginning of the Christian era. There is some question of doubt in the minds of many as to whether Persia is the original home of the peach or whether it came first from China. De-Condolle is of the opinion that China is the original home of the peach and not Persia, as is generally thought.

The first records of the peach in this country seem to date back to 1565, when the Spaniards are said to have planted peach pits at St. Augustine, Florida. There is very little doubt but that the earliest settlers in this country brought pits and cuttings of the fruit they were familiar with in their home countries and that the peach was among these plants imported.

Propagation.—The peach is propagated exclusively by budding. The seeds or pits are collected and generally planted in the fall in rows from 3 to 4 feet apart where the seedlings are to be grown. In some sections where the weather is very cold the pits are stratified and the kernels planted in the spring. In dry climates it is important that the pits are not permitted to dry out.

When the seedlings have reached the proper size they are budded. Usually the seedlings are large enough for budding by midsummer and the budding is done largely in July, August and early September. The shield bud is the form most often employed and the bud is inserted 2 or 3 inches above the surface of the ground. As soon as the bud grows fast to the stock it is a common practice to break over the tops of the seedling stocks by cutting them nearly off just above the point where the bud is inserted. The top can either be removed later in the fall or allowed to remain attached until the following spring. In some cases the top is cut off in the spring without being previously broken over.

A limited amount of budding is sometimes done in June. This is known as June budding, and is only possible in the southern sections, where the plant has the advantage of a longer growing season. Trees that are June budded are ready for planting the following fall.

Soil.—The opinion is current that the peach should be planted on a sandy soil or some type of the lighter soils. While excellent peaches are often grown on this type of soil it does not necessarily follow that the peach cannot be successfully grown on heavier types of soil. The peach will do well on a wide range of soils, including even some of the moderately heavy clay loams. To say that any particular type of soil could be most profitable for the peach is impossible. Profitable crops are grown upon the lightest sands and the heaviest clays, and each soil produces a characteristic type and quality of fruit.

The soil which is selected should be well-drained whatever the type is. The peach will not thrive on poorly drained soils. The soils that are hard and impervious to water must be avoided. They should be moderately fertile. A soil rich in nitrogen is not so desirable because it produces too much foliage, but it should not lack plant food in such quantities as to stunt the growth of the tree. The soils in which alkali occurs should be avoided because they never grow good peaches.

Site.—The site of a peach orchard is equally as important as the soil. The peach is very tender and great care must be exercised in order to keep it from being frozen. As a general proposition a site that is elevated considerably above the surrounding country or that is adjacent to a large body of water is preferable for a peach orchard. Cold air always settles to the lower places, and for that reason it is often colder at the lower elevations than it is at the higher points in the same locality. A large body of water also influences the climate to a great extent. It prevents the warming up of the atmosphere in the immediate vicinity of the water and thus holds back the vegetation until the danger of frost is past and also delays the frost in the fall in a similar manner. The influence of the water is probably only felt for several miles, although the elevation has a great deal to do with the extent of the influence of the water.

Planting.—The ideal preparation of the soil for the peach tree consists in deep plowing and the thorough pulverization. Equally as good a preparation should be given to the land as if corn were to be planted.

Preliminary to the digging of the holes for the trees the grower should plow one or two furrows as deep as the plow will run along the line which marks each row. This practice greatly reduces the amount of digging that must be done. The holes should be broad enough to admit the roots without crowding. The trees should be planted 2 or 3 inches deeper than they stood in the nursery row.

In preparing a tree for planting all of the injured and mutilated roots should be cut off. The long, slender and irregular roots should be shortened to the proper length to make the root system uniform.

Unless the tree is exceptionally large all of the branches should be removed, leaving only a single unbranched stem. The stem should be cut back to the desired height to form the head of the tree. The height ranges from 18 to 30 inches, according to the taste of the grower.

As a rule, only thrifty, well-grown, one-year-old trees should be planted. Each tree should be free from injurious insect pests as well as fungous diseases.

A well-grown tree does not always mean the largest tree in the nursery, but, on the other hand, the medium-sized trees are probably fully as desirable as the larger ones. A tree that has a well-developed root system should always be selected.

The exact time for the planting of the peach cannot readily be given. In general, in the northern section, where the winters are severe, spring planting is preferred. The planting should begin as soon as the ground can be worked. In the middle and the southern latitude, where the winters are mild and where the fall season is favorable for the working of the ground, fall planting is generally successful and is preferred by many growers. It is desirable, however, to have fall-planted trees reëstablish some root action in their new location before winter begins.

The distance apart the peach is planted is regulated by the topography of the land, the fertility of the soil and the varietal characteristics of the tree. The most common distances are 18 x 18 feet, 18 x 20 feet and 20 x 20 feet. Occasionally trees are set 25 x 25 feet apart, and this distance probably does not allow any more space than the trees need.

The peach is usually planted by the square system, but other systems are equally as good.

Cultivation.—Clean culture is the common practice in nearly all of the peach-growing sections. In fact, good cultivation is essential to the continued success of the peach.

The peach orchard should be cultivated throughout the entire season, beginning with the first year the trees are planted. The conditions surrounding the trees should determine what the nature of the tillage should be. If the soil is hard and the cover crop heavy it will be necessary to turn the soil with a plow and follow it with a harrow or such other implement as best suits the individual case. If the soil is light, plowing can sometimes be omitted and some other type of cultivation used to thoroughly pulverize the soil to the desired depth. The soil should be worked with some kind of a tillage implement often enough to keep it loose and friable. A dust mulch 3 or 4 inches deep is valuable in holding the moisture. If a crust forms on the surface it should be immediately broken up. The soil should be worked after every rain.

The tillage operations should continue until the last of July or the first of August. By that time the growth will be made and the fruit buds formed for the next year's crop. The seed for cover or green manure crops should be sown at this time, which should be turned under the following spring.

Pruning.—The peach is a stronger and a more rapid grower than almost any of the other fruits. The young trees are reduced to a single stem or whip and the head is formed from the shoots that grow upon this whip the first year. The peach responds readily to good treatment and gives much pleasure to the pruner.

The object of the pruner in pruning the peach should be to cut out enough wood to force a good strong growth each year, to remove surplus fruiting wood and to give the tree the desired shape. The peach bears its fruit buds in the axis of the leaves and the fruit is borne on one-year-old wood. In removing the new growth some branches should be taken out while the remainder should be cut back to remove some of the fruit buds which they carry. It is difficult to say just how

FIG. 113.—Peach tree before pruning. (After Eustace, Michigan Agriculture College.)

FIG. 114.—Peach tree after pruning. (After Eustace, Michigan Agriculture College.)

much wood should be removed or how much of the remainder should be cut back. Some authorities claim about three-fifths of the wood is the proper amount to remove. The heavier pruning should be done earlier in the spring while the light pruning should be done later, probably after danger of frost is past. The fruit should be kept as near the ground as possible, which can be regulated to a great degree by pruning. The fruiting wood can usually be forced to develop closer to the ground if the top is cut back. As the trees grow older the dehorning of the plant is often profitable. In dehorning the tree the entire top is cut off, leaving only stubs remaining. The stubs will throw out many branches which will form a new top. A few of the branches should be pruned out. This practice lengthens the life of the tree.

Harvesting.—The time of harvesting the peach is determined by the distance to the market and the variety. The tender skinned varieties will have to be picked sooner than the tough skinned sorts. In most cases the peach is picked while the one side of the fruit still shows a little green, particularly if it is to be shipped any distance. For home consumption the fruit should remain on the tree until it is ripe but still firm, so that the halves will not mash when they are cooked. Many varieties are very delicate and must be picked at a certain stage or there will be a loss from overripeness. Experience is the best guide for determining the proper picking time.

The careful handling of the fruit is necessary in order to avoid bruising. The fruit should be placed in the shade until it is hauled to the packing shed. A specially constructed wagon should be provided in order not to jar and bruise the fruit.

There are several styles of packages. The different packages are usually characteristic of the peach-growing regions. The bushel basket, the half-bushel basket, the Georgia carrier and the six-basket crate are the most common types. The Georgia carrier and the six-basket crate are extensively used by some growers, but the bushel basket is perhaps the most widely employed. The ease of handling the bushel basket is no doubt the reason for its general use.

The fruit should be graded as to uniformity in color and size for every package. The grower should endeavor to make an honest as well as an attractive pack, and the fruit should be of good quality throughout the package.

Varieties.—There are many varieties of peaches, and these are usually based on regional differences. The adaptability of varieties to different regions calls for some consideration, but it is usually a factor that is less pronounced than it is with many other fruits. The following varieties are among the most important and the most widely planted: Elberta, Carman, Early Crawford, Late Crawford, Salway, Lemon Cling, Champion, Mountain Rose and Old Mixon Free. There are many other varieties listed and suited to various regions of the country, but they are not so widely distributed.

DISEASES OF THE PEACH.

The peach is subject to the attack of several diseases and insects. This plant has more specific diseases and insects which are characteristic only of very closely related plants than most any other fruit. Many of these troubles are confined particularly to the peach.

Peach Yellows.—The peach yellows is perhaps the most serious disease that attacks the peach. It is also found on the almond, the apricot and the nectarine.

There can be no specific cause assigned to the yellows, but the symptoms of the disease are easily recognized by the premature ripening of the fruit, which is highly colored, and the spotted and premature unfolding of the winter buds. The opening of the leaf buds occur as early as July and as late as November. This symptom is very common on diseased trees during August, September and October. The fruit will ripen from one to six weeks in advance of its normal season and will be deficient in quality.

The yellows is a contagious disease and it spreads from one tree to another. The disease is supposed to be of bacterial origin, but this point is still a disputed question.

The peach yellows must be controlled by preventive measures. Spray materials are not effective in holding this disease in check. All trees that show symptoms of the yellows should be cut out and burned. The diseased tree should never be dragged through the orchard, because this practice will infect more trees, but should be cut down and burned where it stood.

Little Peach.—The disease of little peach is also of obscure origin. The direct cause of this trouble is unknown, but it is thought to be similar to that of the peach yellows. The symptoms of little peach are similar to those of the yellows, except the fruit always remains small, drys up finally and becomes worthless. The same methods for the control of the peach yellows must be used for the control of the little peach.

Fig. 115.—Peaches entirely destroyed by brown rot. (After Scott and Quaintance, United States Department of Agriculture.)

Brown Rot.—The brown rot of the peach is a fungous disease that attacks the flowers, the twigs and the fruit. It is the most destructive to the fruit and becomes most abundant as the fruit approaches maturity. If the weather conditions are favorable for the spread of this disease often from one-half to three-fourths of the crop is ruined in a few days.

The disease first appears as small brown spots on the fruit, which rapidly enlarge, involving the entire fruit in a

FIG. 116.—Peach leaf curl. (After Wallace and Whetzel, Cornell University.)

few days. It has been proved that the plum curculio is very instrumental in the spreading of this disease. The brown rot can be controlled by spraying with self-boiled lime sulphur.

Eradicating the curculio by adding arsenate of lead to the spray mixture is also recommended.

Peach Leaf Curl.—The peach leaf curl is a peculiar disease that causes the leaves to curl up in all kind of shapes. It is caused by a fungous growth. This disease appears periodically and perhaps the weather conditions controls its appearance to a certain extent. Damp, cold springs favor its development and the disease is usually worse during such years.

The loss due to the peach leaf curl is hard to estimate, but authorities are agreed that it reaches into the millions of dollars each year.

The peach leaf curl can be largely controlled by the application of some fungicide, preferably Bordeaux mixture, during the late winter or early spring just prior to the opening of the buds. The application of the fungicide must be thorough, so that all spores are killed as they are produced or as growth starts.

In addition to the above-mentioned diseases there are several less important ones which are found on the peach, but which are controlled by carefully following out the spraying program.

INSECTS OF THE PEACH.

The peach is subject to the attack of several insects, some of which require special means of control.

Peach Tree Borer.—The peach tree borer is found in every locality where peaches are grown. It is a native insect. The loss due to this insect is millions of dollars every year.

The adult of the borer is a moth, the male and the female differing widely in color. The male has four transparent wings with a metallic color, while the female has front wings which are opaque while the back wings are opaque only over about one-half of their area, the remaining half being transparent.

The damage to the peach is done by the larva of this insect. The insect passes the winter in the larval state in the trunk of the tree. Some of the smaller worms pass the winter in a small cocoon protected by a mass of gum on the bark.

usually the larvæ confine their work to the trunk or the roots of the tree, a short distance below the surface of the soil, but occasionally they are found 5 or 6 inches under the ground. When the larvæ are full grown they leave their burrows and spin a cocoon, coming out as adult insects in three or four weeks.

FIG. 117.—Canker on the limb of the peach.

The only sure method for the control of this insect is to dig the larvæ out of their burrows with a sharp knife or some similar instrument. A wire can often be used to kill the insects in their burrows. The burrows of the borers are usually indicated by conspicuous masses of gum together with the casting and chewings of the insect. After the borers are dug out, which should be done sometime in June, a small mound of earth should be pulled up around the trunk to a height of 8 to 10 inches.

Many washes and disinfectants have been used from time to time, but all of these have to be handled with some care, and they are not very satisfactory.

Peach Louse.—The peach louse sometimes becomes serious. The usual methods of control for all of the plant lice are effective against this species. The spraying of the trees with nicotine products will give the most satisfactory results.

San José Scale.—The San José scale often becomes troublesome when the peach is grown near the apple or the pear. The same remedies recommended under the apple for the control of the San José scale should be used for the peach.

OUTLINE FOR SPRAYING THE PEACH.

Number of spray.	Time to spray.	Spray materials.
First	Before the buds swell early in the spring	4–4–50 Bordeaux mixture.
Second	Just after blooming when the fruit is bursting the shucks	4–4–50 Bordeaux mixture plus arsenate of lead 2 pounds to 50 gallons.
Third	Two or three weeks after the second spray	Self-boiled lime sulphur; arsenate of lead 2 pounds to 50 gallons of water (important).
Fourth	About one month before the fruit ripens	Self-boiled lime sulphur.

The trees should be examined carefully every spring and fall for the borer, which should be dug out whenever it is found. Where the yellows or the little peach is present destroy the tree as soon as the disease is discovered.

PLUM.

The plum is a very old fruit. The native species have been found growing in this country for many years. As early as 1524 foreign explorers of America tell of plums which were found growing wild in this country in the vicinity of New York. A little later, in 1539, another explorer describes the plum growing abundantly in the region of Florida. From these old accounts, it would seem that the native plum has been known for many years, and some of our best varieties of today are improvements of some of the wild sorts.

Most of our cultivated plums are derived from several species of wild plums. The European plums were developed from Prunus domestica, Prunus insititia and Prunus cerasifera, the Japanese plums from Prunus triflora and the American plums from Prunus americana, Prunus nigra and Prunus hortulana, while the Chinese species Prunus simonii has given us at least one variety.

The European plums have reached a higher state of development than either the American or the Japanese sorts. This is probably due to the fact that the European varieties have been under cultivation longer and have been more systematically improved.

The plums are divided into several groups. The groups are distinct in characteristics while the varieties in each group are similar to each other. The most common varieties are the Damson, the Yellow Egg, the Diamond, the Bradshaw and the Lombard.

Propagation.—The plum is either propagated by budding or by root grafting. Budding is more generally practised and is more successful. The work is done at the close of the active growing season, which is either in August or early in September. The stocks for the propagation of the plum differ in various sections. In the east and the south the Myrobalan and the Marianna plums are usually employed as stocks. The peach is sometimes used also. In other regions the native seedlings are the best stocks because of their hardiness and their adaptibility to the locality.

The seed should be sown in the spring, and if they are given good care and attention the seedlings will usually be large enough for budding by the following August.

There is some discussion as to whether budding or grafting is preferable, although in practice the greatest success has been obtained by budding. The shield bud is the form always employed. Some propagators use the whip graft, and while the plum can be increased by this method there are many failures, and it is thought that budding is far superior to that of root grafting.

Some species of plums, and particularly the Marianna, grow very easily from hard-wood cuttings. Many cuttings from these species are made every year and are used for stocks on which to bud the named varieties.

Soil.—The plum will succeed on any kind of a soil. Next to the apple, perhaps the European plum can be profitably grown on a greater range of soils than almost any other fruit. When we consider the American and the Japanese varieties it becomes an easy matter to select a plum that can be grown practically everywhere.

The domestica plums generally do the best on a rather heavy clay loam. If this class of soil is well drained and comparatively warm it is also an ideal soil for the European varieties.

The Japanese varieties prefer a lighter soil than the European sorts. A light sandy loam that is warm and friable is best suited to the Japanese varieties. In fact, they will do comparatively well on a soil that is largely sand.

The Americana and the Miner groups require about the same kind of soil. A rich heavy loam is preferred. A small amount of sand is not injurious and does not interfere with their growth if the climate is favorable.

The Wild Goose types and their close relatives have a distaste for cold, heavy, clay soils. A rich sandy loam is preferable, although they do well on a great variety of the looser types of soil.

Planting.—The selection of a good tree should receive the first attention in planting. A two-year-old plum tree is planted in most cases, although there are certain southern sections where one-year-old Japanese trees are large enough to plant. All trees should be of good quality and healthy and budded on the stock which best suits your individual requirements.

The distance apart for planting the plum varies according to the variety, the soil and the locality. Where the ground is rich the trees must be set farther apart than where the soil is poor. Some of the smaller upright growing varieties can be set 15 x 18 feet while other more vigorous growing sort should be planted 18 x 20 feet apart, and occasionally 20 x 25 feet is not too much space for the trees.

The time of planting is regulated by the location and in a general way agrees with that of the cherry. There seems to be no advantage in spring planting over fall planting if the climatic conditions are favorable for fall planting. If the soil is well-prepared and the trees are well-ripened they may be set in the fall with good success. If the trees are not in a well-ripened and mature condition, spring planting is preferred. In selecting and planting the different varieties they should be mixed with reference to cross-pollination. Many varieties are sterile or partially sterile, and if they are planted in a solid block with no other fertile varieties they will never set fruit. This is a very important phase of the industry, and it should be thoroughly understood before planting the plum.

Cultivation.—The plums grow and thrive better when the trees are cultivated. The same conditions suggested for the apple apply with equal force to the plum. The orchard should be plowed in the spring. The soil should be cultivated at frequent intervals throughout the spring and the summer until the middle of July or the first of August, when cultivation should stop. The orchard should then be sown with some cover crop. The cover crop will use up the surplus moisture and the plant food which will check the growth of the trees and they will ripen their wood before cold weather arrives and will pass the winter in good shape.

The cover crops which are selected depend upon the soil, the locality and the condition of the trees. If the soil is sandy and the orchard located in the southern part of the country, crimson clover, cow peas or soy beans are perhaps the best. If the soil is of the heavier types and the orchard located in the north, rye, buckwheat, peas or mammoth clover is preferred. On sandy soils in the north hairy vetch is excellent. The seed of all cover crops should be sown thickly so that a good stand will be obtained. A common mistake is to have the cover crop too thin and little good is derived from its use.

Thinning.—Thinning is important with many fruits, but perhaps more so with the plum than with any other. Many of the American and the Japanese plums have a great tendency to overbear. Sometimes varieties of these plums will set three or four times as many fruits as the tree can mature, and they will often do this year after year. This overbearing tends to weaken the trees and many are killed by it.

The fruit should be thinned immediately after the June drop. Thinning is usually done by hand, and although it seems a rather expensive task it will repay the grower. Good judgment must be used in thinning and the number of fruits allowed to remain will usually vary with every grower. The distance between the plums will depend upon several factors, but a conservative distance is from 3 to 5 inches between each fruit on the limb.

Pruning.—The plum trees vary widely in their habit of growth and their fruit bearing. Owing to this great variation no well-defined system of pruning will suit all types. Many plums resemble the apricot in their fruit-bearing habits, but still many more are like the cherry and still others show more of an inclination to bear only branch buds on the new wood.

The plum is subject to sun scald on its trunk and therefore should be headed low. The young trees of all types will need some cutting back and thinning out to develop a good tree.

Some trees will require pruning to spread them. As the trees become older and more mature very little if any pruning will be necessary. Occasionally some thinning out of water sprouts or the removal of a branch which is rubbing will be necessary, but usually no severe pruning will be needed.

Harvesting.—The plums are perhaps less liable to injury from handling than either the peach or the cherry. As a rule the skin of the plum is tough enough to withstand considerable handling without serious injury. The plum, however, should not be bruised or the skin broken, because this will cause the fruit to decay.

Some varieties of plums color up long before they are ripe, and it requires a little experience to determine the exact time for harvesting. The plum, however, should not be picked until it is almost ripe, although it should not remain on the tree so long that it will be injured in handling or shipping.

The fruit is usually picked with the stem attached. The plums are often very uniform in size, although occasionally they require some grading. The grading is more often necessary with the larger sorts than it is with the smaller varieties. The large prune types are sometimes marketed in boxes similar to those of the cherry, while the smaller varieties are usually sold in half bushel baskets, and occasionally in grape baskets. The size of the plum determines to a large extent the type of package in which it is marketed. In some cases the plums are sorted and graded and are then packed in the four-basket crate.

Varieties.—The selection of the proper varieties is primarily a local question. The planter will do well to consult some successful grower in his local community.

Many varieties of native plums have originated mainly in the Mississippi valley and in some of the southern regions. Iowa, Minnesota, South Dakota and Texas have produced far by the greatest number of good varieties, largely from native stock.

To select a list which will fit all sections of the country would be impossible, but the following varieties have a somewhat wider range than many others: Damson, Burbank, De Sota, Hawkeye, Lombard, Diamond, Abundance and Wild Goose. Many local varieties are good, and in regions where these do well they should be selected.

DISEASES OF THE PLUM.

The plum is affected by practically the same diseases as the cherry. The brown rot, sometimes known as the ripe rot of the plum, is perhaps the most destructive (see description under Cherry). The black knot of the plum is the same as found on the cherry. The shot-hole fungus which attacks the cherry is likewise found on the plum. These diseases are controlled in the same manner as on the cherry.

Gummosis.—This trouble seems to be more prevalent on the plum than upon the other stone fruits, although it is found upon the cherry and the peach as well as upon the plum.

The symptoms of gummosis is the accumulation of a gummy exudation on the trunk and the branches of the tree. The gum at first is light colored and soft, but later turns a dark yellowish color and becomes hard. This gummy material accumulates in large quantities at certain points, particularly in crotches and places where a limb has been split. Small patches are usually found scattered over the trees at many points.

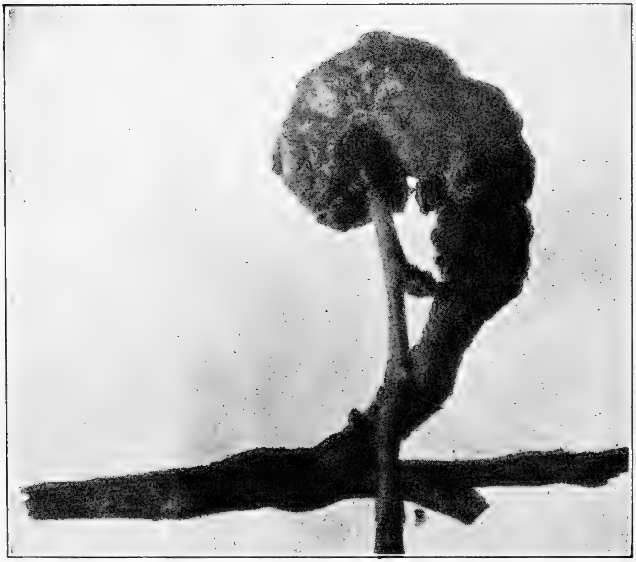


FIG. 118.—Black knot of the plum. (New Jersey Agriculture Experiment Station.)

The cause of this trouble is due to a number of things and in reality is only an attempt by nature to protect a wound on the plant. Borers, insect injuries, splits or any injury to the tree will often cause the plum to exude this gummy material. Usually no great injury results from its presence, and the best way to get rid of it is to remove the primary cause, whatever that may be.

Scab.—The scab on the plum is a disease somewhat similar to that found on the apple. The scab of the plum is also found on the peach and the apricot. The disease is characterized by numerous small, circular, dark-colored spots, usually found on one side of the fruit, but sometimes it covers the entire fruit. The twigs and the leaves are also affected. Bordeaux mixture is usually able to hold this disease in check.

INSECTS OF THE PLUM.

The plum is attacked by several insects, some of which are particularly destructive to it alone like the plum curculio, while others are more or less destructive to all stone fruits. The San José scale and the fruit Lecanium scale are sometimes particularly troublesome.

Curculio.—The plum curculio is the worst insect enemy of the plum. The curculio is primarily an enemy of the stone fruits, but also attacks the apple, the pear and the quince. It is by far the most destructive insect with which the grower of the stone fruits has to contend. In some regions it often destroys the entire crop in an unprotected orchard.

The curculio is a small snout beetle about one-fifth of an inch in length, mottled with black, gray and brown. The beetles attack the fruit as soon as it is set. Two kinds of punctures are made—those for the reception of the egg and those for feeding.

The feeding punctures are only small holes, which are about one-eighth of an inch deep. The egg-laying punctures are much different. A small hole is made in the fruit with the snout and the egg is laid in this hole. After the egg has been deposited the female cuts a crescent-shaped slit under the egg, to protect it from injury while the plum is growing. This way of depositing the egg allows it to develop in a flap of flesh. The egg laying continues over a long period and sometimes it lasts throughout the entire season. However, in most cases the greater number of eggs are laid the first month after the females come out of their winter quarters.

The first step in the control of this insect is to clean up and burn all rubbish. The hibernating quarters should be reduced to a minimum by the removal of everything that will

FIG. 119.—Plum curculio on a young peach. (Quaintance, United States Department of Agriculture.)

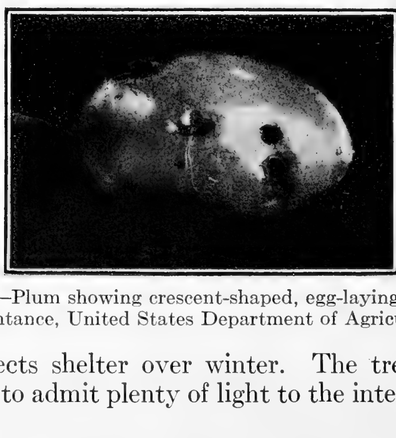


FIG. 120.—Plum showing crescent-shaped, egg-laying punctures. (Quaintance, United States Department of Agriculture.)

give the insects shelter over winter. The trees should be pruned so as to admit plenty of light to the interior branches.

The frequent and thorough cultivation of the ground while the pupa is still in the soil is of great value. The cultivation should begin in the first part of July and continue to the first of August in the north, but it must begin somewhat earlier in the south.

One of the earliest methods of control for the curculio was by jarring. This method was the chief means of control for many years and it is still practised extensively where only a few trees are treated. In order to control the curculio by jarring a sheet is first spread on the ground under the tree. The tree is then suddenly jolted by hitting the trunk with the end of a padded mallet. The beetles when suddenly disturbed curl up and fall on the sheet and can then be collected and destroyed. The jarring, to be the most effective, should be done early in the morning when the beetles are less active.

The jarring has gradually been replaced by spraying in the larger orchard because of the cheaper cost.

The spraying with arsenate of lead either alone or combined with a fungicide has now come to be the most favorite method of controlling the curculio. The spraying of the plum is somewhat more difficult than most of the other fruits, but many growers believe that the result justifies the practice. Two applications are usually made, the first soon after the petals fall and the second from a week to ten days later. Arsenate of lead applied at the rate of about $2\frac{1}{2}$ pounds to 50 gallons is effective. This can be added to either lime sulphur or a 2–2–50 Bordeaux mixture.

OUTLINE FOR SPRAYING THE PLUM.

Number of spray.	Time to spray.	Spray materials.
First	Just before the blossoms open	4–4–50 Bordeaux mixture or lime sulphur 1 to 40.
Second	Just after the blossoms fall	Commercial lime sulphur 1 to 50 or self-boiled lime sulphur, plus 2 pounds arsenate of lead to 50 gallons.
Third	Two weeks after the second	Same as second.
Fourth	About the middle of June	Same as second.
Fifth	Late July or early August	Self-boiled lime sulphur or ammoniacal copper carbonate.

If the plant lice appear spray the trees with Black Leaf 40 at the rate of 1 part to 500 parts of water.

Cut out and burn all knots whenever they are seen.

REVIEW QUESTIONS.

1. Name the stone fruits.
2. Why are these fruits called stone fruits?
3. How does the sweet cherry differ from the sour cherry?
4. Why is the cherry usually propagated by budding?
5. How does the soil for the cherry differ from that of the peach?
6. What conditions influence the distance apart the cherry should be planted?
7. What determines the time for planting young cherry trees?
8. Discuss the cultivation of the cherry.
9. Name three sweet and three sour cherries for home planting.
10. Discuss the brown rot of the cherry and give the best remedy for its control.
11. How is the black knot of the cherry controlled?
12. Give the spray outline for the cherry.
13. What factors prove that the peach is a very old fruit?
14. Discuss the propagation of the peach.
15. Has the soil and the site of a peach orchard any relation to each other?
16. What type of soil is preferable for the peach? Why?
17. Discuss the preparation of the soil before planting the peach.
18. What treatment should be given the young peach tree before planting?
19. What determines the distance in setting out the peach?
20. How do the peach yellows differ from the little peach?
21. What is used for the control of the peach-leaf curl?
22. How can the peach-tree borer be exterminated?
23. Why is it impossible to control the borer with an insecticide?
24. Give the spraying outline for the peach.
25. How does the plum compare in age with the peach?
26. How does the propagation of the plum differ from that of the peach or the cherry?
27. Discuss the methods of planting the plum.
28. What is the value of thinning the fruit of the plum?
29. Name several varieties that are generally grown.
30. Discuss the diseases common to the plum? What remedies are advised?
31. Discuss the plum curculio. How is it controlled?
32. Give the spray outline for the plum.

CHAPTER XVIII.

THE CITRUS FRUITS.

THE citrus fruits include the orange, lemon, grape fruit, tangerine, kumquat and lime. All of these fruits are grown in the citrus belt, and the oranges, lemons and the grape fruit are the most important of the citrus fruits.

The citrus industry is confined to certain definite regions of the United States. The citrus regions are located in California, Florida, Texas, New Mexico and Arizona, but by far the larger commercial plantings are found in California and in Florida. The original home of the citrus fruit was in India and the Malay Archipelago, but today the great bulk of the oranges which supply the markets of the world are produced in California, Florida, Spain, Palestine, Australia, Italy and Japan. Certain parts of Mexico produces citrus fruit to a limited extent, but they seem to lack good shipping qualities.

The citrus fruit was first introduced into this country in southern California. The seed was brought into this State from the lower peninsula of California by the early Spanish settlers. These settlers not only brought the citrus fruits but they introduced many other tropical and semitropical fruits such as figs, grapes, olives and dates.

Orange.—The orange is divided into several species, some of which are edible, as the sweet oranges, and others, the sour oranges, which are used for the manufacture of certain oils and other products.

The sweet orange is the one which is commonly known and which is used extensively for the table. The sweet orange includes many varieties. The Navel and the Valencia are the most important varieties, although there is a long list, and some give excellent promise for the production of superior fruit.

The sour orange is used principally as stock on which to graft the sweet varieties. The fruit of the sour orange is not edible, but it is used to some extent for flavoring. The sour orange is valuable as a stock because of its resistance to the foot rot and the gum diseases.

Grape Fruit.—Technically the term grape fruit is incorrect, but it has gained so much prestige on the market that it will in all probability remain. The correct name of this fruit is pomelo. The grape fruit is usually a prolific bearer. The fruit is gaining rapidly in popularity and more of it is consumed every year.

Kumquat.—The kumquat is a small yellow citrus fruit resembling a small orange. It is sometimes called golden orange. The fruit is often used for decorating and the pulp of the fruit for preserving.

Lime.—The lime is a small yellow citrus fruit resembling a small lemon. It is classed as a shrub, but when it is given room to grow it forms a small tree. The lime is the most tender of the citrus fruits and it is killed back by a slight frost, but usually sprouts up vigorously the next year. The skin of the lime is thin and of a lemon-yellow color. The pulp is a pale green and is filled with a very sharp acid juice. The juice and the pulp of the lime is better for most purposes than that of the lemon, and it is used in preference to the lemon by people in tropical countries. The lime is now found on most of our important northern markets, due to the better transportation facilities.

Lemon.—The lemon is one of the best-known citrus fruits. While the lemon is not as extensively cultivated as the orange it is probably equally as valuable. The lemon is gaining in popularity in the citrus regions and it is now being planted more than formerly. The lemon is supposed to have originated from the citron, and it was first introduced into Palestine and Egypt in the tenth century and into Europe at the time of the crusades. The lemon trees are faster growing than the orange trees, and they are usually more productive and will stand more neglect. The lemon includes both the sweet and the sour types.

Propagation.—The citrus fruits are usually propagated by budding. Although a few varieties can be grown with some success by grafting, cutting and layering these methods are not to be generally recommended. Occasionally the lemon can be grown from cuttings, but the trees are rarely ever successful. The orange cutting can rarely ever be made to take root, and this method of propagation should not be considered.

Fig. 121.—Making a new top on a citrus tree.

The shield or T-bud is universally used in the propagation of the citrus fruits. The success of this method is largely dependent upon the proper selection of the budding wood. Citrus buds should be cut from round plump wood taken from fruiting branches. Suitable wood of this character is difficult to find on the orange but it is more plentiful on the lemon. The orange tree from which the buds are to be selected must be prepared a year in advance. The preparation of the tree consists in systematically pruning the branches to a given length and causing healthy, plump buds to form.

The bud-sticks are usually all cut at one time and stored until they are used. It is thought by some nurserymen that bud-sticks which have been stored produce a larger percentage of buds that will grow. Stored bud-sticks produce a greater percentage of uniform trees because the buds seem to mature in some way during storage. The bud-sticks are tied in bundles and either packed in damp sand, sawdust or damp moss until they are used. The damp moss or sawdust is preferred by most growers, because the sand has a tendency to dull the budding knife. The bud-sticks should have the leaves pruned off, leaving a little of the leaf stem to serve as a handle with which to hold the bud.

FIG. 122.—The method of top working a citrus orchard.

The budding of the citrus fruit is usually performed during November or December in those regions where a more or less definite winter occurs. This is called dormant budding. If any buds fail to grow from dormant budding or are killed back by the winter then spring budding is performed. Spring budding should be done after a vigorous growth has started. However, budding can usually be performed at any time of the year when the bark peels or separates easily from the wood.

Soil.—The citrus fruits are very cosmopolitan with regard to soil. In California as well as in Florida and other citrus regions the citrus fruits are grown on a great variety of soils, ranging from light sandy soil through loams to black, heavy, adobe soils. There are probably no other fruit trees which are so plastic and which will adapt themselves with such ease as to grow on almost any type of soil. The determining factor in the soil seems to be its physical condition and where this is good the citrus fruit is almost sure to grow on any soil. From the stand-point of cultivation and ease of handling the soft sandy loams should be preferred over the sticky, heavier soils.

The subsoil perhaps influences the growth of the citrus fruits to a greater extent than does the top soil. In many cases the layer of soil just below the top soil varies in thickness from a few inches to several feet. Sometimes this subsoil is so hard and so firm as to be impervious to water. Not only does it prevent the water from soaking away or rising from lower levels, but it is so hard that the roots of the plants cannot penetrate it. On such a soil the root development of the tree is greatly restricted.

Sometimes the subsoil is too loose and open and unretentive of moisture. This condition gives a deficiency of plant food and a lack of water.

A good soil then for the citrus tree may be of any type, but preferably a sandy loam which should be at least 4 or 5 feet deep. It must be well trained and the subsoil should neither be hard nor very loose.

Cultivation.—Good preparation of the soil is essential if profitable crops are to be grown. The soil should be thoroughly plowed and worked into a very fine state before any trees are planted. After the trees are set, the soil should be plowed thoroughly once a year and preferably in March or April. At this time the cover crop should be turned under. The plowing should be completed before the tree comes into full bloom, in order to avoid the cutting of the roots at this critical time. The depth of plowing should vary with each year so as to prevent any hard layer from forming by the pressure of the plow.

The proper cultivation determines the success of the orchard. It makes little difference whether the trees are grown on irrigated land or on dry land, frequent cultivations should be given to the soil. The soil should be stirred to a depth of about 4 inches after each irrigation or after each rain. No attempt should be made to cultivate until after the soil has dried out, or until it is in the proper condition for cultivation. If the soil is cultivated when it is too wet it will be hard and lumpy.

Fig. 123.—Protecting a young orange tree from the hot sun.

The tillage implement should be selected with reference to the type of soil. One type of soil will require one kind of a cultivator and another type of soil will need a different tool.

Planting.—The planting of a citrus tree is similar to that of any other fruit tree. The general conditions concerning the preparation of the soil, the digging of the holes, etc., are identical to those of other fruits.

The distance to set the trees is determined by the variety as well as by the fertility and the character of the soil. The smaller growing varieties such as the Mandarin oranges and the limes should not number more than 200 trees to the acre. This will mean that the trees should be set about 12 to 18 feet apart. The larger growing varieties are usually planted farther apart. Usually about 100 trees to the acre is the proper number, which means the trees must stand in the neighborhood of 18 by 24 feet apart.

Harvesting and Curing.—The citrus fruits are harvested throughout the year. There is considerable difference observed in the picking and the packing of the different citrus fruits. Some fruits are picked while they are green and allowed to cure before they are shipped, while others are picked as soon as they are ripe and shipped at once. All citrus fruits must be handled with care, and precaution taken to see that thorns do not fall into the picking vessel. Such thorns or sharp twigs will scratch the skin of the fruit and damage it.

In picking citrus fruit some precaution should be taken to see that no imperfect specimens are included in the package. The fruit must be separated from the tree by means of a clipper which cuts the stem off close to the fruit. The picked fruit should be placed in baskets or crates. The fruit should be taken to the packing house with the greatest care and permitted to cure before it is fit to pack for shipment. After the fruit has been picked for some time the skin will toughen and the fruit will shrink, and then it can be handled with less danger of being injured. The curing time varies with the different citrus fruits and ranges from several days for the orange to several weeks for the lemon. After the fruit has cured properly it is graded and packed.

The oranges are harvested throughout the year. The Valencia are the summer oranges and they are harvested from June to November, while the Navel or winter oranges are picked from November to May. The season for both oranges somewhat overlap.

The oranges should be picked with a great deal of care so that all bruises or cuts will be avoided on the skin. Any abrasion of the skin admits the germs of decay and the fruit is ruined.

The oranges in some cases must be colored or cured by sweating. The sweat-room is an air-tight, fire-proof room built separately from the main packing-house. The heat is provided by kerosene stoves which do not give complete combustion. The hot gases and water vapor fill the sweating-room and envelop the fruit. The temperature is controlled by ventilators. In the sweating process the fruit is kept at a temperature of 100° F. The time of curing varies from three to five days or until the oranges are properly colored.

The harvesting and the curing of the lemon differs greatly from that of the orange. The lemons are usually picked from ten to twelve times a year. The heaviest pickings of the lemon come in March and April, while the lightest pickings come in August and in September. This roughly divides the lemons into a fall and a spring crop. The summer crop is usually rushed to the market while the winter crop is held until later in the season.

The method of picking the lemons from the tree is similar to that of the oranges. The chief difference between the two fruits is that the lemons are always picked by the use of a ring. The lemons are harvested while green and therefore a ring is used to determine the size and maturity of the fruit. The picking rings are made of iron wire. The rings vary slightly in size and during the summer a ring $2\frac{1}{4}$ inches in diameter is used while during the winter a larger size, namely, $2\frac{5}{6}$ inches, in diameter, is used. The larger ring is used in the winter because the fruit will be kept longer and a greater amount of shrinkage will take place.

After the lemons reach the packing-house they must go through a curing process. The curing is done by subjecting the fruit to a sweating. The sweating of the lemons is for the purpose of quickly changing the green color to a light yellow color.

The lemons should be sweated alternately for the best results. The air of the sweating-room should be kept saturated with moisture all the time. If the air is allowed to become dry the lemons shrivel quickly. The temperature of the sweating chamber should be held around 90° F.

The winter lemons are usually stored and held for spring trade. Therefore the winter lemons are not treated in the same manner as the summer lemons. Instead of sweating the fruit and hastening the curing the lemons are prevented from sweating. As soon as the fruit is brought to the packing-house it is washed in a very weak solution of copper sulphate. This solution is made by adding 1 pound of copper sulphate to 1000 gallons of water in the morning and $\frac{1}{2}$

FIG. 124.—Showing the method of washing oranges to remove the sooty mould fungus. (Bulletin No. 123, United States Department of Agriculture, Bureau of Plant Industry.)

pound at noon to keep the strength constant. The fruit is washed in this manner for disinfection against the brown rot. The lemons after being properly graded are placed loosely in packing boxes and stacked up on the storage floor. Lemons are often stored in this manner for six or seven months.

Washing.—In most of the citrus-growing regions the fruit must be washed before it is shipped. If the fruit is grown on a healthy tree, free from diseases or scale insects, washing is not always necessary. The appearance of the fruit cannot be improved by washing unless it is grown where it is dry and windy and the fruit is covered with dust. If the fruit is affected with sooty mould which causes black spots it must be washed.

The fruit is either washed by hand or by machine. Various machines have been invented for this work. A machine which gives good satisfaction is made with a series of brushes. The brushes are slightly larger than scrubbing brushes and are arranged on a chain belt. The fruit is placed on a chute and rolls into a vessel containing water. It is then made to circulate in this vessel between the brushes, and in this way is cleaned. There are several more washing machines, but all are constructed on the same general principles.

Grading.—The citrus fruit cannot be packed as it comes from the orchard. It must first be graded. All fruits of one size should be sorted out and placed in a given bin. Most of the grading is done by machinery. Scattered along the belt which carries the fruit when it is graded are several men whose duty it is to take out all of the imperfect or defective fruits. The remainder are carried along the belt until they reach the opening of the proper size, where they fall through and are caught in a bin. This method of grading saves time and labor. The fruit of different sizes is collected in a separate bin and can then be packed in a uniform manner.

The lemons are usually picked with a ring, which makes them approximately one size, and very little if any grading is necessary. The orange requires more grading perhaps than any other citrus fruit.

Packing.—The citrus fruits are packed either by hand or by machinery. By far the greater percentage is packed by hand. Each fruit is placed in a given position in the box, and uniform packing has been developed to a high degree.

The fruit is wrapped in paper. Sometimes a monogram or some other pleasing design is printed on the wrapping paper.

The fruit is then packed in boxes and the number of fruit in each box is determined by the size of each specimen. The number is always the same for a given size.

The oranges which are suitable for packing vary in size from $2\frac{1}{8}$ to $3\frac{1}{2}$ inches. The orange crate measures approximately 12 x 12 x 28 inches. This crate holds 360 specimens of the smallest size and only 80 of the largest size.

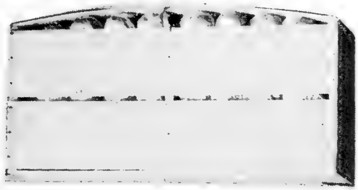


FIG. 125.—The usual package for citrus fruit.

The grape fruit is packed similar to that of the orange. The picking season for this fruit ranges from December until the following August. The fruit is ordinarily stored in boxes for several days, until the skin becomes soft. After the skin has reached the proper stage the fruit is wrapped in paper and packed in boxes the same as oranges.

DISEASES OF THE CITRUS FRUITS.

The citrus trees are susceptible to the attack of a number of diseases. The fungus diseases as well as the physiological troubles cause great loss to the citrus grower. In regions where the climate is moist the damage from fungous diseases is greater than in regions where the climate is dry. The reverse is true with regard to the physiological troubles.

The disease injury to the citrus tree is found on the root, the stem and the fruit, and in this respect resembles the injuries found on many of our temperate fruits.

Gum Diseases.—The citrus fruits often secrete gum from many parts of the tree, due to a number of causes. It seems to be the direct result of certain forms of diseases, and generally such troubles are classed as gum diseases.

The leaf gumming is very common, especially on the orange. It is more prevalent when the weather is very warm. The gum appears as little drops, usually on the undersides of the leaves. It is reddish brown in color. This trouble is not very serious and should cause no uneasiness.

The brown rot gumming is caused by the brown-rot fungus. It is most common on lemon trees. The greatest exudation of the gum usually occurs on the trunk of the tree close to the bud union. This disease can be largely prevented by avoiding soil conditions which are the most favorable for the growth of the fungus. Do not allow water to stand around the tree or to come in contact with the trunk.

Twig gumming is sometimes found on nursery stock. It is thought to be caused when the trees are copiously watered after they have dried out considerably. The gum is found on the twigs and causes the bark to split. The leaves usually drop and the twigs die.

Rots.—Besides the gum diseases there are several rots which are injurious. The foot rot and the toadstool rot are the most important. In Florida the foot rot is well distributed, but it is comparatively rare in the citrus belt of California. The root rot is the result of a fungus which causes the roots to rot. The affected roots soon become soft and slimy and the disease gradually spreads downward. The sour orange is the least susceptible to the attack of the fungus, and the disease is largely controlled by grafting on the sour orange stock.

Toadstool Rot.—The toadstool rot is the result of a fungus growth. This fungus is native to the root of the oaks, but it has been able to flourish on the citrus trees, and it is causing much damage. The disease usually kills the tree in three or four years and the affected tree dies gradually. During a long, rainy season this fungus produces several clusters of brownish colored toadstools from the roots. It is from these toadstools produced as the fruiting bodies that the fungus takes the name. At present there is no satisfactory remedy for this disease.

Brown Rot.—The *brown rot* of the fruit causes great losses annually. The spores of this disease enter the fruit through the breathing pores, where they germinate and grow in the fruit. In a short time the fruit begins to decay and it soon develops the characteristic brown color. All of the citrus fruits are affected with this rot, but the lemons suffer the least from its attacks. The loss from this disease is the greatest during wet weather. This disease continues to spread rapidly in the packing house and often destroys whole boxes of fruit before it is detected.

The brown rot can easily be controlled if the fruit is washed in water which contains copper sulphate at the rate of 1½ pounds to 1000 gallons of water.

Stem-end Rot.—The *stem-end rot* affects the stem of the fruit and causes it to drop. The dropping begins with the green fruits and continues through the entire season. The stem-end rot often causes the fruit to decay after it has reached the market. This disease is difficult to control, but the most successful method of control is to keep the tree carefully pruned and to remove and destroy all mummied fruit and dead twigs.

Mould.—The *blue* and the *green mould* of the fruit causes great losses in the citrus industry. These moulds are only slightly parasitic on perfect fruits, and the decay is confined principally to those fruits which have been injured in handling. The moulds produce a soft rot and the spores appear as blue or green powder on the surface of the affected fruit. The loss from this disease can be largely prevented by the careful handling of the fruit.

Several other less important diseases are found on the citrus fruit, and the reader is referred to some more extensive treatise of that subject should he desire more information concerning citrus diseases.

INSECTS OF THE CITRUS FRUITS.

The insects which attack the citrus fruits are small in number, but they are very resistant to any control measures. They cause great financial lost annually. The scale insects are the most widely distributed and probably cause the greatest damage.

The amount of the insect damage is largely controlled by the climate. In one region a certain insect pest will predominate and do great damage while in another region a different insect will do the greatest damage. Each citrus region usually has some well-defined insect which may not be serious in any other region.

FIG. 126.—An orange tree partly killed by the red scale. (After Quayle, California Agriculture Experiment Station.)

The control and eradication of all citrus insects is based principally upon sanitation. All weeds should be destroyed. The fence rows should be clean and rubbish which harbors insects should be removed. Where perfect sanitation exists and a systematic and a logical program of fumigation is practised no great amount of damage is caused by the insect pests.

Scale Insects.—The scale insects which are troublesome in most every case are foreign insects which have been introduced into this country through shipments of nursery stock and by other ways. Some of the scale insects not only damage the plants by sucking out the juices but they secrete a sweet substance, which gives a good medium for the growth of certain moulds.

Fig. 127.—Citrus trees covered with tents preparatory to fumigating them, taken at night when the operation is carried on. (After Quayle, California Agriculture Experiment Station.)

The most practical means of control of the scale insects is by fumigating with hydrocyanic acid gas. Each insect varies in its power to withstand the gas and separate dosage tables have been worked out for each important scale insect. The success of this gas in controlling the scale insect is in its ease of generation and its exceedingly poisonous nature.

The fumigation is done by the use of a tent placed over the tree. The tents are made of the best duck and vary in size from 20 to 36 feet for different sized trees.

The cost of fumigating is about thirty cents for the average sized tree.

Thrip.—Besides the scale insects several others are injurious. The orange thrip is often troublesome and is found principally in the flowers of the citrus fruit. The presence of the thrip is usually first detected by the distorted and irregular growth of young leaves.

The thrip injures the fruit by producing irregular scars around the stem and at other places over the surface. The damage done to the fruit does not injure the edible qualities, but it reduces the sale and places it in an inferior grade.

The most effective remedy for the thrip recommended by the United States Department of Agriculture is $2\frac{1}{4}$ quarts of commercial lime sulphur at 22° B. plus $3\frac{1}{2}$ fluidounces of a 40 per cent. Black Leaf extract to 30 gallons of water. This material should be sprayed on the trees with a force of 175 or 200 pounds, pressure.

Red Spider.—There are two species of red spider injurious to the citrus fruit. They are found throughout the citrus regions both in Florida and in California.

The red spider is a small red insect which often becomes so abundant on a leaf as to give a reddish color to it. The best remedy for the red spider is sulphur. It is used in either the dry form or in the form of lime sulphur solution. When it is used dry the sulphur is dusted on the plant, usually when the foliage is a little damp. When lime sulphur is used the commercial product is diluted 1 gallon to 35 gallons of water. The lime sulphur is becoming more popular and its cost is much less than fumigation.

Control of Insects.—The control measures for the citrus insects are different than the control measures for most other insects. This is made necessary because the trees have their leaves the entire season, and since most of the serious insects are scale insects it is impossible to spray the trees with a solution strong enough to kill the insects and not kill all of the foliage. Because of this combination some other way for the control of insects is necessary.

About 1886 California first seriously considered fumigation as a means of destroying injurious insects. As time passed the methods of fumigation were greatly improved but the fundamental principles remain the same.

Fumigation is practised by covering the tree with a tent made of heavy duck. Under the tent the fumigating material is placed. Hydrocyanic acid gas is the material commonly used, and is made by depositing sodium or potassium cyanide in an earthen jar and covering it with sulphuric acid. The jars should be at least 2 gallons in capacity, to prevent the acid from foaming up and spilling out. The amount of material which is used depends upon the size of the tree and the insect which is doing the damage. There are dosage tables worked out by the United States Department of Agriculture and the various State experiment stations, and these should be consulted for a more detailed study of fumigation.

The fumigation gives better results and produces less injury to the foliage if it is done at night instead of in the daytime.

The season of the year at which fumigating is done depends upon the life history of the insects and the condition of the tree. The fumigation should be carried on when the insects are in the most tender stage and can be easily killed, and the time will vary slightly for each insect. However, from August to January seems to be the time which gives the most satisfactory results.

The dosages as well as the length of time vary with the different scale insects. This phase can be learned in some more complete treatise on the subject.

REVIEW QUESTIONS.

1. Name the fruits included in the citrus class.
2. Why is the citrus industry confined to certain special districts?
3. How does the grape fruit differ from the orange?
4. Discuss the propagation of the citrus fruit. What form of budding is used?
5. What is the best type of soil for the citrus fruit? How does the subsoil regulate the value of the top soil?
6. Why is good cultivation essential?
7. How should a citrus orchard be planted?
8. Discuss the curing of citrus fruits. How does the curing of the orange differ from that of the lemon?
9. What method of picking is used for the lemon? Why?
10. How does the picking of the orange differ from that of the lemon?

11. What is the value of washing citrus fruits? In what solution is the washing done?
12. Discuss the grading of citrus fruits.
13. Discuss the packing of the lemon, grape fruit and orange.
14. Discuss the principal diseases and give the methods of control.
15. What class of insects is the most injurious to the citrus fruit? Why?
16. Discuss the fumigation of a citrus orchard.
17. Why is fumigation used instead of spraying?
18. When is the best time to fumigate? Why?
19. Discuss the various ways of controlling the different diseases on the citrus fruit.

CHAPTER XIX.

BEAUTIFYING THE HOME GROUNDS.

The beautifying of the home grounds is not appreciated as much in America as it rightfully deserves. For that reason it is hoped that a few pages relative to the improvement of the home surroundings will stimulate sufficient interest in this subject so the average individual will attempt the improvement of his property by the judicious planning, and the planting of the home grounds. Why is it that so many beautiful residences are built and so little thought given to the grounds encircling them? Is it not true that the value of a property is largely determined by its location and its environment? Did you ever stop to think that by the expenditure of a few dollars for the purchase of shrubs and ornamental plants that you will materially increase the value of your property? It is important, however, that the shrubs are placed in an artistic way, and it is hoped that Figs. 132 to 142 will aid in suggesting the correct locations and the proper massing of the ornamentals in order to produce the best effects. The list of shrubs suggested include only a few of the better and most important ornamentals. These are adapted for planting about the home, and it is hoped that this list will be used only as a guide. A reliable local nurseryman should also be consulted, because oftentimes different strains or varieties are much better adapted to certain local regions, and in such cases these varieties should be chosen. The list given is far from being complete, and other shrubs which are known to be valuable can be added.

Locating the House.—In locating a residence, whether it is on a small city lot or on a ten-acre tract, aim to set the house comparatively close to one side of the boundary and at the proper distance from the street or road. The distance the house can be located from the street is determined by the size of the lot, the city regulations and the local environment, all of which need consideration. Where the conditions make it possible never place the house closer than 30 feet from the front boundary. The location of the residence on the lot is not so rigidly assigned to a given place by city ordinances, and the individual can usually place it in the center or to one side without any restriction. To produce the most pleasing effects the owner should set the house close to one boundary line and a proportional distance back from the street.

If the grounds are large the location of the buildings usually becomes more complicated because outbuildings are necessary. The buildings must be arranged so that the grouping will form a unit and placed so they will not cut up the grounds into separate pieces. If the house and other buildings are located near one side of the property a large open lawn will result on the opposite side and in the rear. This arrangement of the building will give open vistas and pleasing views from the main rooms. It will also give the impression of increasing the extent of the lawn. On city or suburban lots the house should also be located nearer to one side of the lot and not set directly in the center. Such an arrangement does not permit the ground to be cut in half. It also gives a larger lawn, and the planting of the shrubs is much more effective if they are massed along the border, which leaves an open lawn between the house and one boundary. The house should be located so the larger portion of the grounds can be enjoyed from the principal rooms.

Drainage.—The drainage of the soil is very important in the consideration of any property, and it either increases or decreases its value. The injurious effects of drainage are not only seen on the growing of plants, but poor drainage is unhealthy and is entirely unsuited to the development of both the lawn and the trees. It is therefore necessary to drain the land, whenever the location demands it, not only from the esthetic point of view but from the health considerations. There are many ways in which a piece of land can be drained, but space will not permit of a discussion of the various methods. In case any complicated conditions arise that cannot judiciously be handled by the owner an engineer or a drainage expert should be consulted. The best plan, however, is not to select a poorly drained piece of land on which to build a residence. The drainage will be largely determined by the nature of the subsoil, and when you are selecting the building site due consideration should be given to the type of subsoil which underlies the top soil. If the subsoil is comparatively close to the surface and composed of heavy impervious material in the nature of a hard pan the drainage will be poor and in all probability the only relief will be to tile drain. If, on the other hand, the subsoil is comparatively deep or is composed of loose material the drainage will be more perfect and will usually form an ideal site, so far as this phase is concerned.

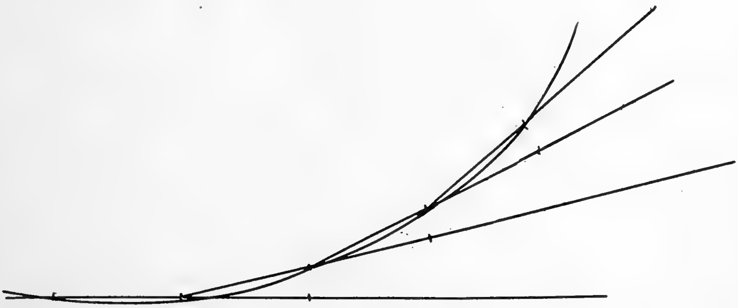


Fig. 128.—One method of laying out a curve.

Arrangement of Walks and Drives.—On small city lots the walks and drives should be the shortest distance between the two points, namely, the outside walk and the door-step. Likewise it would be pure folly to construct an automobile drive in any other manner than to have it go directly from the street to the garage in a straight line. However, the method of constructing walks and drives differs when we consider the suburban home or the country place, and in these cases the walks and the roads must be viewed from a different aspect.

In a suburban home or a country estate it is always desirable to locate the outbuildings at a place where they are not prominent and to connect them to the main highway with a road in which a graceful curve has been introduced. Easy flowing curves for the roads are not only permissible in such cases but are only recommended on such grounds that are amply large enough to accommodate this treatment. Curved

Fig. 129.—A good method for measuring the opposite side of a curved road.

walks and drives should be avoided on small city lots. Curves, no matter where they are introduced, should be easy and flowing wherever they are used. Abrupt angles and corners should be avoided. Whenever a road or a walk is made to curve some excuse must be apparent for the curve. The excuse for a curve usually takes the form of a tree or a group of shrubs massed in the proper places.

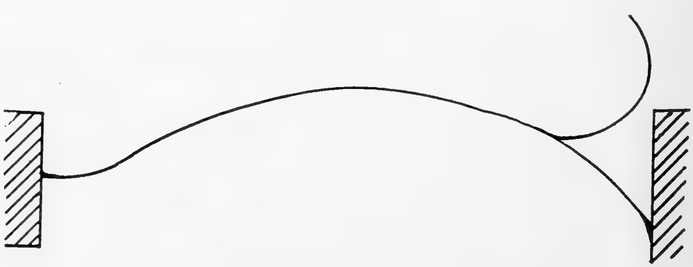


Fig. 130.—The correct curve for a road or a walk.

Treatment of Curved Walks or Drives.—As previously stated, when a walk or a drive is made to curve some excuse must be given for the existence of the curve, which is best done by the judicious grouping of shrubs or low evergreen trees.

When it is desired to prevent one curve from being visible from another, groups composed largely of evergreens should be selected and planted near the hollows of the curves. Massed plantings should never be placed at the extreme center of the curve but located on either side of it. To secure the best effects from this treatment the character and the outline of the grouping should be extremely different.

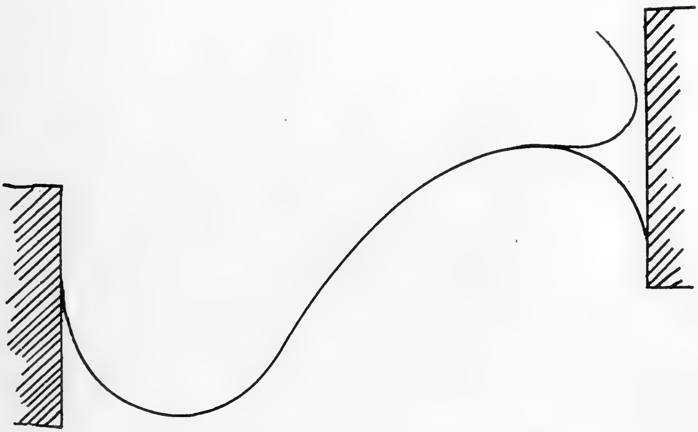


FIG. 131.—Incorrect curve for a road or a walk.

Grouping and Massing of Shrubs.—Rarely ever should a shrub be planted singly. Single planting in some instances is used, but the grouping of shrubs should be the common practice. Some skill and art is necessary in the judicious massing of shrubs, and some facts relative to the growth of the plants are necessary. The principal practice of the older landscape gardeners was to group the shrubs in such a way that the taller growing plants always formed the extreme border and the smaller growing shrubs were placed in the front, so that a more or less uniform growth of foliage was the result. Rarely ever is this procedure excusable. Do we ever find such an arrangement of shrubs in nature? Consequently, when it is desirable to have our places look natural, natural ways of planting should be used. Strive to group the planting so that irregular lines are produced. Interplant shrubs of varying heights and do not place all tall-growing or all

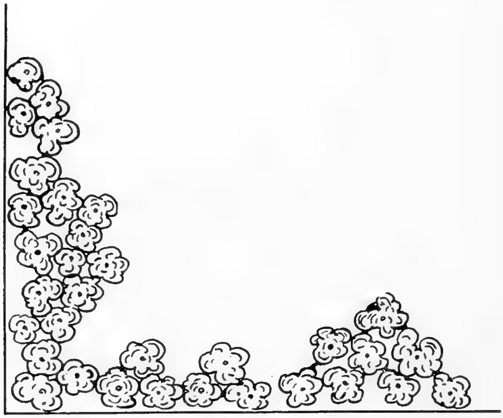


FIG. 132.—The proper way to group shrubs in the corner of a lot.

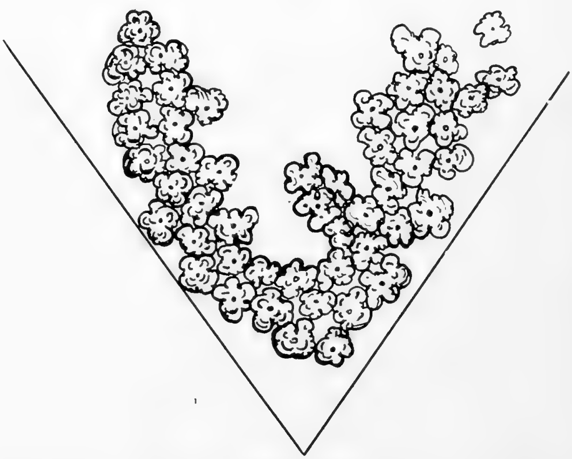


FIG. 133.—The proper way to group shrubs in an angle.

low-growing shrubs together, so that they produce distinct uniform lines of foliage. The tall- and the low-growing shrubs should be massed together. I do not mean that one plant should be alternated with another, but groups of one kind should be massed with groups of another kind.

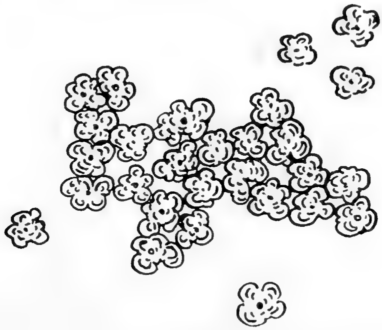


FIG. 134.—The proper way to mass shrubs in isolated groups.

Single specimen plants have a place on large lawns, but when they are used the individual plant should appear to be attached to a group of shrubs and placed at some little

FIG. 135.—An unattractive residence due to the lack of shrubs.

distance from the clump. The distance the single shrubs are located from the general mass should be gauged so that the specimen does not appear to be entirely distinct but to have some connection with the larger group. The more prominent the projection of a mass of shrubbery the better it will be fitted for receiving a single specimen plant as an extension.

Fig. 136.—A well-balanced planting.

There are several well-defined places that shrubs and ornamental plants should be located to produce the best

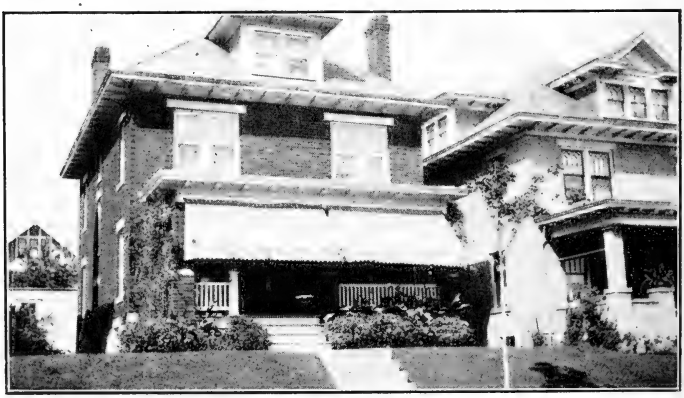


Fig. 137.—An attractive foundation made by planting annual plants.

effect: (1) grouping or massing along the borders, (2) grouping near the centers of curves in walks and roads, (3) grouping in the angle of two walks or roads, (4) planting along the foundations.

The Lawn.—This chapter would not be considered complete without some mention of the lawn. A number of books have been written on this subject, telling how to make a lawn and how to maintain it in its best form, and for that reason only mere mention will be made here. However, a few statements are necessary. In the first place the soil should be well drained, and when it is possible a loam soil is to be preferred, but this is not essential. The land should be thoroughly manured, plowed and cultivated previous to

Fig. 138.—A well-planted street. Note the uniformity due to community planting.

seeding. All stones, pieces of wood, roots and stumps must be removed and a coating of well-rotted manure placed on top of the soil when it is possible.

The next important thing to do is to select a good lawn grass. Various mixtures are on the market, but I believe better results can be obtained by making your own mixture and confining it to two or three grasses. In many localities perhaps one is sufficient. The Kentucky blue grass and the red top will make an ideal lawn in the great majority of cases if they are properly handled. Occasionally some other grasses must be used in certain regions. Seed heavily and from 4 to 6 bushels of seed to the acre, or about 1 bushel to 7000 square feet, is not too much. Few people realize the importance of a thick stand in all parts of the lawn, and to have success you must sow the seed thickly in order to keep out weeds and other wild grasses. The seed should be sown in two directions and at right angles to each other to ensure a uniform stand of grass.

A lawn to be effective and beautiful should be kept mowed and clean shaven all of the time. A regular time must be chosen to cut the grass, and the length of the time between each cutting must be largely determined by the season of the year and the amount of rainfall. In the spring when the grass is growing fast it should be cut every week or ten days and the clippings allowed to remain on the lawn. The clippings fall between the blades of grass and form a mulch which aids in preventing evaporation as well as enriching the soil. As the season advances and the rainfall becomes less, the time between successive cuttings should be lengthened.

Fig. 139 represents a tentative arrangement for the grouping of a few ornamental plants on a city lot emphasizing the screen and foundation planting. The selection of varieties must necessarily vary in the different parts of the country, as well as in the different sections of the same country. Only plants suitable for foundation and for border planting should be selected. One or more varieties may be massed in groups, which should be determined by the individual doing the planting. In general the fewer the number of varieties the more satisfactory the result will be.

This plan presupposes a garden in the rear, which is screened from view by a mass of shrubs at the boundary line. In selecting the plants for the grouping, some of the taller and more vigorous growers will be the most satisfactory for screening the undesirable portions.

In selecting suitable shrubs consult the list of shrubs adapted to your location. More detailed and specific information regarding your local conditions can be secured by consulting some nurseryman or landscape gardener in your immediate vicinity.

Fig. 140 represents the grouping of ornamentals on a corner lot. This is designed to screen the garden, as well as to give privacy to the lawn. Foundation plantings are also emphasized. The garden or drying ground is screened from

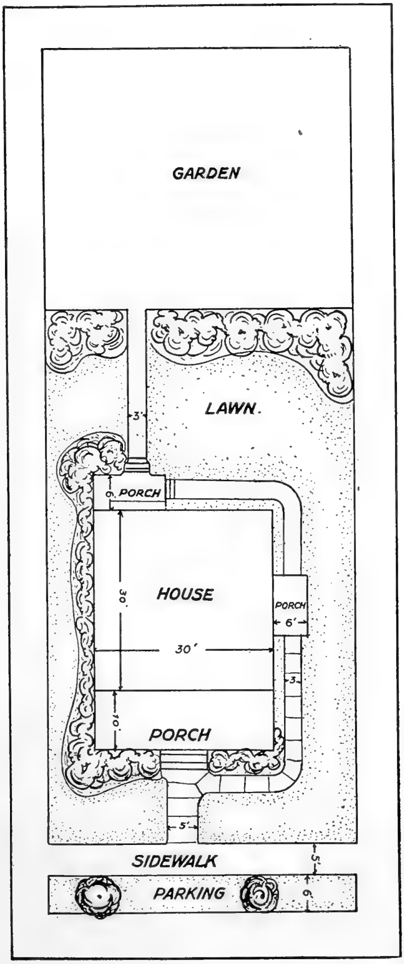


FIG. 139.—A suggestive plan for the grouping of ornamentals on a city lot.

view by the use of the taller growing shrubs, while shrubs varying in height should be used in the border. The selection

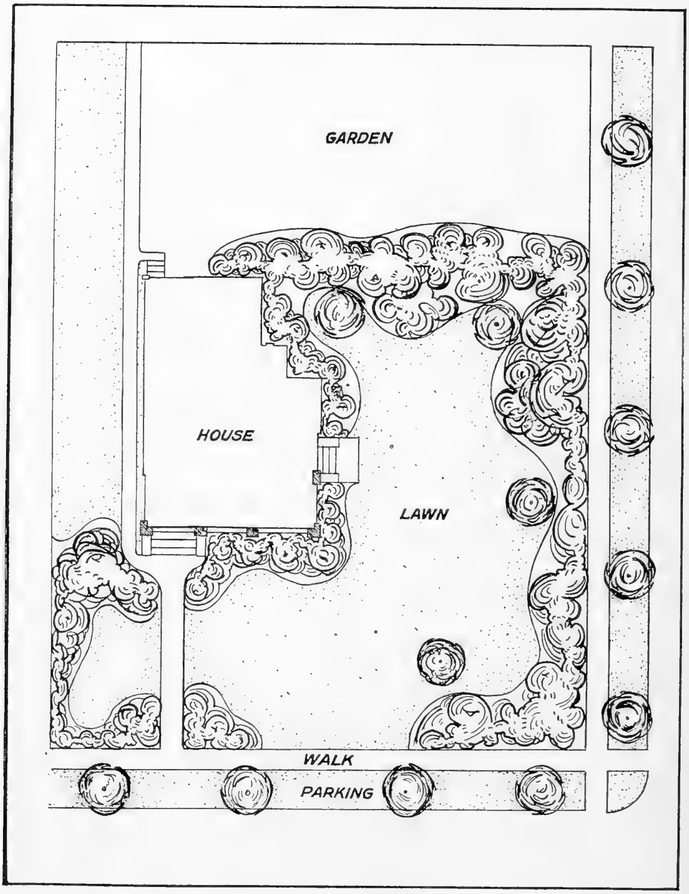


Fig. 140.—A suggestive plan for the grouping of ornamentals on a city lot with two sides exposed to the street.

of the shrubs to produce this effect can necessarily vary, and each individual should select those plants which are to their liking. As a rule better effects will be produced if a number

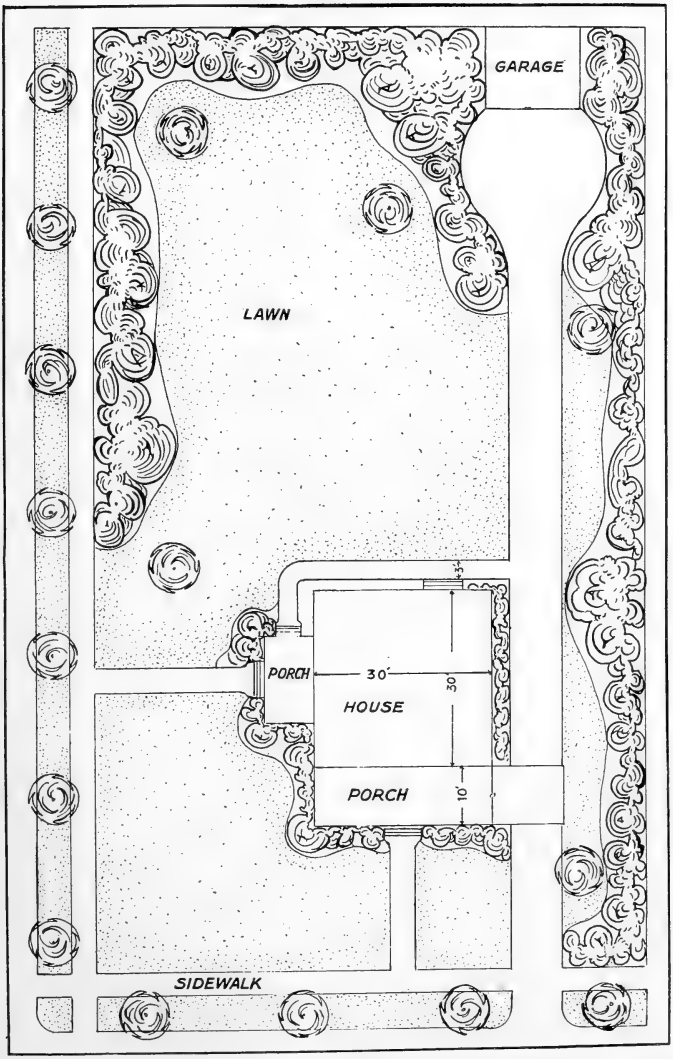


FIG. 141.—A suggestive plan for the grouping of ornamentals on a corner lot with two entrances and a garage.

of the same kind of shrubs are grouped together and not too many different kinds selected.

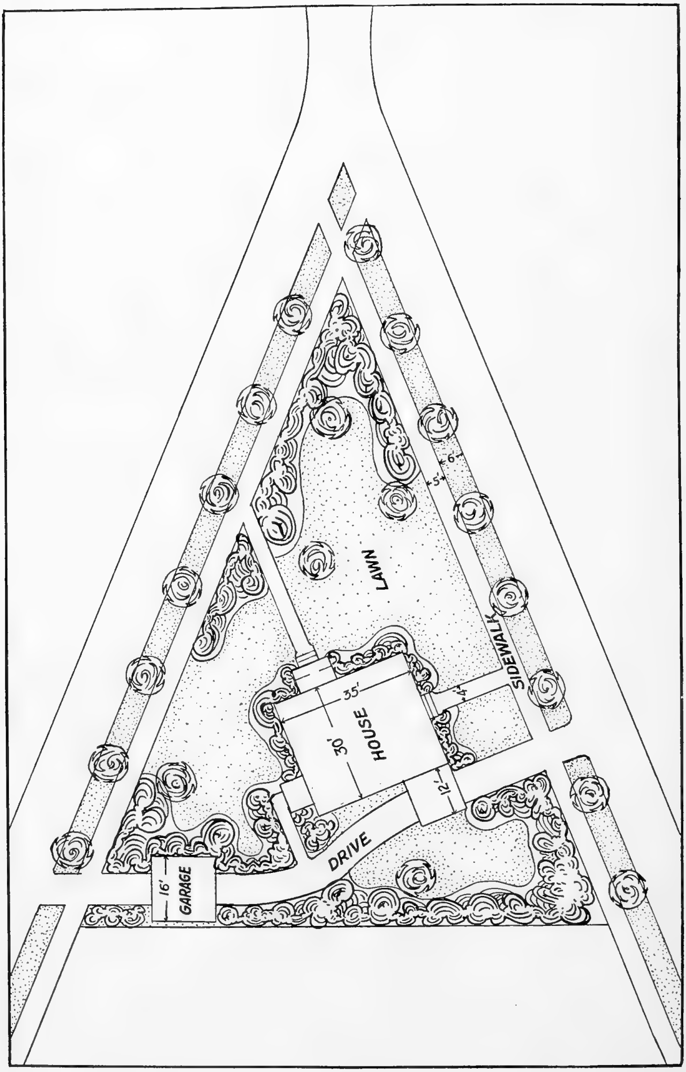


FIG. 142.—A suggestive plan for the treatment of an irregular piece of ground bordering on two roads.

Fig. 141 represents the planting of a lot where two sides are exposed and a residence that has a prominent entrance from two streets. This plan also introduces a garage and a drive leading to it. No garden or drying ground is provided. In this plan the shrubs are intended to screen the borders, and to effectively conceal the objectionable features connected with the garage. The open side lawn is screened so that privacy will result and where croquet or tennis can be indulged in for recreation. Foundation planting is in evidence and for this some of the smaller growing shrubs should be selected. The drive should be of cement or gravel and graded in such a way so as to provide good drainage.

Fig. 142 illustrates a suggestive arrangement for an irregular piece of ground. This plan omits the garden and introduces a continuous drive through the grounds. The garage is practically concealed by plantings from all sides. The sharp corners are turned and rounded by the grouping of shrubs which give the open lawn graceful curves. Foundation planting is also used. The selection of the shrubs will necessarily vary, due to the location and the individual preference of the owner.

REVIEW QUESTIONS.

1. What determines the value of a piece of property?
2. Why does the planting of shrubs improve the looks of a home?
3. Where is the proper place to locate a house on a city lot?
4. What principles are involved in locating a house?
5. Why is it important that the ground should be well drained?
6. Discuss the arrangement of walks and drives.
7. Why should abrupt angles be avoided?
8. How should curved walks and drives be treated?
9. How should shrubs be planted?
10. Is the single planting or the massing of shrubs the most effective? Why?
11. When single plantings are used where should they be placed?
12. Name the four well-defined locations where shrubs should be planted
13. Discuss the lawn.
14. How often should it be mowed?
15. What is the value of regular mowing of the lawn?

APPENDIX.

A LIST OF SHRUBS WHICH CAN BE USED AS A GUIDE FOR THE NORTH ATLANTIC REGIONS, INCLUDING MAINE, NEW HAMPSHIRE, VERMONT, MASSACHUSETTS, CONNECTICUT, RHODE ISLAND, NEW YORK, NEW JERSEY, PENNSYLVANIA, DELAWARE AND MARYLAND.

Botanical name.	English name.	Height.	Color.	Time of bloom.	How used.
Azalea lutea	Flame-colored azalea	6–7	Orange	June	Mass.
Berberis thunbergii	Japanese barberry	3–4	Yellow	May, June	Mass; hedge.
Berberis vulgaris	European barberry	4–5	Yellow	May, June	Mass.
Berberis vulgaris atropurpurea	Purple-leaved barberry	4–6	Yellow	May	Mass; hedge.
Buddleia intermedia	Hybrid buddleia	4–6	Violet	Summer	Mass.
Caragana arborescens	Siberian pea tree	10–12	Yellow	May	Mass; hedge.
Cornus siberica	Siberian dogwood	6–8	Cream	June	Mass.
Chionanthus virginica	White fringe	8–10	White	May	Single; mass.
Deutzia crenata (Pride of Rochester)	Deutzia	6–8	White	May, June	Single; mass.
Deutzia gracilis	Slender deutzia	2–3	White	May, June	Mass.
Diervilla candida	White weigelia	6–8	White	June, July	Single; mass.
Diervilla floribunda	Weigelia	5–6	Crimson	June	Single; mass.
Diervilla florida candida	Weigelia	4–6	White	May, June	Single; mass.
Diervilla hybrida	Eva Rathke weigelia	6–8	Varied	Summer	Mass.
Euonymus atropurpureus	Burning bush	8–12	Yellow	Autumn	Mass.
Forsythia suspensa	Drooping golden bell	7–8	Yellow	April	Mass.

Forsythia viridissima	Golden bell	7–8	Yellow	April	Mass.
Hibiscus syriacus	Rose of Sharon	8–10	Various	Aug., Sept.	Mass.
Hydrangea paniculata grandiflora	Large-flowered hydrangea	6–7	White	Aug., Sept.	Single; mass.
Ligustrum vulgare	Privet	6–10	....	June, July	Hedge; mass.
Lonicera fragrantissima	Fragrant honeysuckle	6–8	Pink	May	Single; mass.
Lonicera japonica	Vine honeysuckle	10–15	White to yellow	Summer	Excellent climber.
Lonicera tatarica	Tartarian honeysuckle	6–8	Pink to white	May, June	Single; mass.
Philadelphus coronarius	Mock orange	7–8	White	May, June	Single; border.
Philadelphus grandiflorus	Large-flowered mock orange	8–12	White	June	Mass.
Rhus canadensis	Sumac	3–4	Yellow	May	Mass.
Rosa rugosa	Rose	4–6	Red	Summer	Mass.
Rosa setigera	Prairie rose	5–6	Pink	June, July	Border; mass.
Sambucus canadensis	American elder	8–12	White	June, July	Mass.
Sambucus nigra aurea	Golden elder	6–8	White	June, July	Mass.
Spiræa bumalda	Anthony Waterer spirea	2–3	Pink	July, Aug.	Single; mass.
Spiræa arguta	Spirea	5–6	White	June, July	Mass.
Spiræa thunbergii	Thunberg's spirea	3–4	White	May, June	Single; mass.
Spiræa van houttei	Van Houtte's spirea	5–6	White	May, June	Single; mass
Staphylea trilobata	Bladder nut	5–6	White	May, June	Single; mass.
Symphoricarpos racemosus	Snowberry	3–5	Pink	Summer	Mass.
Syringa persica	Persian lilac	6–8	Lilac	May, June	Mass.
Syringa vulgaris	Lilac	8–10	Purple	May	Single; mass.
Viburnum opulus	Highbush cranberry	7–8	White	May, June	Single; mass.
Viburnum plicatum	Japanese snowball	6–8	White	June	Mass.
Viburnum sterile	Snowball	6–8	White	May, June	Single; mass.

A LIST OF SHRUBS WHICH CAN BE USED AS A GUIDE FOR THE SOUTH ATLANTIC REGIONS, INCLUDING NORTH CAROLINA, SOUTH CAROLINA, VIRGINIA, WEST VIRGINIA, GEORGIA AND FLORIDA.

Botanical name.	English name.	Height.	Color.	Time of bloom.	How used.
Azalea indica	Azalea	6–8	Various	May, June	Hedge; mass.
Azalea lutea	Flame-colored azalea	6–7	Orange	May, June	Mass.
Berberis thunbergii	Japanese barberry	3–4	Yellow	May	Hedge; mass.
Berberis vulgaris	European barberry	4–6	Yellow	May	Hedge; mass.
Berberis vulgaris atropurpurea	Purple-leaved barberry	4–6	Yellow	May	Mass; hedge.
Buddleia intermedia	Hybrid buddleia	4–6	Yellow	Summer	Mass.
Calycanthus fertilis	Carolina allspice	4–6	Brown	May, June	Mass.
Calycanthus floridus	Strawberry shrub	4–6	Reddish brown	June	Mass.
Camellia japonica	Camellia	..	Various	....	Mass.
Camellia thea	Tea plant	..	White	....	Mass.
Cercis canadensis	Red bud	10–20	Pink	April, May	Single; mass.
Cercis chinensis	Oriental Judas tree	12–15	Pink	April	Single; mass.
Chionanthus virginica	Fringe tree	5–10	White	April, May	Single; border.
Citrus trifoliata	Trifoliate orange	..	White	....	Hedge.
Cornus florida	White-flowered dogwood	8–10	White	May	Mass.
Cydonia japonica	Japanese quince	4–6	Crimson	April, May	Mass.
Deutzia crenata	Deutzia	4–6	White	May	Single; mass.
Deutzia crenata candidissima	Deutzia	6–8	White	June	Mass.
Diervilla florida	Weigelia	5–6	Pink	June	Single; mass.

Exochorda grandiflora	Pearl bush	7–8	White	May	Mass.
Forsythia fortunei	Fortune's golden bell	7–8	Yellow	April	Mass.
Forsythia suspensa	Drooping golden bell	7–8	Yellow	April	Mass.
Forsythia viridissima	Golden bell	7–8	Yellow	April	Mass.
Gardenia jasminiodes	Crape jasmine	4–10	Varied	Summer	Single; mass.
Hydrangea paniculata grandiflora	Large-flowered hydrangea	6–7	White	Sept., Oct.	Single; mass.
Ilex apaca	American holly	6–8	Yellow	June	Single; mass.
Lagerstœmia indica	Crape myrtle	10–20	Varied	....	Mass.
Laurocerasus caroliniana	Wild orange	6–8	White	April, May	Hedge.
Laurocerasus laurocerasus	Cherry laurel	10–12	White	April, May	Mass; hedge.
Ligustrum ovalifolium	California privet	6–10	White	May, June	Hedge.
Ligustrum vulgare	Privet	6–10	White	May, June	Hedge.
Lonicera fragantissima	Honeysuckle	5–6	Pink	April, May	Single; mass.
Lonicera japonica	Vine honeysuckle	10–15	White to yellow	Summer	Excellent climber.
Lonicera tatarica	Tartarian honeysuckle	6–8	Pink to white	May, June	Single; mass.
Osmanthus squifolium	Holly-leaved olive	..	White	Autumn	
Philadelphus coronarius	Mock orange	7–8	White	May, June	Single; mass.
Philadelphus grandiflorus	Large-flowered mock orange	8–12	White	May, June	Single; mass.
Rosa setigera	Prairie rose	5–6	Pink	May, June	Border; mass.
Sambucus canadensis	American elder	8–12	White	June	Mass.
Sambucus nigra aurea	Golden elder	6–8	White	June	Mass.
Spiræa arguta	Spirea	5–6	White	April, May	Single; mass.
Spiræa thunbergii	Thunberg's spirea	4–5	White	April, May	Single; mass.
Spiræa van houttei	Van Houtte's spirea	5–6	White	May	Single; mass.
Syringa vulgaris	Lilac	8–10	Purple	May	Single; mass.
Viburnum opulus	Highbush cranberry	7–8	White	May	Single; mass.
Viburnum sterile	Snowball	6–8	White	May	Single; mass.

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A LIST OF SHRUBS WHICH CAN BE USED AS A GUIDE FOR THE SOUTHERN REGIONS, INCLUDING ALABAMA, TENNESSEE, MISSISSIPPI, ARKANSAS AND LOUISIANA.

Botanical name.	English name.	Height.	Color.	Time of bloom.	How used.
Azalea aborescens	Azalea	6–8	Rose	July	Mass.
Azalea gandavensis	Ghent azalea	4–5	Various	May, June	Mass.
Azalea lutea	Flame-colored azalea	4–6	Orange	June	Mass.
Berberis thunbergii	Japanese barberry	3–5	Yellow	May	Foundation.
Berberis vulgaris	European barberry	4–6	Yellow	May	Hedge; mass.
Berberis vulgaris atropurpurea	Purple-leaved barberry	4–6	Yellow	May	Hedge; mass.
Buddleia intermedia	Hybrid buddleia	4–6	Violet	Summer	Mass.
Calycanthus fertilis	Carolina allspice	4–5	Brown	May, June	Mass.
Calycanthus floridus	Strawberry shrub	4–6	Reddish brown	June	Mass.
Cercis chinensis	Oriental Judas tree	12–15	Pink	April	Single; mass.
Cirtus trifoliata	Trifoliate orange	..	White	....	Hedge.
Deutzia crenata candidissima	Deutzia	6–7	White	May, June	Mass.
Diervilla florida	Weigelia	5–6	Pink	May, June	Single; mass.
Exochorda grandiflora	Pearl bush	7–8	White	May	Mass.
Forsythia viridissima	Golden bell	7–8	Yellow	April	Mass.

Forsythia suspensa	Drooping golden bell	7–8	Yellow	April	Mass.
Hydrangea paniculata grandiflora	Large-flowered hydrangea	6–7	White	Aug., Sept.	Single; mass.
Hibiscus syriacus	Rose of Sharon	8–10	Various	Aug., Sept.	Mass.
Lagerstrœmia indica	Crape myrtle	10–20	Varied	. . . .	Mass.
Lonicera japonica	Vine honeysuckle	10–15	White to yellow	Summer	Excellent climber.
Lonicera tatarica	Tartarian honeysuckle	6–7	Pink to white	April, May	Single; mass.
Philadelphus coronarius	Mock orange	6–8	White	May, June	Single; mass.
Philadelphus grandiflorus	Large-flowered mock orange	8–12	White	May, June	Single; mass.
Rhodotypos kerrioides	White kerria	4–5	White	May	Mass.
Rhododendron maximum	Rhododendron	8–10	Rose	June, July	Mass.
Rosa alba	White rose	5–6	White	June	Mass.
Rosa multiflora	Climbing rose	4–6	White	June	Mass.
Rosa setigera	Prairie rose	5–6	Pink	June	Mass.
Sambucus canadensis	American elder	8–12	White	June	Mass.
Sambucus nigra aurea	Golden elder	6–8	White	June	Mass.
Spiræa arguta	Spirea	5–6	White	April, May	Mass.
Spiræa bumalda	Anthony Waterer spirea	2–3	Pink	July, Aug.	Mass.
Spiræa thunbergii	Thunberg's spirea	4–5	White	May, June	Mass.
Spiræa van houttei	Van Houtte's spirea	4–5	White	May, June	Mass.
Tamarix gallica	French tamarisk	8–10	White or pink	April, May	Mass.
Viburnum lantana	Wayfaring tree	8–10	White	May	Mass.
Viburnum opulus	Highbush cranberry	7–8	White	May	Single; mass.
Viburnum sterilis	Snowball	6–8	White	May	Single; mass.

A LIST OF SHRUBS WHICH CAN BE USED AS A GUIDE FOR CENTRAL REGIONS, INCLUDING OHIO, INDIANA, ILLINOIS, KENTUCKY, IOWA AND MISSOURI.

Botanical name.	English name.	Height.	Color.	Time of bloom.	How used.
Amygdalus pumila	Flowering almond	2–3	Rose	May	Border; mass.
Azalea lutea	Flame-colored azalea	6–7	Orange	June	Mass.
Berberis thunbergii	Japanese barberry	3–4	Yellow	May	Mass.
Berberis vulgaris	European barberry	4–6	Yellow	May	Mass.
Berberis vulgaris atropurpurea	Purple-leaved barberry	5–6	Yellow	May	Hedge.
Buddleia intermedia	Hybrid buddleia	4–6	Violet	Summer	Mass.
Calycanthus fertilis	Carolina allspice	4–6	Brown	May, June	Mass.
Calycanthus floridus	Strawberry shrub	4–5	Brown	June	Single; mass.
Chionanthus virginica	White fringe	8–10	White	May	Single; mass.
Cornus florida	White flowering dogwood	15–20	White	May	Mass.
Cornus siberica	Siberian dogwood	6–7	White	May	Mass.
Cratægus crustgalli	Cockspur thorn	10–12	White	May	Hedge; mass.
Cydonia japonica	Japan quince	4–6	Crimson	April, May	Mass; border.
Deutzia gracilis	Deutzia	3–4	White	May, June	Mass.
Deutzia lemoinei	Lemoines deutzia	3–4	White	June	Mass; border.
Diervilla candida	White weigelia	6–8	White	June	Single; mass.
Diervilla Eva Rathke	Hybrid weigelia	5–6	Crimson	June, July	Single; mass.
Diervilla floribunda	Weigelia	5–6	Crimson	June	Single; mass.
Diervilla florida	Weigelia	5–6	Rose	June	Single; mass.

Exochorda grandiflora	Pearl bush	7–8	White	May	Mass.
Forsythia suspensa	Drooping golden bell	7–8	Yellow	April	Mass.
Forsythia viridissima	Golden bell	7–8	Yellow	April	Mass.
Hydrangea arborescens	Summer snowball	4–8	White	June, July	Mass.
Hydrangea paniculata grandiflora	Large-flowered hydrangea	6–7	White	Aug., Sept.	Mass.
Kerria japonica	Globe flower	4–6	Yellow	June	Mass.
Ligustrum regalianum	Regals privet	4–5	White	June	Mass; hedge.
Lonicera japonica	Vine honeysuckle	10–15	Yellow to white	Summer	Excellent climber.
Lonicera morrowi	Japanese bush honeysuckle	4–6	White	May, June	Mass.
Lonicera tatarica	Tartarian honeysuckle	6–8	White	May, June	Mass.
Prunus japonica var. alba plana	Double white almond	2–5	White	May	Mass.
Rhus cotinus	Smoke tree	8–10	Yellowish green	June	Single; mass.
Ribes aureum	Flowering currant	5–6	Yellow	May	Mass; border.
Rosa rugosa	Japanese rose	4–5	Varied	Summer	Single; mass.
Rosa setigera	Prairie rose	5–6	Pink	June, July	Single; mass.
Sambucus canadensis	American elder	8–12	White	June	Mass.
Sambucus nigra aurea	Golden elder	6–8	White	June	Mass.
Spiræa bumalda	Anthony Waterer spirea	2–3	Crimson	July, Aug.	Mass.
Spiræa prunifolia	Plum-leaved spirea	5–6	White	May	Single; mass.
Spiræa thunbergii	Thunberg's spirea	4–5	White	May	Single; mass.
Spiræa van houttei	Van Houtte's spirea	5–6	White	May	Single; mass.
Symphoricarpos racemosus	Snowberry	3–5	Pinkish white	Summer	Mass.
Syringa persica	Persian lilac	5–6	White	May	Single; mass.
Syringa vulgaris	Lilac	8–10	Purple	May	Single; mass.
Viburnum cassinoides	White rod	6–8	White	June	Mass; border.
Viburnum opulus	Highbush cranberry	6–8	White	June	Mass.

A LIST OF SHRUBS WHICH CAN BE USED AS A GUIDE FOR THE CENTRAL WESTERN STATES, INCLUDING COLORADO, UTAH, NEVADA, WYOMING, NEBRASKA AND KANSAS.

Botanical name.	English name.	Height.	Color.	Time of bloom.	How used.
Amelanchier alnifolia	June berry	5–8	White	May	Mass.
Amorpha fruticasa	False indigo	5–10	Violet	....	Mass.
Azalea lutea	Flame-colored azalea	6–7	Orange	June	Mass.
Berberis thunbergii	Japanese barberry	4–5	Yellow	May, June	Mass; hedge.
Berberis vulgaris	European barberry	4–5	Yellow	May, June	Mass.
Berberis vulgaris atropurpurea	Purple-leaved barberry	4–5	Yellow	May, June	Mass.
Buddleia intermedia	Hybrid buddleia	4–6	Violet	Summer	Mass.
Caragana arborescens	Siberian pea tree	10–12	Yellow	May, June	Single; mass.
Cercis canadensis	Oriental Judas tree	10–15	Pink	April	Single; mass.
Cornus siberica	Siberian dogwood	6–8	Cream	June	Mass.
Cydonia japonica	Japan quince	5–6	Scarlet	May	Mass; border.
Deutzia gracilis	Deutzia	2–3	White	May	Mass.
Euonymus atropurpureus	Burning bush	8–12	Yellow	June	Mass.
Exochorda grandiflora	Pearl bush	7–8	White	May	Mass.
Forsythia suspensa	Drooping golden bell	7–8	Yellow	April	Mass.

Hydrangea paniculata grandiflora	Large-flowered hydrangea	6–7	White	Aug., Sept.	Single; mass.
Lepargyræa argentea	Buffalo berry	4–8	....	April, May	Hedge.
Ligustrum ibota	Japanese privet	5–6	White	June	Mass; hedge.
Lonicera tatarica	Tartarian honeysuckle	6–8	Pink to white	May, June	Single; mass.
Philadelphus coronarius	Mock orange	8–12	White	May	Single; mass.
Physocarpus opulifolius	Ninebark	2–3	White	May, June	Mass.
Physocarpus opulifolius aurea	Golden ninebark	4–5	White	May, June	Mass.
Rhododendron maximum	Rhododendron	8–10	Rose	June	Mass.
Rhodotyphus kerrioides	White kerria	4–6	White	May	Mass.
Rhus glabra	Smooth sumac	3–10	Greenish yellow	May	Mass.
Rosa alba	White rose	5–6	White	June	Mass.
Rosa multiflora	Climbing rose	4–6	White	June	Mass.
Sambucus canadensis	American elder	8–12	White	June, July	Mass.
Sambucus nigra aurea	Golden elder	6–8	White	June, July	Mass.
Spiræa thunbergii	Thunberg's spirea	3–5	White	May	Single; mass.
Spiræa van houttei	Van Houtte's spirea	4–5	White	May	Single; mass.
Syringa vulgaris	Lilac	8–10	Purple	May	Single; mass.
Syringa persica	Persian lilac	6–8	Lilac	May, June	Single.
Tamarix gallica	Tamarisk	8–10	White or pink	May, June	Mass.
Toxylon pomiferum	Osage orange	15–20	....	May, June	Hedge.
Viburnum opulus	Highbush cranberry	7–8	White	May, June	Single; mass.
Viburnum lentago	Sheepberry	8–10	White	May, June	Mass.

A LIST OF SHRUBS WHICH CAN BE USED AS A GUIDE FOR THE NORTH CENTRAL STATES, INCLUDING NORTH DAKOTA, SOUTH DAKOTA, MONTANA, MINNESOTA, WISCONSIN AND IDAHO.

Botanical name.	English name.	Height.	Color.	Time of bloom.	How used.
Amelanchier alnifolia	June berry	3–6	White	May, June	Mass.
Amelanchier botryapium	June berry	5–6	White	May, June	Mass.
Berberis thunbergii	Japanese barberry	3–4	Yellow	May, June	Mass; hedge.
Berberis vulgaris	European barberry	4–5	Yellow	May, June	Mass.
Berberis vulgaris atropurpurea	Purple-leaved barberry	4–5	Yellow	May, June	Mass; hedge.
Buddleia intermedia	Hybrid buddleia	4–6	Violet	Summer	Mass.
Caragana arborescens	Siberian pea tree	10–12	Yellow	May, June	Mass; border.
Cephalanthus occidentalis	Button bush	4–6	White	July	Mass.
Chionanthus virginica	White fringe	8–10	White	May	Single; mass.
Clethra alnifolia	Sweet pepper bush	3–5	White	July	Mass.
Cornus sanguinea	Red osier	6–8	White	June	Mass.
Cornus siberica	Siberian dogwood	6–8	Cream	June	Mass.
Corylus americana	Hazel nut	4–8	....	April	Mass.
Cydonia japonica	Japan quince	4–6	Crimson pink	April, May	Mass.
Deutzia crenata (Pride of Rochester)	Deutzia	4–6	White	June	Mass.

Diervilla florida	Weigelia	5–6	Pink	June	Mass.
Euonymus atropurpureus	Burning bush	8–12	Yellow	June	Mass.
Hydrangea paniculata	Hydrangea	6–8	White	Aug., Sept.	Single; mass.
Hydrangea paniculata grandiflora	Large-flowered hydrangea	6–7	White	Aug., Sept.	Single; mass.
Ligustrum vulgare	Privet	6–8	White	June	Mass; hedge.
Lonicera japonica	Vine honeysuckle	10–15	White to yellow	Summer	Excellent climber.
Lonicera tatarica	Tartarian honeysuckle	6–8	Pink to white	May, June	Single; mass.
Philadelphus coronarius	Mock orange	8–12	White	May, June	Single; mass.
Rhodotyphus kerrioides	White kerria	4–6	White	May, June	Mass.
Rhus canadensis	Sumac	3–4	Yellow	May	Mass.
Ribes alpinum	Mountain currant	3–4	Yellow	May	Single; mass.
Rosa rugosa	Rose	5–6	Rose	Summer	Mass.
Sambucus canadensis	American elder	6–10	White	June, July	Mass.
Sambucus nigra aurea	Golden elder	6–7	White	June, July	Mass.
Spiræa thunbergii	Thunberg's spirea	3–5	White	May, June	Single; mass.
Spiræa van houttei	Van Houtte's spirea	4–5	White	May, June	Single; mass.
Symphoricarpos racemosus	Snowberry	3–5	Pinkish white	Summer	Mass.
Syringa vulgaris	Lilac	8–10	Purple	May	Single; mass.
Tamarix gallica	Tamarisk	8–10	White to pink	May, June	Mass.
Toxylon pomiferum	Osage orange	15–20	....	June	Mass.
Viburnum lantana	Wayfaring tree	8–10	White	May, June	Single; mass.

A LIST OF SHRUBS WHICH CAN BE USED AS A GUIDE FOR THE PACIFIC COAST REGIONS, INCLUDING WASHINGTON, OREGON AND CALIFORNIA.

Botanical name.	English name.	Height.	Color.	Time of bloom.	How used.
Berberis fascicularis	Fascicled barberry	4–6	Yellow	Summer	Mass.
Berberis thunbergii	Japanese barberry	3–4	Yellow	May, June	Mass; hedge.
Berberis vulgaris	European barberry	4–5	Yellow	May, June	Mass.
Berberis vulgaris atropurpurea	Purple-leaved barberry	4–5	Yellow	May, June	Mass.
Camellia thea	Tea plant	..	White	....	Mass.
Citrus trifoliata	Trifoliate orange	..	White	....	Hedge.
Cornus siberica	Siberian dogwood	6–8	Cream	June	Mass.
Cornus stolonifera	Red osier	6–8	White	June	Mass.
Cydonia japonica	Japan quince	4–6	Crimson	April, May	Mass.
Diervilla florida	Weigelia	5–6	Pink	June	Single; mass.
Gardenia jasminoides	Crape jasmine	4–10	Varied	Summer	Single; mass.
Hydrangea paniculata grandiflora	Large-flowered hydrangea	5–7	Pink to white	Aug., Sept.	Single; mass.
Lagerstrœmia indica	Crape myrtle	10–20	Varied	....	Mass.
Ligustrum ovalifolium	California privet	6–10	White	June, July	Hedge.
Lonicera morrowi	Japanese honeysuckle	5–6	....	May, June	Single; mass.

Lonicera japonica	Vine honeysuckle	10–15	White to yellow	Summer	Excellent climber.
Lonicera tartarica	Tartarian honeysuckle	6–7	Pink to white	May, June	Single; mass.
Philadelphus coronarius	Mock orange	7–8	White	May, June	Single; mass.
Philadelphus grandiflorus	Large-flowered mock orange	8–12	White	June	Single; mass.
Nerum oleander	Oleander	6–10	Varied	Summer	Single; mass.
Osmathus aquifolium	Holly-leaved olive				
Rosa alba	White rose	5–6	White	June	Mass.
Rosa multiflora	Climbing rose	4–6	White	June	Mass.
Rosa rugosa	Rose	4–6	Red	Summer	Mass.
Rosa setigera	Prairie rose	5–6	Pink	June, July	Border; mass.
Sambucus canadensis	American elder	8–12	White	June, July	Mass.
Sambucus nigra aurea	Golden elder	6–8	White	June, July	Mass.
Spiræa arguta	Spirea	5–6	White	May	Single; mass.
Spiræa bumalda	Anthony Waterer spirea	2–3	Pink	July, Aug.	Mass.
Spiræa thunbergii	Thunberg's spiræa	4–5	White	April, May	Single; mass.
Spiræa van houttei	Van Houtte's spiræa	5–6	White	May	Single; mass.
Syringa persica	Persian lilac	6–8	Lilac	May, June	Single.
Syringa vulgaris	Lilac	8–10	Purple	May	Single; mass.
Tamarix gallica	French tamarisk	8–10	White or pink	May	Mass.
Viburnum opulus	Highbush cranberry	7–8	White	May	Single; mass.
Viburnum sterile	Snowball	6–7	White	May	Single; mass.
Wistaria frutescens	American wistaria	10–15	Purple	June	Vine.

A LIST OF SHRUBS WHICH CAN BE USED AS A GUIDE FOR THE SOUTHWESTERN REGIONS, INCLUDING ARIZONA, TEXAS AND OKLAHOMA.

Botanical name.	English name.	Height.	Color.	Time of bloom.	How used.
Azalea lutea	Flame-colored azalea	4–6	Orange	May	Mass.
Berberis thunbergii	Japanese barberry	3–4	Yellow	May	Mass; hedge.
Berberis vulgaris	European barberry	4–5	Yellow	May	Mass.
Boxus sempercirens	Boxwood	8–12	....	....	Single; hedge.
Boxus suffruticosa	Dwarf boxwood	4–10	....	....	Single; hedge.
Cornus siberica	Siberian dogwood	6–8	Cream	June	Mass.
Deutzia gracilis	Deutzia	2–3	White	May	Mass.
Forsythia suspensa	Drooping golden bell	7–8	Yellow	April	Mass.
Gardenia jasminoides	Crape jasmine	4–10	Varied	Summer	Single; mass.
Hibiscus syriacus	Althea	8–10	Various	Aug.	Mass.
Hydrangea paniculata grandiflora	Large-flowered hydrangea	6–7	White	Fall	Single; mass.
Lagerstrœmia indica	Crape myrtle	10–20	Varied	....	Mass.
Ligustrum ovalifolium	California privet	6–8	White	June	Hedge.
Ligustrum vulgare	Privet	6–8	White	May	Hedge.
Lonicera japonica	Vine honeysuckle	15–20	White to yellow	Summer	Excellent climber.
Lonicera tatarica	Tartarian honeysuckle	6–8	Pink to white	May	Single; mass.
Morus alba pendula	Weeping mulberry	8–10	....	....	Single.
Nerium oleander	Oleander	6–10	Varied	Summer	Single; mass.
Philadelphus coronarius	Mock orange	8–12	White	May	Single; mass.
Rhodotypos kerrioides	White kerria	4–5	White	April, May	Mass.
Rosa alba	White rose	5-6	White	May, June	Mass.
Rosa multiflora	Climbing rose	4–5	White	May, June	Mass.
Rosa setigera	Prairie rose	5–6	Pink	May, June	Mass.
Sambucus canadensis	American elder	8–12	White	May, June	Mass.
Sambucus nigra aurea	Golden elder	6–8	White	May, June	Mass.
Spiræa thunbergii	Thunberg's spirea	3–5	White	May	Single; mass.
Spiræa van houttei	Van Houtte's spirea	4–5	White	May	Single; mass.
Washingtonia filfifera	Palm	..	....	....	Mass; border.
Washingtonia robusta	Palm	..	....	....	Mass; border.
Wistaria frutescens	American wistaria	10–15	Purple	June	Vine.
Wistaria specosia	American wistaria	15–20	Lilac purple	May	Border.

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