



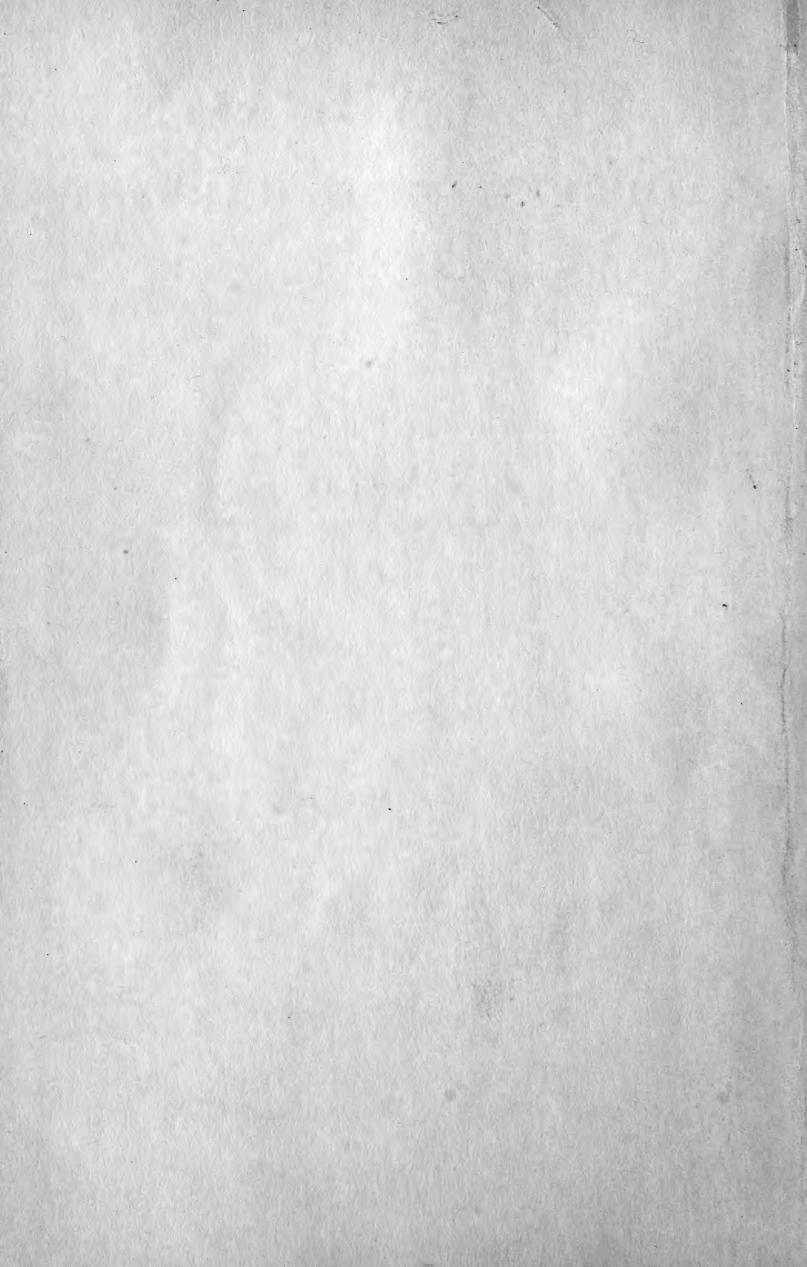
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LATE CABBAGE

FROM SEED UNTIL HARVEST

ALSO SEED RAISING

BY

E. N. REED

Specialist in Late Cabbage and Cabbage Seed

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DEDICATION

I HEREBY DEDICATE THIS WORK
TO MY LOVING WIFE

Cornelia

Together here this life we live
Its varied pathways trod,
Forever our dearest hopes shall be
Eternity with God.

THE AUTHOR.

1191 JAN

PREFACE

As time advances it becomes more and more apparent that each of our vegetable crops must have some special thought if we are to continue their successful culture.

Each year some insect or plant disease seems to work havoc in some section of the country, or some unusual weather condition prevails which greatly reduces a full crop. Noxious weeds, improper rotation, poor seed or poor cultural methods, all lend a hand to hinder success.

In the preparation of this book it has been the aim of the writer to discuss briefly some of the chief rights and wrongs, so that one may have success without costly experience.

Life is too short to learn everything by experience, and manipulations are too expensive. The aim of our Agricultural schools and colleges to-day is to teach a man while he is young, to prepare him for his work so that he need not spend a large portion of his life experimenting before he begins to succeed.

I have tried to weave into this work not only my own experience, but also the knowledge gained by the experimental work of our best colleges throughout the great cabbage belt, which takes in a large portion of Northern United States.

I, the writer, am a practical grower, not only of cabbage, but also of seed. I am not a man with untried theories; in the past seven years I have not had a crop of cabbage cut less than twenty tons per acre. In 1916 The Department of Vegetable Gardening of Cornell University cut a portion of my field of cabbage which gave a yield of thirty tons and seventy pounds per acre. The piece of ground on which this cabbage grew was an ordinary field of a hill farm.

I wish to thank the following for any material, photos or assistance which they have rendered me in the preparation of this book:

Prof. A. E. Wilkinson, College of Agriculture, Department of Veg. Gardening, Ithaca, N. Y.; Prof. Chas. Chupp, College of Agriculture, Department of Plant Pathology, Ithaca, N. Y.; Prof. J. W. Wellington, of Geneva Exp. Station.

Special bulletins upon various subjects from Vermont, Ohio, Washington, D. C., and New York have been noted.

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INTRODUCTION

THE cabbage plant is a native of the coast of Europe. The original plant looks very different from what we now call our cabbage; it is merely a large broad-leaf plant which never forms a head. From this original plant have been developed a great many strains of both Early- and Late-maturing Cabbage, as well as Cauliflower, Brussels Sprouts, Kohlrabi, Collards, and Kale, all of which are cultivated. There are also a number of wild plants which are related, such as Shepherd's Purse, Pepper Grass, and Mustard. The mustard is very often cultivated, but it is such a noxious plant that it had better be classed with the weeds.

Practically all the above mentioned plants belong to the cabbage family and they will all be subject to the same diseases. This fact plays a very important part, especially where mustard is getting such a foothold as it is in most of our older cultivated lands. Any of these weeds will keep a cabbage disease propagated from year to year.

Of the various strains of cabbage, I wish to confine my work to those maturing in the fall of the year. The late-maturing strains have a different root system than the early ones; they have more of a spreading nature, that is, the plant throws out longer roots in all directions, so

that it feeds in quite a larger area of soil. The early cabbage roots do not extend out very far, but are confined to more of a spherical area; this gives rise to different fertilization and cultivation methods.

After the early crop of cabbage is out of the way, the next comes what most growers call "Domestics." These require about the same cultural methods as do the late ones, which are called "Danish" or sometimes "Holland."

The Domestics are mostly consumed in a short time after they are harvested, or else they are sent to the sauerkraut factories, where they are made into sauerkraut. Generally speaking, the acreage of Domestics is considerably less than that of Danish. Standard varieties in Domestics are: Warren, Flat Dutch, Succession, All Head Early, Glory, and Copenhagen Market.

While some of the Danish are made into sauerkraut, most of them are consumed after the Domestics are out of the way and before southern cabbage comes on the market in the spring. A large portion of the Danish have to be stored by methods which will be described later on in this book.

In the Danish class there are two shapes of heads, as well as in the Domestics, only with the Domestics one can find a very much flatter head than in the Danish. As a rule there are no harder cabbage than the Danish Ball Head, and those with a flattish-topped head which have a peaked base. Fig. 1.

The Red cabbage belongs in the Danish group, as their ripening and habits are about the same. As a usual thing the red ones are more tender-fleshed, therefore they will

not keep as long and are more liable to crack open before harvest. Most of the reds are sold where they will be used on lunch counters, in restaurants, or where a fancy dish is desired. As a rule they do not yield over two-thirds

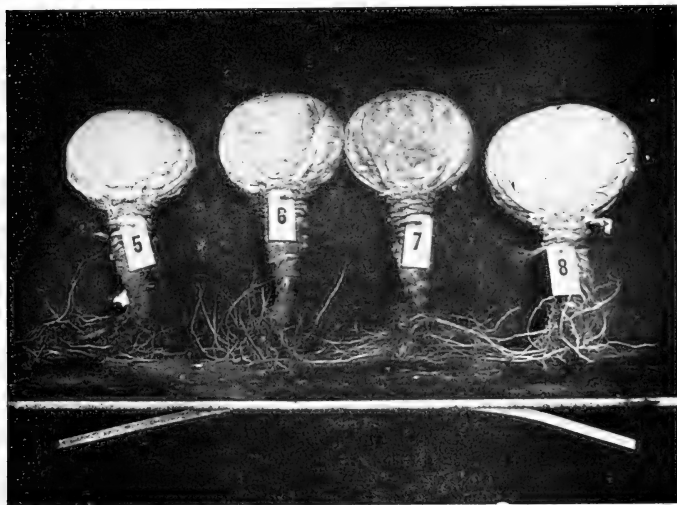


FIG. 1.—Types of Danish Cabbage.

as much as either Domestic or Danish, nor do they keep as well.

The Danish cabbage is often spoken of by many as not being as palatable, and as more fibrous or tough than the earlier sorts. While this is true to a certain extent, a large portion of the trouble lies in a poor strain, improper fertilization, or cultural methods. If a grower who is breeding up a strain will select away from such qualities, his cabbage will be just as tender and sweet as any.

LATE CABBAGE

FROM SEED UNTIL HARVEST

CHAPTER I

CROP ROTATION

IF we are to compete successfully with others in crop production in these days we must study the fertility condition of our soil, as well as the crop we expect to grow; this brings us to crop rotation.

We should study crop rotation for two reasons: first, from the standpoint of keeping up soil fertility; the chief way to do this is to keep up the supply of humus or organic matter. Second, from the standpoint of disease prevention.

Before one takes any steps toward growing a crop the rotation question should be thoroughly in mind; this is especially true with the cabbage crop. This crop of all crops needs as wide a rotation as possible, or in other words as long a period as possible should elapse before another crop of the same kind is planted upon that field. If cabbage is planted year after year, or even every other year upon the same field, club root will develop. Even though club root

does not develop the crop will not yield as well as though you had used ground upon which no cruciferous crop had been grown for four to six years. This changing of crops from one field to another gives the chance to keep up the needed supply of humus in the soil, and right here let me say that few other crops exhaust soil fertility any faster than does the cabbage.

HUMUS

Humus is the substance that results from the decay of plant or animal material in the soil. The soil water passing through humus derives power to leach out the mineral elements which are essential to plant growth. The more humus in the soil the stronger will be the soil water and the more leaching power it will have. When a humus-forming substance decays to form humus, there are fertilizing elements released from the substances which also aid plant growth. For example, when you plow under a piece of sod ground, decay of the roots takes place and there is a quantity of nitrogen, phosphorus and potash liberated, all of which are plant foods. The soil water passing through the decayed roots derives power to leach out mineral elements in the soil which are not available to a plant and thus make them available.

KINDS OF ROTATION

It is always best for a man to follow some definite rotation of crops. The rotation I have followed very successfully in bringing up a run-down farm is what is known as a three-year rotation. Let me trace a field for three years,

then you will exactly understand. First year grain or canning-factory peas seeded with timothy and clover. Second year, clover meadow. Third year, plow the field and plant corn, potatoes or cabbage. "My," but you may say, "that makes a lot of plowing and just look at the grass seed expenses." I wish to reply by saying you cannot add humus to your soil more cheaply than by turning in a good clover sod every third year. If your clover cuts 3 tons of hay per acre, then you have left in your soil roots fertilizer equal in value to 15 tons of stable manure.

What will this cost in comparison with a four-year rotation? An extra plowing once in six years or every other complete rotation. The same will be true of the grass-seed expense. The extra plowing per acre once in six years costs about \$3.00, the grass-seed per acre (4 quarts of timothy and 8 quarts of clover) is valued at \$3.50, making a total of \$6.50 for two complete rotations, or \$3.25 for each rotation.

We have a clover sod every third year valued at \$30 per acre. In a four-year rotation we have a timothy sod every fourth year, valued at one-half as much as the clover sod or \$15 per acre. You can readily see that the value of the timothy sod for one year is \$3.75 and for three years it is \$11.25. Now take the value of the clover sod for the three-year rotation, which is \$30, and subtract the extra cost of plowing and grass seed, caused by using a three-year rotation, which is \$3.25, and you have the net value of the clover sod or \$26.75. Subtract from this the value of the timothy for three years, which was \$11.25, and as a result you have a net gain in favor of the three-year rotation of \$15.50; in other words if you will follow a three-year rota-

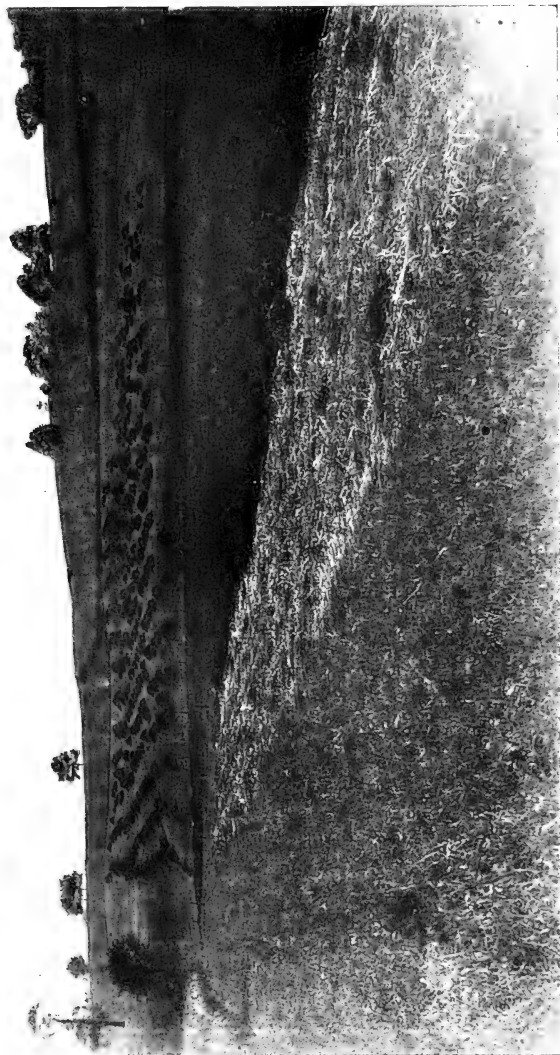


FIG. 2.—Results obtained by following a three-year rotation. Eight years ago in the field where the cocked clover is nothing grew but daisies.

tion you can add plant food to your soil per acre to the value of $\$5.16\frac{2}{3}$ cents annually.

NOTE.—Plowing figured at \$3 per acre, manure at \$2 per ton, clover seed at \$12 per bushel, and timothy at \$4 per bushel. I always think it pays to put timothy with clover when seeding, because there are some spots in almost every farm where one does not get a desired stand of clover every year. The timothy will come on and make a stand of grass and also furnish roots to be plowed under.

The crops on a four-year rotation will be about as follows: First year, grain or canning-factory peas; second year, clover hay; third year, timothy hay; fourth year, some cultivated crop—cabbage, corn, potatoes or beans. You might have a five-year rotation, having three years of hay, I think about the only case that this would be practical would be when alfalfa came in as the three years of hay.

It seldom happens that a man will use over one-half of his sod ground that he plows for a cabbage crop. You will readily see that this gives a chance to avoid putting cabbage on the same field only once in six years, or if he is using a four-year rotation only once in eight years.

CHAPTER II

CABBAGE SEED

WHERE GROWN

AFTER one has decided to grow cabbage, the question of seed at once presents itself. Where is cabbage seed grown? We always used to think that most of the late cabbage seed came from the old country, but in late years this country is producing a great deal of the seed used. It has been found that native seed is far superior to that which is imported.

Long Island, Oregon and Michigan, I believe, now produce a large share of the native-grown seed. The reason these three parts of the country and not the cabbage belt in general are growing seed is because these special sections have a climate adapted to wintering the plants out of doors with very little extra labor.

Where sections have produced cabbage and cabbage seed so continuously as those in the old country, it is no wonder that strains begin to weaken and diseased seed is obtained when purchased from that source.

I wish right here to relate a little instance which proved very conclusively to the cabbage growers of this country the difference in hardiness between native-grown seed and that which is imported. I was very much pleased to have the honor of breeding and growing the native seed.

One of our best farmers set two acres of cabbage from seed which was imported; he also set two more acres beside them in the same field from seed I furnished him. The soil on this four-acre field was all treated alike and had been for years past. The seed from each source was treated with a solution of corrosive sublimate to kill disease which often is carried on cabbage seed.

For some time this four-acre field looked to be the banner field of the county, but about the time the cabbage commenced to head, those plants from the imported seed began to show an occasional brown leaf. In a few weeks' time the whole two acres were worthless,—they had contracted the black rot,—while the two acres from native-grown seed were as healthy and strong as could be asked for. To my knowledge there was not a diseased head found among the plants grown from native seed.

SIZE, SHAPE AND VITALITY OF CABBAGE SEED

Cabbage seed is a little larger than the ordinary yellow mustard seed, although the various strains differ in size. It is usually a little shriveled when dry. By this I mean that it is not exactly round and smooth like a ball.

Owing to a peculiar oily seed coat, it is said that mustard seed would stay in the ground for twenty years, and at the end of that period, if conditions were right, it would grow. While the cabbage belongs to the same family, and has the same oily seed coat, its useful vitality is limited to about six years. After perhaps the second year the vitality quite rapidly decreases, therefore it is good policy to test seed before sowing.

Do not be satisfied with seed that will simply sprout; put them into some dirt and see if they will throw good strong plants. Often seed that will germinate between damp blotting paper or in a seed tester will not throw good strong plants. If I were forced to depend upon commercial seed I would purchase it one year ahead, and grow some cabbage, then I would know what I had before I set a whole field.

If you know of some one who is producing good seed from a good strain, by all means secure your seed from him. The price you have to pay is the very last thing to look at. It is certainly penny-wise and dollar-foolish to spend time and money on a crop, then use poor, cheap seed that would not produce a good crop under the best of conditions. I will assure you that the average crop will be poor enough if you do all you can to make it your best.

Our best potato growers want seed potatoes from stock that yields 500 or 600 bushels per acre. They have found that blood tells, even in potatoes. This same principle applies to cabbage. Seed from a strain that has yielded 20 to 30 tons per acre is far more valuable than seed from a strain that has never been tested out. (Fig. 3.)

Suppose you purchase seed enough for two separate acres of cabbage; the seed for one acre is common stock costing \$2.00 per pound, the seed for the other acre was raised from a high-yielding strain and cost perhaps \$4.00 per pound; now it will take about one-half pound of seed to insure plants enough for each acre; this makes the cost \$1.00 and \$2.00 respectively. You then set each acre, using about eight thousand plants apiece. The acre where

you used the cheap (\$2.00) seed grows cabbage heads that weigh about four pounds each, making a yield of 16 tons



FIG. 3.—Results obtained by using a high-yielding strain. Cabbage in this field yielded over thirty tons per acre.

per acre. The acre where you used the high-yielding strain will grow heads that weigh about five pounds each, making a yield of 20 tons per acre. Now then, you have

gained 4 tons of cabbage per acre, worth at least \$6.00 per ton. All this for the small investment of \$1.00 in a little better grade of seed; this leaves a net profit of \$23.00.

If it costs \$40.00 an acre to grow an acre of cabbage, one acre would cost \$40.00, and the other \$41.00, the gross returns from the acre where the cheap seed was used would be \$96.00, the net profit per acre would be the difference between \$96.00 and \$40.00, or \$56.00. The gross returns from the acre where the better seed was used would be \$120.00. The net profit per acre would be the difference between \$120.00, and \$41.00, or \$79.00.

I have tried this seed business out year after year, and I am positive the difference is no less than I have represented.

STRAINS NOT TRUE TO TYPE

A person not knowing about cabbage-seed raising will often wonder why he gets mixed cabbage, when he ordered only one kind. This is very easily accounted for. It often happens in the seed-growing districts that one neighbor will be growing Domestic seed, another neighbor just over the fence will be growing Danish seed. These two fields may cross-pollinate from wind carrying the pollen, but the chief reason is insects and bees. Perhaps some other neighbor will be growing Brussels sprouts seeds; if so, cross-breeding will take place and the result will be a worthless plant.

There are also many cases of seed getting mixed with other varieties after it is harvested; this often happens during retail trade.

CHAPTER III

LOCATING AND SOWING A CABBAGE SEED BED

FULLY one-half of all cabbage failures comes from things that can be traced to seed, seed sowing, or getting a stand of good healthy plants in the seed bed.

In choosing a location for the seed bed too much care cannot be exercised. The ground should be well-drained, mellow soil, and as free from weeds as possible. Never locate where there has been an old barnyard or where any soakage from one will get onto your bed; never use ground that has had cabbage or any other cruciferous crop grown on it for at least six years, because club root is more liable to develop.

Some are very successful by breaking up a piece of old pasture, and using this on which to sow their seed; under such circumstances one should be careful not to use ground that has had a lot of manure dropped on it by stock which have been fed diseased cabbage. Neither should the stock have run over some old diseased cabbage field, then across your chosen spot. Very often the poorest place for a seed bed is some nice wash land along a stream.

If you are in a section of the county that is not all level, the safest place is at least the first rise of ground. Do not locate at the foot of some steep bank or on any other ground where there will be danger from washing. Often

a good sharp shower has been known to ruin a seed bed. The mellow and looser the soil, of course, the easier the plants will take up at setting time.

FITTING THE SEED BED

If the land to be used is sod ground, fall plowing is always best, because you cannot get the capillary attraction thoroughly established with spring plowing, especially if the season is dry.

The plants have only a few weeks in which to grow before transplanting time, and it is very important that we control every factor in our power to get them ready at the proper time. Being a week or ten days late in transplanting often results in a great loss of moisture to the crop in a dry year. We never know when a dry year is coming. A very thorough preparation of the bed is necessary. The soil must be worked up fine and mellow if you expect a good germination.

Do not expect to put a seed bed in first-class shape when the ground is damp and soggy; choose bright, sunny days when the ground will dry as you stir it.

I like a good disk harrow to use in pulverizing the soil for a seed bed. If one does not have a disk harrow, a common spring-tooth harrow will answer. As soon as the seed bed has been leveled I prefer to sow my fertilizer so that the rest of the fitting will work it in. (See Seed-bed Fertilization.) I prefer to broad-cast my fertilizer, whether seed is to be broad-casted or sown in rows. (See Seed Sowing.) Having the fertilizer now on, proceed to work

the bed until the ground is very fine and mellow. If there are no lumps larger than a pea it is all the better. If the ground is lumpy a plunker (plank drag) will greatly help in pulverizing it. A common land roller will greatly help, if one does not have a plunker. Last of all, go over the bed with a spike-toothed drag, or some other smoothing harrow.

SEED-BED FERTILIZATION

Common commercial fertilizers are best for growing cabbage seedlings, especially if the ground has a fair supply of organic matter. It usually will have, when sod ground is broken up for a seed bed. If there is a lack of organic matter the best way to supply it is by applying well-rotted manure at the rate of 20 tons per acre.

There are several objections to using manure at all; it is apt to contain weed seeds, diseased cabbage, cauliflowers or some other cruciferous plant, thus bringing disease to the seed bed: it is also hard to get it worked into the soil evenly.

My rule for commercial fertilizer is as follows: For 1 pound of seed select 2000 square feet of ground on which apply 100 pounds of a good complete fertilizer with about the following formula:

Nitrogen.....	4 per cent
Phosphoric acid.....	10 per cent
Potash.....	6 per cent

If the ground is deficient in organic matter, and you apply the manure as above suggested, I would omit the

nitrogen supply, making the fertilizer formula read as follows:

Phosphoric acid	10 per cent
Potash	6 per cent

It is best not to use too much nitrogen, as it has a tendency to produce spindling, watery plants in a wet season. If the plants are growing too slowly, it is better to apply it later as described under "Transplanting."

For a plot on which you would sow a pound of seed, 100 pounds of very fine quicklime or wood ashes will be of value in sweetening up the soil and helping to hold in check any club root that might be in the ground. If air-slaked or ground limestone is used, the quantity should be double. If hydrated lime is used, use one-third more. The lime should be applied and worked in as early as possible; this gives it more chance to act upon the soil. If the ground is fall-plowed, apply the lime then, and work it in.

About 300 pounds of wood ashes would furnish the same amount of lime and also all potash needed.

AMOUNT OF SEED REQUIRED FOR ONE ACRE

There are about 136,000 cabbage seeds in 1 pound. This, however, is not a safe rule to go by when figuring the amount you need to get plants enough for one acre of cabbage.

Generally speaking, the average cabbage seed will not germinate over 75 per cent. The cabbage plant is at its weakest point when it is getting into the world. Quite a percentage of the seeds that germinate never get to be

large enough to set. Many die before they get through the ground, and insects destroy thousands of them.

The very safest way is to sow about twice as much seed as will ordinarily be required. I always say, allow $\frac{1}{2}$ pound of seed for every acre of cabbage you expect to set. One year with another you will save dollars by following a practice like this. If you have a surplus of plants you can almost always sell more than enough to pay for all your seed. There always has been and probably always will be a class of people that will not have plants enough of their own.

Then there is another very important thing about having a good supply—that is, you have a chance to pick out good healthy, stocky plants; the first pick of a seed bed is to be preferred. I think if there was nothing more to be gained than this, you have the satisfaction of knowing you started with the best. Start the best you can and you will usually end up poorly enough.

Many a man has bought diseased plants or stock that was not true to name, because he was not forehanded enough to have plants in abundance for himself. Some men make a business of growing plants for sale; there is quite a fair profit to be made in this way if a man will stick to it year after year. Some years a man cannot sell enough to pay for his seed and fertilizer, then perhaps the next year he will do well enough to more than make up. About all that is necessary to sell them is to do a little advertising in your local paper, and you will soon have a reputation for growing plants.

Danish stock usually sells for from 50 cents to one

dollar per 1000 plants. The earliest plants usually bring the most money. If early Domestic stock is raised they are usually started in cold frames; plants handled this way bring from \$3 to \$5 per thousand. Domestic stock grown in the open brings about the same price as the Danish plants.

WHEN TO SOW CABBAGE SEED

“When shall I sow my cabbage seed?” is a question very frequently asked. Of course the answer will vary, according to the locality and also to the kind of cabbage, whether Domestic or those of the Danish class. I can answer it only for my own locality, which is central New York.

As a rule, the Domestics want to be sown just as soon as the ground will permit; the young plants are quite resistant to any frosts that may occur. I do not recall ever seeing young plants damaged in the seed bed in the spring. For Danish seed, May 1 is a very satisfactory date, one year with another. This is about the time of early oat sowing.

If the seed bed is to be covered with a screen of cheesecloth, the seed sowing may be put off a week or ten days, as seedlings grow much faster under a screen of this kind. Further directions about screening will be given in a chapter on screening.

WHY SEEDS FAIL TO GROW

There are many reasons why seeds fail to grow and make good strong plants. Among the most common is improper depth of planting. Seed planted too deep, no

matter how strong their germination, will give a stand of weak plants. Plants which come from seed which is planted too deep must form a second set of roots near the surface of the ground; these are called aerial roots, and are necessary to the healthy growth of the plant. These aerial roots will grow as soon as the seed starts to germinate if it is planted at the proper depth. If planted too deep the young plants will not grow well until these aerial roots have formed. This means a standstill in growth of perhaps a week or ten days. Good cabbage seed that is planted $\frac{1}{2}$ inch deep will be very likely to germinate from 85 to 95 per cent. If this same seed were planted 4 or 5 inches it probably would not germinate over 5 or 10 per cent. There must be proper amounts of air, heat and moisture for best results.

Sowing seed and commercial fertilizer together is not to be recommended, for often the fertilizer is so strong that it will destroy the young plant roots. Seed put into lumpy, loose soil often will not germinate because of the lack of moisture; should it germinate under such conditions there is danger of losing many of them by the soil drying out before the plant gets deeply rooted. Do not plant too deep. The soil should be well firmed around the seed to insure proper moisture for germination. Seed sown just before a heavy rain do not come through the surface crust as readily, because they often do not have strength enough in their slender stems to lift it.

Cabbage seed may be sown too early in the season before the weather conditions are suitable to its germination; better plants will be obtained if sowing is put off until

ground and weather conditions are suitable. Often seedlings are destroyed by insects shortly after they come through the ground.

TREATING CABBAGE SEED FOR DISEASE

As a safeguard against introducing several very destructive cabbage diseases, one should always treat his seed with a solution of Bichloride of Mercury (Corrosive



FIG. 4.—Not a healthy head was harvested from this field. Seed treatment would have prevented this loss.

Sublimate) before sowing. (Fig. 4.) As heretofore mentioned, cabbage seed have an oily seed coat to which disease germs will adhere and be carried from one year to another.

If there were any disease in the stock from which the seed were produced, this disease will be very likely to be found upon the cabbage seed.

When cabbage seeds are threshed the whole plant is pretty well ground up, so that if there were any disease, the seed would be pretty apt to have some sticking on its oily seed coat.

One of my neighbors last year lost 11 acres simply because he failed to treat his seed. The damage does not stop here, for he has his ground infested with disease, which will carry for many years to come. This man sold a great many thousand plants to others, and of course they all had failures. Perhaps it would be a very good question to ask when buying plants whether or not the man treated his seed before sowing. I would not buy and set a plant from any one unless I was positive the stock was clean.

Here are the simple directions: To treat 1 pound of seed, dissolve one Corrosive Sublimate tablet in 1 pint of water; use an earthen dish for the work. Soak the seed fifteen minutes in this solution, then take them out and rinse in clean water. This rinsing is quite important, as the Corrosive Sublimate will prevent germination if allowed to remain on the seed. Now spread the seed to dry, but not in the sun or near artificial heat. The seed may be sown when damp, providing you do not want to use a seed drill.

The Corrosive Sublimate tables tmay be obtained from any drug store for about 1 cent each. These tablets contain $7\frac{2}{10}$ grains of Corrosive Sublimate and when dissolved

in 1 pint of water make a solution of 1 to 1000. The tablets are deadly poison and should be kept away from children.

SOWING CABBAGE SEED

Having our seed bed ready and our seed treated for disease, the next step is sowing the seed. Localities vary as to the methods they use; some sow all seed in rows, while others sow broad-cast. It is far more difficult than it seems to sow broad-cast, and do a good, even job. If you are going to sow broad-cast by hand, one will do a better job to divide the seed into two parts, then sow the bed over with one part of the seed, walking east and west, then sow the other part walking north and south. Some like to mix the seed with sand or fine dirt; this makes a larger quantity which may be distributed evenly with greater ease.

Seed sown broad-cast should be on as clean ground as possible, as they cannot be cultivated or weeded out. Generally speaking, the plants will be a little more stocky, as they are not crowded as much as in rows. Cover the seed as near $\frac{1}{2}$ inch as possible. A peg-toothed harrow is a good tool to use if the bed is of any size; if small, it can be covered by hand with a rake. If you are forced by continued rainy weather to sow your seed when the ground is damp, it is best not to roll the seed bed, otherwise the bed should be rolled or firmed thoroughly in some manner.

If the row method is adopted, the best way is to use a seed drill. There are a number of good drills on the market, such as Planet Jr., and Iron Age. In using the row

method, I prefer rows 6 to 8 inches apart, and the seed sown very thin in the row; from 4 to 6 seed per inch is enough if the germination is good. This thin sowing gives more stocky plants, which are to be preferred to tall, spindling ones. I think a man will get a few more plants from a pound of seed sown in rows, as the covering is more even.

There are a few sections where the soil is so heavy that the seed have to be covered with dry sand, otherwise the soil will bake so hard that the young plants cannot come through; under such conditions the row method is best. Some claim plants can be taken up better when seed is sown in rows. Of the two methods, broad-casting is the simplest and the one most used by the average farmer.

Never sow a seed bed when the ground is damp and soggy, if you can help it; the ground will bake and form a crust at the surface which will prevent the seed from coming through.

It is not wise to sow seed just before a heavy rain, on account of the crust which forms when the ground is drying out. Better wait until the ground has become dry enough to work again after the rain; sowing in damp ground and just before a rain causes more poor stands of plants than sowing poor seed.

CHAPTER IV

SCREENING

It is only of late years that the cabbage grower has been troubled with insects when trying to grow his seedlings. Perhaps I could not explain the matter any better than by quoting the summary of the Geneva bulletin, No. 334, by W. J. Schoene. "The important insects attacking seedlings are the turnip flea-beetle, *Phyllotreta vittata* Fab., which injures the leaves of the young plant; and the cabbage maggot, *Pegomya* Spp., which attacks the underground portion of the plant."

Cheesecloth conserves the moisture, increases the temperature, and in the early season furnishes a more congenial condition for growth. Plants raised under cheesecloth start sooner, grow faster, and obtain the desired size a week or ten days earlier than plants in the open.

Experiments show that screening completely protects the seedlings from maggot injuries, also that certain grades of cheesecloth will prevent injury by flea-beetles.

The experience of four years has shown that the use of cheesecloth is entirely practicable, the cost of protecting plants ranging from 6 to 20 cents per 1000.

THE FLEA-BEETLE (*Phyllotreta vittata* Fab.)

Many of us have often wondered where our young cabbage seedlings disappeared to, when they had only

the cotyledon on them; then we have often wondered what was eating the young plants, making them look so ragged. The turnip flea-beetle is responsible for the trouble. This little black beetle is not any larger than the head of a pin.

Since wild mustard has become so common, the flea-beetle has thrived pretty well, as this plant furnishes the majority of its food. Since the mustard and cabbage are germinating at about the same time, the starving beetles come from their hibernating quarters and begin to destroy the young plants.

Not only are the cotyledons eaten, but later the first leaves are often damaged; as a usual thing the danger period lasts only from five to seven days, or until the plants get their more hardy leaves.

The flea-beetle larvæ often damage the underground portion of the young plants by eating out the center of the stem. This work is often laid to the cabbage maggot, but upon close examination, you will see that the work is done by the flea-beetle larvæ. Both flea-beetle and maggot cause more trouble if the seed bed is located in a warm, sheltered place.

THE CABBAGE MAGGOT (*Pegomya* Spp.)

The adult of the cabbage maggot much resembles the house-fly. This fly deposits the eggs at the surface of the ground around the young seedlings. The eggs hatch and the young larvæ work down and commence to feed upon the root system of the plant; as a usual thing they do not attain headway in a seed bed until ten days or two weeks before setting time. At first one only notices a few withered

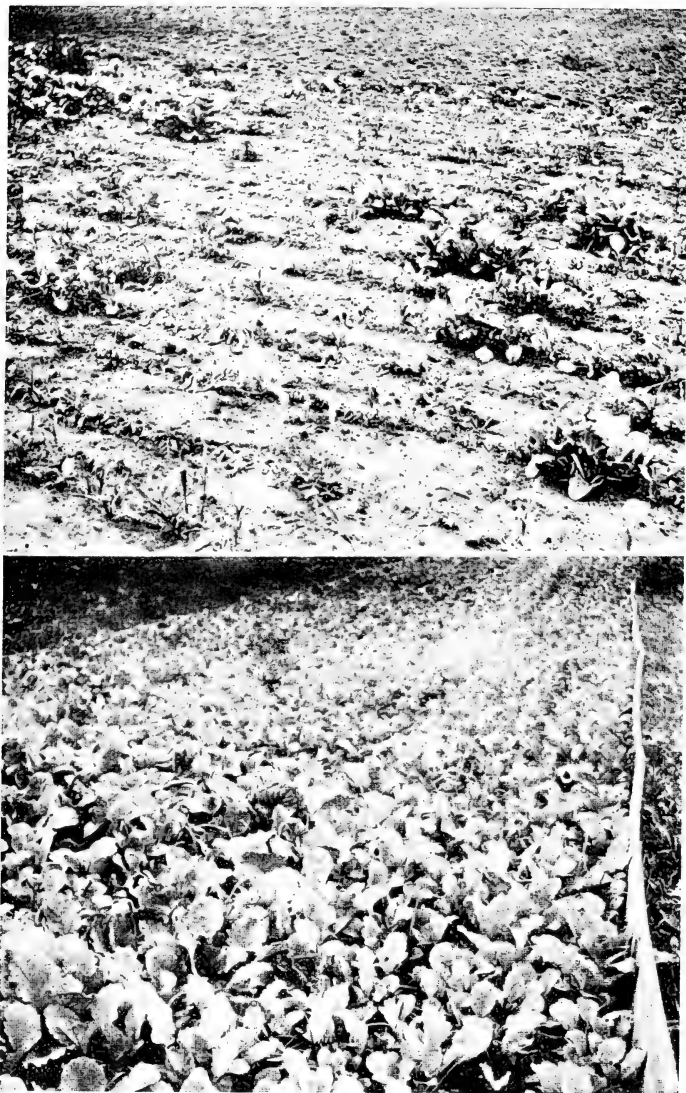


FIG. 5.—Note the protection a screen of cheesecloth affords against insects. Cut below screened. Cut above not screened.

plants; if the weather is dry and warm, the plants root slowly, then the maggots will destroy a bed in a few days. Many plants look all right until pulled, then you will discover they have only a few roots, usually not enough to carry them through the transplanting operation.

CONSTRUCTING A CHEESECLOTH SCREEN FOR A SEED BED

The work of screening consists of setting up boards around the seed bed over which cheesecloth is stretched and tacked about every 6 inches. Stake the corners of your bed before sowing; then, after it is sown, set up the boards around the edge. These boards may be any where from 6 inches to 10 inches wide; I think perhaps 8 is most desirable. There should be galvanized wires stretched across the bed about every 4 feet to keep the screen from sagging down on the young plants; in turn these wires should be supported about every 10 feet by a small stake. The wires can pass over the tops of the stakes and small staples driven in to hold them in place; do not use rusty wires, because they will wear holes through the cloth when it rests upon them.

Put the cheesecloth screen on as soon as you sow the seed; it prevents the ground from baking and the seed will germinate much better and faster. The amount of seed can be reduced one-third or more for a given number of plants if the screen is used. Care should be exercised not to sow seed too thickly under a screen.

Plants are a little more tender and watery when raised under a screen. To overcome this it is best to remove the screen a week or ten days before the plants are ready to

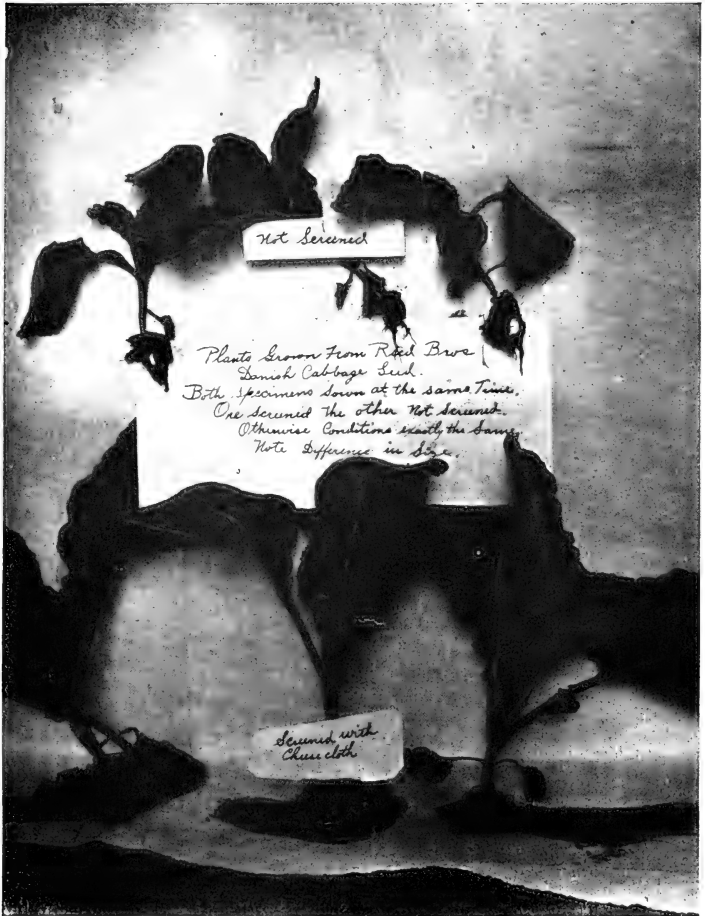


FIG. 6.—Upper plants grown in the open. Lower plants grown under a screen of cheesecloth. All other conditions the same.

set; the maggots cannot develop enough in this length of time to do any harm.

When the plants get to just about the right size, it is best to transplant, or they will get too large. Often, in a very few days, if the weather is warm and wet, the plants will double in size. If such conditions prevail you will have to be on hand to transplant, or they will grow tall and spindling, which is very undesirable.

I have been screening my seed bed for a number of years, and I am so well pleased with the results that if there were no insects to bother, I would continue just the same. You are almost sure of a good stand of plants under a screen, no matter what the weather.

One year it was so dry that the seed in an open bed would not germinate until the bed was wet artificially, but those under the screen came along all right. I proceeded with setting when the proper time came, as the plants under the screen were plenty big enough. Dry weather continued all summer, and in the fall I had the best piece of cabbage in the county. People came from far and near to see the piece. This piece harvested over 20 tons per acre and that year cabbage brought from \$15.00 to \$20.00 per ton from the field. It always pays to be on hand with a crop.

The best grade of cheesecloth to use for screening is that having from 20 to 30 threads to the inch. This same screen can be used for three or four years, depending upon the care you give it. A piece of paper placed under the cloth when sewing breadths together will help to make it feed freely through the sewing machine.

CHAPTER V

TYPE OF SOIL BEST ADAPTED TO CABBAGE— FIELD PREPARATION

THE cabbage, being one of our hardiest vegetables, will adapt itself to most soils; those of gravelly nature are not as suitable, because they lack the moisture-holding power. The crop often does best on a clay loam found on so many hills and uplands; perhaps the reason this type of soil was not used for cabbage-growing in the past was because it was not properly tilled and well fertilized.

In the past a great deal of cabbage-raising was done along the streams and in the richer valleys. This soil produced cabbage so many years that the yield is now greatly reduced. The soil has become "cabbage-sick," so to speak; disease has gotten in and the soil must have a rest.

While I cannot give you a set of directions telling just where you should put your cabbage every year, I may be able to suggest some things that will help in choosing a field better adapted to the crop.

First of all—do not put cabbage where you have recently had them, or any other cruciferous crop. It is better to have from five to seven years between two crops if possible. Fields flooded by a stream quite often develop club root. Do not put them on a field where wild mustard will club root.

KILLING QUACK GRASS

I prefer sod ground on which to grow my cabbage if I can get it. Most truck growers and farmers run some kind of a rotation and have more or less quack grass. From the sod to be broken up I would select for my field that portion where the quack grass is worst. Of course, if you have no quack grass, put your cabbage where you please, if other conditions are all right.

If you have a quack field, plow it the last of August just deep enough to get below all roots, give it a thorough dragging during the hot days in the fall, and work all the quack roots to the surface you can. If roots get so thick they clog a drag, rake them up with a horse rake and draw them off, or burn if they are dry. Do not be afraid to get down deep and do business with a sharp spring-toothed harrow. Let me say right here that a spring-toothed harrow is the only tool that is worth using for this work.

Put on three horses if you have them, and do a thorough job. Early in the spring plow this field again, deeply this time, perhaps 10 to 12 inches. Now the few remaining quack roots can be dragged out from this side of the furrows and the quack grass is conquered.

The reason we have always failed to kill quack grass in our crops is because of the few roots down in the soil below the harrow and cultivator. The under-roots throw up new shoots and of course new roots form from them. If the grower will use some method like the one here described and get out those under roots, quack grass is not hard to

handle. My farm used to be infested so badly that I thought at one time I would have to abandon some of the fields. By following the principle here given I have the quack grass completely under control.

PREPARING A FIELD FOR CABBAGE

In the preparation of a field for cabbage, always fall-plow if possible, as this gives more moisture to the crop. No other crop that the farmer raises requires so much moisture.

If you cannot fall-plow, do it as soon in the spring as the ground is fit. Do not put off plowing because the crop is not going out until some time in June. Commencing in the spring as soon as the ground is fit, it should be dragged at least once a week until setting time. Here is something that is of twofold importance; it not only conserves the moisture, but most of the weed seeds in the soil will germinate and be killed. You can kill more weeds with a harrow this way than you can by cultivating and hoeing half the summer. This is a point well worth keeping in mind.

Put your ground in mellow shape; it is a lot easier to do it with a harrow than with a cultivator and a hoe. Often the use of a plunker will work wonders in pulverizing lumpy ground. In some instances a roller can be used for the same purpose.

If a field has been properly fitted, you will never have to wait for a rain at transplanting time. Just under the surface of the ground it will be very moist. Most men

are inclined to slight field preparation. This is one of the most important steps in cabbage culture.

I cannot tell you just what tools will best prepare your field, because some soils need disking and rolling or planking to pulverize them, while others can be put in excellent shape by the use of either the spring-toothed or the disk harrow. If you are using a spring-tooth, do not expect to do good work with an old tool. I have seen men try to fit a field with an old spring-toothed harrow having no points on the teeth; in fact the teeth were half worn off. Honestly, they were wasting a good share of their time and not doing much more good than by dragging a cat around by the tail.

Throw that old harrow away or sell it to some one who wants one that will draw easy. Now get one with wide teeth on it, and be sure that they are set close enough together, so that they cut nearly all the ground. Some firms are making what they call an easy-draft harrow; they have narrowed up the width of the teeth, reduced the number, and set them farther apart on the frame. This kind of a tool cuts only part of the ground and leaves ridges of hard soil; weeds, having a tough stem like thistles, will easily slip through such a tool.

From five to eight harrowings are none too many for good fitting; the finer you can get your soil the more moisture you can draw up from underneath and retain for the crop. This moisture is of great help in dissolving plant food.

Some men are in such a hurry about fitting their fields that when they come to transplant they need a crowbar

to do the work with. If your ground is thoroughly fitted, the cultivator will work much freer, and there will be less danger of its jumping and damaging plants when you are working close to them.

Do not try to work land that is too wet, you will only pack it down and make it harder than it was before. If you do not believe this, drag some land that is too wet, then let it lay until it is well dried out; now plow it, and you will have a large, hard lump everywhere the horses put their feet when you were dragging it.

DITCHING

If you have fields on the farm that have wet spots in them they should be ditched before the cabbage are set. The crop is not put out until late in the season, and there are many days that are not suitable to work the soil that could be made to count well if they were spent in ditching.

I well remember two neighbors each having a field that was inclined to be wet in spots. Neighbor A said, he was going to run a little ditch in his field and then he would be sure not to lose part of his crop should the season be wet. Neighbor B said he guessed he would chance his this year, as he had cut some pretty good hay on those wet spots.

Well, the season happened to be unusually wet and the results was that neighbor A harvested a full crop of cabbage, if I remember correctly nearly 25 tons per acre, while neighbor B had only about one-fourth that amount.

The school of experience is a sure way to knowledge, but the tuition is rather high.

If you are going to do some work of this kind, use only vitrified tile, and let some one who knows how tell you about laying out your system. Any agricultural school can furnish you the information.

CHAPTER VI

FERTILIZATION

CABBAGE needs plenty to eat as well as to drink if we expect to get large yields. This does not mean that it needs wet land. It takes as much fertilizer out of the soil to grow 5 tons of cabbage per acre as it does to grow 20 bushels of wheat.

It takes about 1000 spoonfuls of water to make one spoonful of commercial fertilizer all available for a plant; now do you wonder that I have advised preservation of moisture in the preceding chapter?

I cannot give a formula for fertilizer that will fit every man's conditions, while it is true that many soils need the same kind of chemicals, yet one man's soil may need twice as much as another to produce the same results. The amount of organic matter in the soil plays a very important part in the fertilization question.

What does organic matter do for the soil? Organic matter is the life of the soil; it makes the soil loose and spongy. A soil in this condition admits air freely, which, together with the moisture it holds, breaks down the vegetable matter. When this operation takes place, there are acids thrown off which dissolve the minerals in the soil, such as, phosphoric acid and potash, and make them available for the plants. The more this breaking down

process can be stimulated, the more plant food will be liberated. A soil which is so full of organic matter that it feels light and soft will hold minerals in solution for a much longer period than a soil that is hard and gritty.

For cabbage I like to use a combination of stable manure and commercial fertilizer. For example, on a soil that is up in good heart, that is, one that has had sod or manure worked into it in previous years, give it a dressing of 10 tons of manure per acre and then apply broadcast from 800 to 1500 pounds of a fertilizer analyzing 2 per cent nitrogen, 10 per cent phosphoric acid, and 8 per cent potash. If you have a liberal supply of nitrogen that will become available for the crop, say a heavy clover sod, you might leave off the 2 per cent nitrogen from the above formula; use plenty of phosphoric acid and potash. These are the elements that form good hard heads. If no manure is at hand, simply increase the amount of commercial fertilizer.

In an ordinary season, there is little danger of getting on too much nitrogen, but in occasionally very wet years a very large supply is apt to make the cabbage grow too leafy and loose; as a rule cabbages need to grow firm and hard. This gives them good keeping qualities.

Two fields set side by side, the plants raised from the same seed and set at the same time, will produce cabbage that looks entirely different if nothing but the nitrogen supply is varied. Many times such variations as this have been laid to the seed producers when really the trouble was in the fertilization. There is always more of all fertilizing elements available in a wet year.

If there is a lack of nitrogen, which will be most noticeable in a dry year by the very slow growth of the crop, it may be supplied some time in August by giving the field a top dressing of nitrate of soda. This is very easily done by taking a small pail which is carried from a strap over the shoulder and, walking between the rows, turning small handfuls of nitrate through a grain tube taken from a grain drill. This tube is carried in one hand and held in front of you as you walk along. This method is far better than trying to sow it broadcast, as you will see none of the nitrate falls upon the large leaves of the plant. By holding the tube perhaps one foot from the ground, the nitrate will spread over a good share of the space between the rows.

METHOD OF TESTING FIELD TO FIND WHAT FERTILIZER IS NEEDED

Every man should make a few test spots on his farm to find out what kind of fertilizer and what amounts are most profitable to use. By the following method one can make a fair test of what his farm needs; it is better to take several years' average than to base it all upon one.

Somewhere in your cabbage field where the ground is as near average as possible, stake off 12 plots 25 feet square, number these 1, 2, 3, 4, 5, etc.

No.

1	apply	Nothing
2	20¢	worth of Nitrogen
3	20¢	worth of Phosphoric acid
4	20¢	worth of Potash



FIG. 7.—Cutting and weighing fertilizer test plots.



FIG. 8.—After the weights of each plot have been taken the variation in the size of the piles makes an impression which is not soon forgotten.

No.	
5	20¢ worth of Manure
6	Nothing
7	10¢ worth of Nitrogen
7	10¢ worth of Phosphoric acid
8	10¢ worth of Nitrogen
8	10¢ worth of Potash
9	10¢ worth of Phosphoric acid
9	10¢ worth of Potash
10	6 $\frac{2}{3}$ ¢ worth of Nitrogen, Phosphoric acid, and Potash
11	20¢ worth of Lime
12	Nothing

These separate plots should have their fertilizer sown on by hand and worked in, then treat them just the same as the rest of your field until harvest. At harvest cut each plot and weigh the heads, the three where you applied nothing will give you an average of what your ground will produce without fertilizer. By subtracting this average from each of the treated plots, you will have the gain caused by the treatment. From these results you can figure out an acre; 25 feet square or 625 square feet is approximately $\frac{1}{70}$ of an acre.

The cutting and weighing of a fertilizer test like this is often of interest to neighboring growers. (Figs. 7 and 8.)

SOWING FERTILIZER BROADCAST AND HOME MIXING OF FERTILIZER

Always sow your fertilizer for late cabbage broadcast. This causes the roots to run out in all directions, thus

increasing their root system. They are what we call gross feeders, that is, they feed by simply filling the soil with small roots. If you put the fertilizers in hills or in a small circle around each plant, there is very little tendency for the roots to run out in a large feeding area.

Do not be afraid to fertilize liberally; you will get enough extra cabbage to more than pay the cost of the fertilizer, if you use them for nothing but cow feed. Cabbage and buckwheat show the effects of fertilizer the most of any crop that I can mention.

There are several machines with which you may apply the fertilizer and have it evenly distributed. A common grain drill is all right, provided you drag the ground twice the opposite way from which you went with the drill. This cross-dragging will carry the fertilizer all through the soil, as you do not want it left in rows, which it otherwise would be, just coming from the drill teeth. Any of the fertilizer sowers or lime sowers will apply the goods in a satisfactory manner, but the fertilizer should be worked into the soil. Care should always be taken to keep the fertilizers dry, otherwise they will make all sorts of trouble when trying to apply them. I have seen fertilizers get so damp and sticky that some drying material such as plaster or dried muck had to be mixed with them before they could be sown. This is often the case with home-mixed goods, when a lot of nitrate of soda is used. Do not let this little warning about damp goods keep you from home-mixing your own fertilizer. It has been repeatedly proven that home-mixed goods are best and by far the cheapest. All the tools that are necessary are a pair of scales, a shovel,

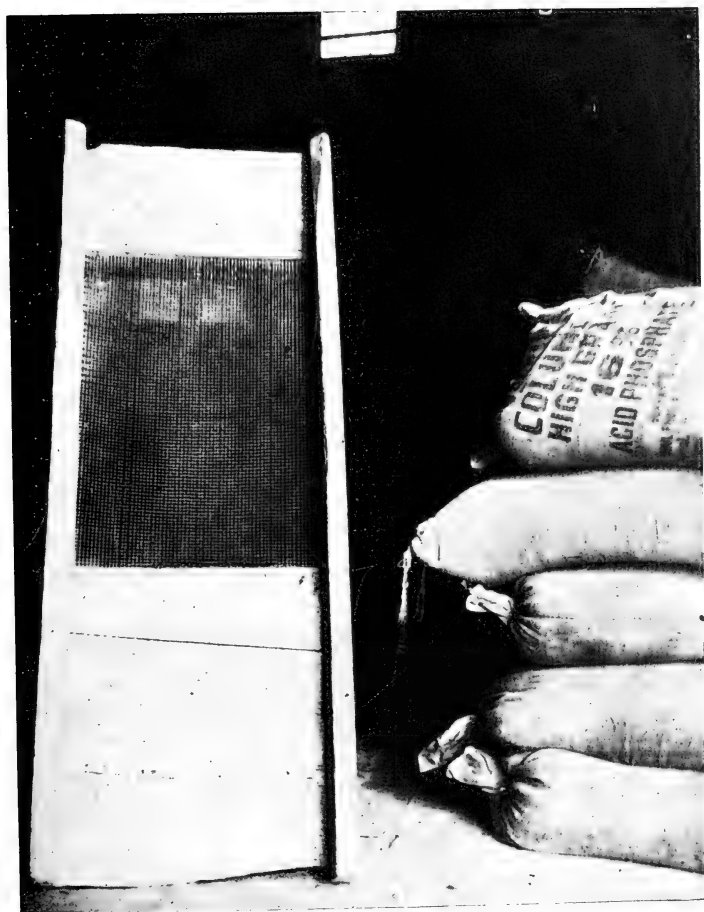


FIG. 9.—Home-made fertilizer screen. (Common sand sieve.)

and a sand sieve. A sand sieve may be easily made by tacking a piece of $\frac{1}{4}$ -inch mesh galvanized screen across two side pieces spaced about 20 inches apart (Fig. 9).

There is nothing more to home mixing of fertilizers than simply weighing out the required amounts of chemicals and shoveling them together a couple of times, then running them over the sand sieve to take out any lumps that might make trouble. Simply get the habit and you will always do it. The following table will be found of value to a person who mixes his own chemicals:

HOME-MIXER'S FERTILIZER TABLE

ANY FORMULA AT A GLANCE

Exact number of pounds of each material required for the equivalent of two thousand (2000) pounds of ready Mixed Fertilizer of analysis desired.

Percentages or Units Desired.	Ammonia from Nitrate of Soda, 18%	Ammonia from Blood, 16%	Ammonia from Cottonseed-meal, 7½%	Ammonia from Tankage, 6½%	Phosphoric Acid from Tankage, 7%	Available Phosphoric Acid.		Potash from Muriate of Potash, 48%	Potash from Sulphate of Potash, 48%	Potash from Kainite, 12%	Phosphoric Acid from Bone, 12%	Ammonia from Dried Fish Scrap and 10% Tankage.
						From 14% Acid Phosphate	From 16% Acid Phosphate					
1	110	125	267	308	285	143	125	42	42	166	166	200
2	220	250	533	615	570	286	250	84	84	333	333	400
3	330	375	800	923	860	430	375	126	126	500	500	600
4	440	500	1067	1231	1140	570	500	168	168	667	667	800
5	550	625	1333	1538	1430	715	625	210	210	833	833	1000
6	660	750	1600	1846	1715	860	750	252	252	1000	1000	1200
7	770	875	1867	...	2000	1000	875	294	294	1167	1167	1400
8	880	1000	...	...	...	1143	1000	336	336	1333	1333	1600
9	990	1125	...	...	...	1286	1125	378	378	1500	1500	1800
10	1100	1250	...	...	...	1430	1250	420	420	1667	1667	2000
11	1210	1375	...	...	...	1570	1375	462	462	1833	1833	
12	1320	1500	...	...	...	1715	1500	505	505	2000	2000	

AMOUNT OF FERTILIZER REMOVED BY ONE TON OF CABBAGE

The following table gives the number of pounds of fertilizing elements removed by one ton of cabbage.

Nitrogen, 4.8 lbs.,	equal to 32 lbs. of nitrate of soda
Phosphoric acid, 1.68 lbs.,	equal to 12 lbs. of 14% phosphoric acid
Potash, 8 lbs.,	equal to 16 lbs. of sulphate of potash

By looking at the foregoing table, one would think that instead of using a fertilizer for cabbage that analyzed 2 per cent nitrogen, 10 per cent phosphoric acid, and 4 per cent potash, you would need one with like results to those found in the table, which are 4.8 pounds nitrogen, 1.68 pounds phosphoric acid, and 8 pounds of potash. The reason for using so much more phosphoric acid than is found by an analysis of a ton of cabbage is that there is less available phosphoric acid in the soil than of either of the other elements. Generally speaking, most soils are deficient in available phosphoric acid. Phosphoric acid does not travel in the soil like the other chemicals, but remains just about where one puts it.

LIME FOR CABBAGE

There are few cabbage fields that will not be benefited by an application of about 1 ton of caustic lime (freshly burned lime) or its equivalent in one of the other two forms, raw ground rock or hydrated.

Lime in the freshly burned state contains the most

calcium oxide per 100 pounds (calcium oxide is the soil-sweetening element in lime) of any of the three forms of commercial lime, i.e., caustic, raw ground rock, and hydrated.

Taking freshly burned lime as a base or 100 per cent, the other forms are valued as follows: 100 pounds of lime rock when burned will make 56 pounds of caustic lime. Caustic lime is made by filling large kilns with alternate layers of lime rock and coal, and then burning the coal; the result is that there is 44 per cent of gas liberated from the rock, leaving 56 per cent of lime. This being the case, ground lime rock is worth 56 per cent as much as caustic lime. Hydrated lime is worth 74 per cent as much as caustic lime. This is made by slaking freshly burned lime with steam; the process adds about 18 per cent of water, one form being just about as valuable as another, according to their respective percentage of pure lime. Fineness of any form is an important thing; when buying lime one has to take into account the percentages of pure lime in whatever form one buys. Freight rates also will have to be considered, and cost of hauling and spreading. It can readily be seen that it will take nearly 2 tons of ground rock to do the same amount of good that 1 ton of caustic lime would do. Hydrated lime is about three-fourths as valuable as caustic lime.

Here is a fair range of prices to go by when buying lime delivered at your R. R. station.

Raw ground rock (very fine)	\$2.00 per ton
Hydrated lime	\$3.00
Caustic lime (lump form)	\$4.00

If caustic lime is used in the lump form just as it comes from the kilns, it will have to be drawn to the field and put in piles to slake. Under ordinary weather conditions, it will take a pile of about 1 ton six weeks to slake ready for spreading. If handled in this way it is usually loaded into a wagon box after slaking and spread by hand with a shovel. One ton before slaking will usually make about 2 tons afterwards.

Some take a manure spreader and fill about half full of manure, then finish out with lime. As a rule it is not a good practice to spread lime and manure together. The lime has a tendency to liberate the nitrogen in the manure so that it will be lost. Some slake their lime in a shed by turning water on the pile; this must be run over a screen if sowed other than by hand and must be dry. Generally speaking caustic lime is easiest handled in a ground state.

Any of the three forms that you decide to use should be applied broadcast and worked in. If you are treating a piece of ground for club root, from 2 to 4 tons of caustic lime will be necessary. The application should be made in the fall and worked into the soil as deeply as possible. (See Club Root, under chapter on diseases.)

CHAPTER VII

TRANSPLANTING FROM THE SEED BED TO THE FIELD

WHEN TO TRANSPLANT

THIS is a question that every one must decide for himself. There are several points to be considered when making up your mind what the proper time is. First, what are you going to do with your cabbage? If you want the cabbage to ear, that is, for shipment in the fall, they should be set in good season. In my locality, which is Central New York, this would be from the 10th to the 20th of June. If you are growing Domestics, a week or ten days earlier than the above date would be all right.

If you intend to store your cabbage, it is best not to have them too ripe, and setting may be put off a week. Generally speaking, July set cabbage will make only soft, light heads; cabbage of this quality is of poor flavor and is often strong and tough. Hard, crisp heads are always tender and of good flavor if they are grown from a good strain. (Fig. 10.)

The weather conditions have a lot to do with the time to set, also the amount of available plant food. The drier the season, the earlier you should set, and the harder it will be to have your plants ready on time. Early-set

cabbage almost always produces much harder and heavier heads. Did I hear someone say that if you set early, your cabbage would crack? There may be a very little truth in this, but for every pound of cabbage you lose



FIG. 10.—Cabbage at the right set June 15th; at the left, July 1st.

by the cracking of a few heads you will gain 10 pounds on the smaller heads; besides, you will have the cracked heads to feed or sell for chicken feed or sauerkraut.

I have heard many a man say, "I wish my cabbage had two weeks longer to grow. They are just doing fine."

LATE CABBAGE

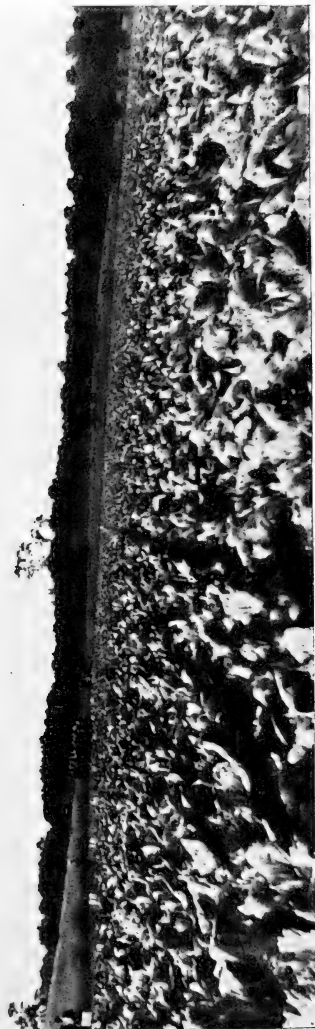


FIG. 11.—Produce a crop that you will be proud to show to your neighbors.

Let me tell you, the time to have those two weeks is in the spring. You cannot do business by that "Guess I will get a crop" method, and get a crop every time. (Fig. 11.) Some of the years when cabbage brings a good price because the crop is short you will be the loser if you let things go by the "guess so" method. You can tell by the way a



FIG. 12.—Field of Danish cabbage, July 1st. Success is assured here, as plants have a good start.

load of cabbage rides in a wagon what kind of a man grew the crop. A good load of hard cabbage will ride in a wagon just as if the wagon was loaded with stones, while a load of soft heads will bound along as if they were so many cushions. Punks, most growers call them.

I have seen two fields of cabbage set two weeks apart in a dry season; the early-set field produced nearly a full

crop, while the other one did not produce over one-half crop.

Here is the reason—when it gets about July first, in a very dry year, the sun has taken from the soil a large portion of the spring moisture, unless you have been more careful about preserving it than most men are. The early-set crop gets a good root system established, which catches a large portion of this moisture, but you must do your part with the cultivator and keep a dust mulch on the surface. (Fig. 12.)

APPLYING NITRATE OF SODA TO HASTEN SEEDLINGS

If you see your plants are going to be late, you can hasten them somewhat by giving them a dressing of nitrate of soda; if possible put it on just before a rain. From 3 to 5 pounds sown on broadcast will answer for a bed of 1000 square feet.

If the weather is very dry and there is no prospect of rain, dissolve 5 pounds in 100 gallons of water; apply this solution at night with a watering pot or any other convenient method. This solution will not be strong enough to burn the plants; of course more water would be better.

It will seldom be necessary to use any treatment on seedlings under a screen of cheesecloth.

TAKING UP SEEDLINGS

It almost always pays to loosen the seedlings when taking them from the seed bed. Do not think you are in such a hurry that you can tear the plants out of the ground,

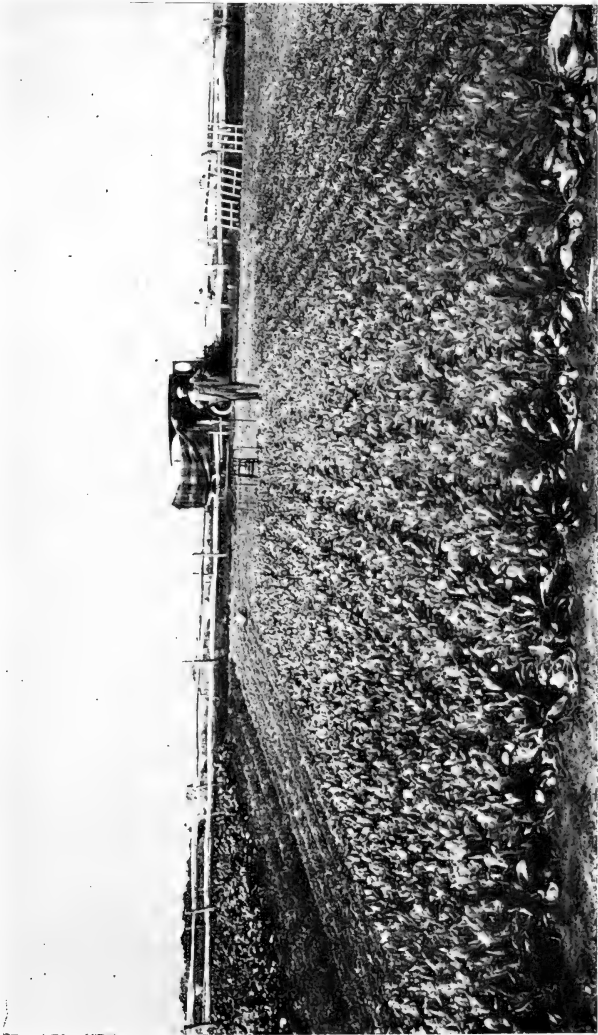


FIG. 13.—Good stand of plants. Seed bed sown in rows.

especially if it is dry, and then reset them and have them start quickly. If you destroy most of the root system, it will take a week to get a new one as large as the one you destroyed.

If the plants to be taken up are in rows, a common spading fork or manure fork will make a good tool to loosen them with—simply shove it into the ground beside the row and pry over on the handle. This method has one objection, that is, it destroys all the plants that are not of suitable size. (Fig. 13.) A method that is perhaps better, although not quite as rapid, and the one which is used in taking up plants from a seed bed sown broadcast, is to take a screw-driver and loosen each plant. After a little practice a man will work quite rapidly and the plants will have a fine root system left on them. All the small plants will be left for future use or to sell if the market demands.

Some of you will say this method is too fussy; maybe so, but it is the little things done at the right time that bring success to the great things.

As fast as you take them up, dip the roots in a pail of water; this will keep them fresh much longer and they will be more easily handled.

TRANSPLANTING AND TRANSPLANTING MACHINERY

What is the best method to follow when transplanting cabbage? The time used to be when hand-setting was thought best, but that time has long gone by. Perhaps quite a portion of the growers are using two-horse machines. The two-horse setter consists of a barrel mounted on two



FIG. 14.—Two-horse cabbage setter.



FIG. 15.—Two-horse cabbage setter in operation.

low wheels. At the rear of each wheel and very near the ground is fastened a seat; just under and in front of each of these seats, is fastened a disk or a small plow that opens up a furrow into which the plant is placed by the men on these seats; then back of each seat is an arrangement which fills up the furrow into which the operators have just placed the roots of their plants. Then back of all this there are a pair of wooden rollers, which pack the furrow around the plants.

From the barrel a lead of hose supplies a stream of water to the furrow just after it has been opened. (Fig. 14.)

This machine requires three men and a team to operate. (Fig. 15.) As a usual thing, the plants are set in rows only one way. I think it would be practically impossible to set plants as thickly as they should be where only medium small heads are wanted and row them both ways. This one way of rowing plants means that you must hand-hoe the crop, if you keep the weeds out of the rows. Most setting work with a two-horse machine is done very unevenly; the plants will be anywhere from 2 to 4 feet apart. If you ask the men what distance they are setting the plants the reply will usually be, from 20 to 30 inches on the average.

After the rig has set an acre or so, you just measure off 100 feet of a row, and then count the plants; nine times out of ten they will be much farther apart than the operator thinks. This uneven setting will account for some of the very undesirable large heads which some growers produce.

For satisfactory work with a two-horse machine a good steady team is necessary and two very painstaking men. With these last conditions good work can be done. Of

late a good many growers have been using the Masters hand planter. (See Fig. 16.)



FIG. 16.—Masters' hand planter.

This is a tool that for years has been used in the tobacco region. Of all ways to transplant cabbage the hand planter

is best in my opinion; the cabbage can be rowed both ways and it does not require a lot of help and water. I never have seen the weather so dry that one could not go right along with setting when the proper time came if his field was properly fitted.

The Masters hand planter consists of two tubes both of which open into a pair of steel jaws at the bottom. One tube carries water, which can be let out with the pressure of the thumb. The other tube is the one through which you drop the plants. The plants are carried in a little basket suspended by a string around the neck of the operator. Simply place the setter where you want to plant. Its weight will carry it deep enough into the loose soil; drop in the plant with your free hand, then press the water button and the operation is done. When you raise the machine from the ground you open the jaws, leaving the plant in the ground with a little water which seals its roots to the already moist soil. You see the pointed steel jaws on the lower end of the setter go down through the dry dirt on the surface and all the setting is done in the moist soil without disturbing the dust mulch on the surface. There is no packing of the ground, so that the sun will draw out all the water you put in and leave the plant in a baked, hard lump of soil.

Forty quarts of water are sufficient to water 1000 plants. What more could you ask than to have every plant set just where you want it, the roots being down in the moist soil with a little water and a dust mulch on the surface to prevent evaporation? You have not driven all over your ground just after it has rained, the way you often do

with a two-horse rig, and packed it all down. If you have marked your ground both ways, you can set the plants so you can cultivate both ways; this will let the cultivator keep down all weeds and no hard work will be necessary.

A man can work this setter much more rapidly when the ground is dry. I use the Masters hand setter, and raise over 100 tons of cabbage annually, having never done any hand work on my crops or had a weedy field of cabbage.

Three men with two of these setters, which only cost \$4.00 each, will set and water as many plants per day as a two-horse rig, providing the two-horse rig has extra men to pull plants and a horse to draw water. The Department of Vegetable Gardening of Cornell made an estimate on the cost of setting one acre of cabbage by the two methods.

TEAM SETTING

Cost of Setting 2 Acres

Setter double team and one man to drive . . .	\$4.00
Two men to operate setter @ \$2.00	4.00
Two men to pull plants and draw water	
@ \$2.00	4.00
Single horse to draw water	2.00
	<hr/>
Total	\$14.00

This outfit will set about 2 acres per day at a cost of \$14.00, or \$7.00 per acre.

HAND SETTING

Cost of Setting 2 Acres

Two men, each having a hand setter, @ \$2.00	\$4.00
One man to pull plants and draw water	2.00
Single horse part of one-half day	1.00
	<hr/>
Total	\$7.00

This outfit will set about 2 acres per day at a cost of \$7.00, or \$3.50 for one acre. There will be practically no skipped plants and every one will live, whereas by the team method there will be numerous skips and some plants will die which will have to be set in later, if a stand is maintained.

The cost of a team setter is about \$50.00, while 2 hand setters cost only \$8.00. The difference in investment, interest on money and depreciation of machines are all worth looking at. Not every man wants to purchase a two-horse setter; therefore if he sets with one he must hire. This means waiting until he can get one or perhaps setting when his ground is not fit or the plants are too large. The cost of these hand setters is so small that every man can afford to own one and set when he pleases. This is of great value at such a busy time of year. If there are several men on the farm, the team can be kept going at some other work, and you can still push cabbage setting. It seems as if there are a few facts stated here that every thinking man would grasp.

PROPER DISTANCE APART TO SET CABBAGE

The proper distance to set cabbage will depend upon the fertility of the ground, the size of heads you want, also upon the moisture supply, and time you set.

Soil in good tilth, well top-dressed, will usually grow medium to large heads, if the rows are 3 feet apart and the cabbage 30 to 36 inches apart in the rows. For small to medium heads, rows 3 feet apart and 18 to 24 inches in the row will be about right.

It is not usually satisfactory to place rows of late cabbage closer than 3 feet, as one wishes to cultivate quite late as a general thing. The market will call cabbage weighing from 2 to 4 pounds small, from 4 to 6 medium, and from 6 up large. Generally speaking, the medium to small heads are most marketable.

The following table gives the number of plants on an acre set at different distances.

No. of Plants		No. of Plants	
1 by 3.....	14,520	3 by 3.....	4,840
1 by 3½.....	12,446	2½ by 2.....	8,712
1 by 4.....	10,890	2½ by 2½.....	6,970
1½ by 1.....	29,040	2½ by 3.....	5,808
1½ by 1½.....	19,360	3 by 3½.....	4,148
1½ by 2.....	15,520	3 by 4.....	3,360
1½ by 2½.....	11,616	3 by 5.....	2,901
1½ by 3.....	9,680	3 by 6.....	2,420
1½ by 4.....	7,790	3½ by 3½.....	3,556
2 by 2.....	10,890	3½ by 4.....	3,112
2 by 3.....	7,260	4 by 4.....	2,722
2 by 3½.....	6,223	4 by 6.....	1,815
2 by 4.....	5,415		

CHAPTER VIII

CULTIVATION

PERHAPS it is useless to talk a great deal about cultivation, as this is a subject that is discussed by every agricultural paper of the day. At the same time, I wish to say a little that is of vital importance to this special crop.

There are few other crops that show the results of cultivation as much as does the cabbage.

When I was a boy, my father used to let me have a piece of land on which to grow turnips. I used to govern the size of the turnips by the number of cultivations I gave them; that is, if, with the average number of cultivations, the turnips were not getting the satisfactory size, I would cultivate oftener. I think this practice applies exactly to the cabbage crop.

After every rain there will be a crust formed at the surface of the ground; this means that there will be a direct communication from the up-coming soil water to the atmosphere. This upward movement of soil water is what we call capillary attraction. We all know that when we break the crust and form what is called a dust mulch we check the loss of water from this source; when checked by the mulch, of course, the plant roots have a chance to take it.

After every cultivation, new water passages commence

to form, as a result of the up-coming water dampening the under side of the dust mulch. Repeated cultivations, even though it has not rained, break these water passages, and the result is, you save more moisture for your crop.

Cultivate from 8 to 12 times or more if you like. Each time you loosen up the surface, you give the crop more air and also check the evaporation.



FIG. 17.—Planet Jr., cultivator rigged for shallow work.

Plants need plenty of air; one reason why a plant will not grow well on wet land is, because the soil is so full of water that the air cannot get in to aid the liberation of plant food.

The cabbage plant simply fills the soil with roots, there-

still maintain a good dust mulch. Fig. 17 shows a Planet Jr. cultivator rigged for shallow cultivation.

If some one had told you that you could harvest 18 tons of cabbage per acre if you would cultivate shallow, or only 12 tons if you cultivated deep, I am sure you would rig your cultivator for shallow work. Well, now,



FIG. 18.—Spike-toothed cultivator, used where the rows are narrow.

this is just about what the results are between the two methods. It is best to set cabbage in rows both ways, or check-row them, as it is often called. This will permit the use of a cultivator in keeping down all weeds between the plants as well as in the rows. Where the plants are closer together than 24 inches in the row, I use a spiked-tooth cultivator in going crosswise of the rows; usually one cannot get through more than twice or three times

crosswise, as the leaves will be too large. While the plants are small, the deep cultivation the spike-tooth will give will do no harm, as the ground has not yet become filled with roots (Fig. 18).

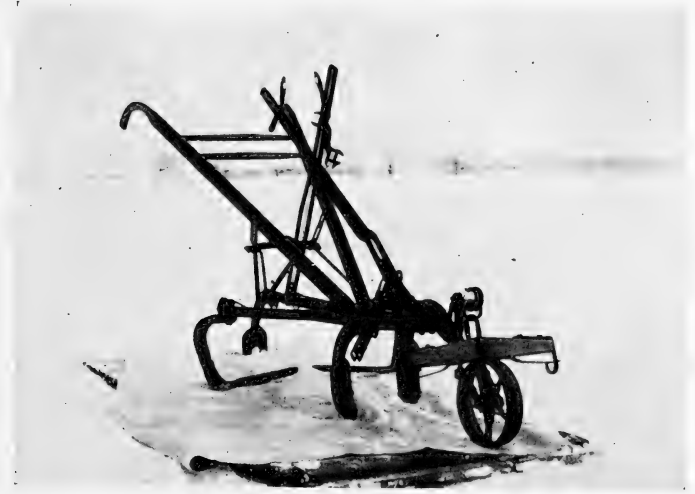


FIG. 19.—Planet Jr. cultivator with hoes turned in. Used when cabbage are small if one wishes to get very close to the plants.

When I commence to go the wide way of the row I turn the long end of the hoes or blades in on the back legs of the cultivator. This allows me to get very close to the cabbage once or twice, and get what few remaining weeds there may be (Fig. 19). Now, for the rest of the season turn the long end of the hoes out and you will find that you can cultivate so as to stir most of the surface dirt, even

under the large cabbage leaves, without breaking them off. See Fig. 17.

Keep the cultivator going all the season. If the plants get very large, so that the leaves touch each other, I would choose the heat of the day for cultivating. Say, from 10 A.M. until 4 P.M. During this period the cabbage are a little wilted and will not break as readily. The cells are not quite so full of plant juice and this makes them a little more flabby.

I do not like the two-horse cultivator for cabbage, nor any other machine that breaks the leaves or disturbs the plant.

CABBAGE CRACKING

In a dry season very frequent cultivations will prevent the plant from forming a small, hard head. If small, hard heads are allowed to form, they will almost always crack open if the weather turns wet in the fall, as it often does after a dry summer. The aim is to keep the plant growing freely.

A few weeks before harvest a field often has quite a number of heads that crack and the longer the field stands the more heads there are that continue to crack. Here is a case where a very deep cultivation will do some good. It will break off a lot of the plant roots, thus stopping them from growing so rapidly. Another remedy is to take a four-tined fork and go over the field and loosen all plants that show signs of cracking. Place the fork tines straddle of the stump and raise up with the handle to the fork.

This will turn the cabbage half-way over, thus breaking a lot of the roots.

In this chapter we have found that we cultivate for four distinctive reasons:

1. For the preservation of moisture.
2. To kill weeds.
3. Admission of air into the soil.
4. Preventing bursting of mature heads in certain seasons.

CHAPTER IX

INSECT ENEMIES

LIKE many other of our vegetable crops, the cabbage has an insect pest, which commences to feed upon it as soon as the cotyledons are out of the ground. There seems to be quite a succession of pests to fight, even up to the time the cabbage commences to head.

FLEA-BEETLE

The flea-beetle (*Epitrix cucumeris*) is the first insect enemy the cabbage has. It is a small insect about $\frac{1}{12}$ of an inch long with a black body and dull yellow legs. Its legs are very stout and will enable the beetle to jump like a flea if it is disturbed; this is where it gets the name "flea-beetle."

The flea-beetle commences its work on the young cabbage plants as soon as they are out of the ground. While it is a biting insect, it is not effectively controlled by poisonous sprays; to protect the young plants the most effective method is the use of the cheesecloth screen. (See chapter on Screening.)

There is also another quite effective remedy used; this consists of the use of some very fine dust, which is applied to the young plants while the dew is on, as it sticks better

when the plants are damp. Very fine dry lime, wood ashes, soot, and land plaster are all used with about equal success.

A person usually needs to be quite watchful of his seedlings for the first week, as these beetles seem to come without warning. They winter over in the winged stage, and are all ready for business upon the first appearance of the cabbage seedlings; they also feed upon the tomato and potato. Keeping fields cleared from rubbish will help to lessen their wintering quarters. The female beetle lays eggs in the soil in June or July, which hatch into small, slender worm-like larvæ; these larvæ feed upon potatoes and other fleshy roots. It was formerly believed that there was but one litter of brood here in the north, but it has lately been found that there are eggs deposited early enough in the spring so that the larvæ damage the cabbage seedling root to some extent.

THE CABBAGE MAGGOT

Of all insects that trouble the cabbage, I believe the maggot (*Pegomya brassicæ*) is the worst. The parent insect of the maggot is a fly, resembling the common house-fly but somewhat smaller. This fly deposits its eggs near the stems of the cabbage plants when they are only a few weeks old. These eggs hatch into small white larvæ or maggots, which at once commence to feed upon the root system of the plants. Very frequently whole seed beds are ruined by their work. (See Fig. 5, chapter on Screening.)

In three or four weeks the maggots get their full growth and change into brown oval objects called puparia; in about two weeks more an adult fly emerges and is ready

to start a second litter of brood. The insect passes the winter as a puparium in the soil; the second litter of brood often make considerable trouble with cabbage after they are set in the field.

There are several methods of treatment that are effective; screening the seedlings with cheesecloth is a positive prevention. (See chapter on Screening.) The next most effective remedy is spraying of the plants in the seed bed and all foliage nearby with the following solution: One-fifth ounce white arsenic, 1 pint molasses, and 1 gallon of water. This application should be repeated once in seven days and also after every rain. This solution will be eaten by the flies which come to lay eggs; as a result they will be killed, therefore no maggots will be produced. I think if a bee-keeper lived nearby, it would be wise not to use this method, as it probably would cause him considerable damage, for which one might be liable. A trap crop of radishes sown ten days ahead of the cabbage and kept sprayed with the white arsenic solution is also very effective.

If the cabbage plants are in rows, and the maggots are already at work, one-third of the dirt on one side of the rows may be removed, and a 10 per cent solution of crude carbolic acid and water applied which will kill the maggots; after the application replace the dirt again.

If the maggots are at work on the plants which are set in the field, apply the carbolic acid solution to each plant.

Placing a small tarred paper pad around each plant has been recommended. This method is practical for small areas.

CUTWORMS

After setting the cabbage seedling in the field, one often finds many plants cut off just at the surface of the ground. The cutworm is usually the cause of the trouble. There are several species of cutworms. They are the larvæ of the night-flying moths; these moths usually lay their eggs in sod ground in the late summer or early fall. The eggs soon hatch and the little worms feed upon grass roots and the like until cold weather. In the late fall they go down deep into the ground and stay over winter. By cabbage-setting time in the spring they are large enough to eat off the stems of quite large plants. They usually come to the surface of the ground to do their work. Most all feeding is done at night and in the day time they lay hidden under rubbish or burrow down in the ground near the plant.

For large areas, fall plowing and thorough spring preparation will destroy large numbers. For small areas, prepare fresh-cut clover or small bunches of cabbage leaves and soak them in Paris green and water, or some similar poison, and scatter these over the field before the cabbage are set. Be careful that poultry or stock do not get this poisoned material.

Another means of protection for small areas is to wrap stiff paper around the stem of each plant; these papers should extend into the ground about $\frac{1}{2}$ inch and at least $1\frac{1}{2}$ inches above ground.

For a field already set, where the worms are at work quite badly, the following will be found very effective:

Make a poison bait of ten pounds of bran, 1 pound of White Arsenic or Paris green, moisten with just enough water to make the material hold together; to sweeten the mixture add a quart of cheap molasses. A small handful of this bait should be placed near each plant in the evening, so that the worms will be attracted to it during the night.

MAY BEETLE

(*Lachnosterna fusca*)

The large, dark-brown, night-flying May beetle is familiar to almost everyone. It lays its eggs in May or June among grass roots. In about one month these eggs hatch, and the larvæ begin to feed upon roots of all sorts. They continue to feed and grow summer after summer until the third year, when they change back to a parent beetle again. During the winter they burrow deep into the ground and remain dormant in a sort of egg-shaped earthen cell.

It is in the larval state that the damage is done to the cabbage crop. These larvæ, or more often called potato grubs, will eat off the roots of a cabbage plant, causing its death. They work a great deal worse in ground that has not been plowed for several years, such as where an old pasture or meadow of three or four years' standing is put to cabbage. Fall plowing and working of the land are of value in destroying the pest. It is often advisable not to put land of this kind to cabbage the first year after it is broken up. Sow it to millet or something of that sort the first year, then put it to cabbage the following year.

CRICKETS

The common black cricket often makes considerable trouble in a field of cabbage just after the plants are set. Their work is often confused with that of the cutworm. They attack the stem of the cabbage plant and eat a portion of it away; often they cut it entirely off. They hide under stones or rubbish of all sorts and are always ready for mischief.

In a field where they are making trouble, it is best to start the cultivation as soon as possible; this seems to drive them away and break up their hiding places. Start the cultivator in the center of the field and work towards each edge. If they are noticed jumping around while the cabbage are being set, it is a good plan to dispose of them. The use of a bran mash the same as described for cutworm will be found valuable.

GREEN CABBAGE WORM

(*Pontia Rapæ*)

We have two species of the green cabbage worms. One a native, the other a European pest. The butterflies are very much alike for both species, there being only a slight difference in the wing markings; they are nearly white when young with a few dark spots on the wings.

According to Sempers, as the butterflies age they change to a yellower color. It is a very common sight to see them flying over a cabbage field. (Fig. 20.)

The eggs are laid on the under side of the leaves and

hatch in about one week. The worms from the two species differ in color, the imported species being green, while our native one is pale blue with yellow stripes. The little worms grow very fast as a result of their very rapid eating; in about two weeks they get their full growth and transform into a chrysalis. In this state they stay from one to two weeks, whence they hatch into a butterfly again. There are



FIG. 20.—Imported cabbage worm. *a.* Larva. *b.* Chrysalis. *c.* Male butterfly. (Riley.)

usually about three litters of brood during a season, and the last one passes the winter in the chrysalis stage.

The pest seldom does as much damage as a person thinks when he looks at the ragged leaves which they have made.

They may be controlled by spraying with arsenate of lead, 3 pounds to 50 gallons of water, or with Paris green, 1 pound to 150 gallons of water; a little Bordeaux sticker added to the solution will help to make it adhere to the leaves better. The following is the formula for the sticker:

2 pounds resin, 1 pound sal-soda and 1 gallon of water; cook over a slow fire until it is an amber color.

This poison may be put on dry if desired, 1 pound Paris green mixed with 20 pounds of air-slaked lime or flour, applied with powder gun or sifter. It is best to make the application when the dew is on, as the powder will stick much longer; there is little danger in applying poison to cabbage before the heads are half-grown. The plant grows from the center and none of the outside leaves ever fold to make the heads.

There is a practice often followed which will be found of value in destroying the first crop of worms which hatch. If the first crop is destroyed, a great reduction will be made in the butterflies which lay the eggs. Put $\frac{1}{4}$ pound of arsenate of lead in a pail of water, into which the tops of the plants are dipped as fast as they are taken from the seed bed; this coats over the entire plant, so that any worms which might hatch from eggs upon these plants will be destroyed.

OTHER LEAF-EATING WORMS

There are several other leaf-eating worms which are appearing in various parts of the country. The Cabbage Plusia worm (*Plusia brassicæ*) is one that is making some little trouble; it eats irregular holes in the leaves and also burrows into the heads of cabbage. When full grown, it is about 2 inches long and of a pale green color with paler longitudinal stripes on its sides and back. It belongs to the measuring worm or looper family, as this is the manner in which it travels.

Any of these leaf-eating worms which appear early in the season may be treated the same as the green cabbage worm. If they are troublesome, when the cabbage have attained considerable size, the use of pyrethrum or hellebore is recommended. Hot water at a temperature of 130 degrees F. will kill all such worms which it reaches.

CABBAGE APHIS

(*Aphis Brassicæ*)

The cabbage aphis or louse is a very peculiar insect, usually covered with a flour-like powder. The adult is not much larger than the head of a pin; some of them are winged and some are not; in shape they resemble the rest of the louse family. They have great powers of reproduction, rearing from 12 to 20 litters of brood in a single season, and in turn the young multiply when only six days old. The female lice can either lay eggs or produce young alive; it takes only a few lice to soon rear a large family.

In certain dry, hot seasons they seem to cause considerable trouble with cabbage and cauliflower; the lice seem to be in families or colonies and have power to curl the leaves so that they are difficult to get at. Being a sucking insect they must be controlled by some contact spray, the following being very satisfactory: Take $\frac{3}{4}$ of a pint of Black Leaf 40, 4 pounds of dissolved soap, and from 60 to 80 gallons of water.

Small fields may be sprayed with a knapsack sprayer, but for large areas a power orchard outfit with two leads of hose does best work. The plants require a thorough

wetting of both sides of the leaves and also in the center of the plant; two applications of this kind will entirely free a field from lice. Sometimes a little squirt hand spray can be used to advantage when there are only a few scattered patches. Kerosene emulsion will also kill the lice.

A few lice on an occasional seedling at setting time will spread the pest pretty evenly over an entire field. The pest is often best controlled by killing these first lice on the young plants.

Here is a very effective remedy: Take a twelve- or fourteen-quart pail of Black Leaf 40 solution made by the above formula, and as fast as you pull your plants dip the tops into it; this will kill all lice and prevent spreading from this source. By adding $\frac{1}{4}$ pound of arsenate of lead to each pail of Black Leaf 40 solution, you can treat the plants for green cabbage worms and plant lice at the same time. (See Green Worms.)

All sucking insects breathe through pores in their bodies, and by using some spray solution which has an oily or soapy nature, you can coat them over, which will close these pores and smother the insects.

SOFT-SHELLED SNAILS

In the past few years this slug has been causing some damage to late cabbage after the heads are nearly mature. The slug much resembles the shelled snail, except that the shell is missing; they are a slimy, oval-shaped slug, sliding along in the same manner as the shelled snail, eating at random on the head when young. They often grow to the

size of a chestnut, and it is when they attain this size that the very worst damage is done. They will burrow down into a head $\frac{1}{2}$ inch or more, making it look very unsightly. Later most of the eating will be done on the under side of the head, because here they are protected by the outer leaves; this is especially true when the weather gets cooler in the fall. In cool, damp seasons this slug makes the most trouble.

The snails do not stay on the cabbage all of the time, but may be found in the day time hidden under stones or rubbish near the plants. Probably most of their eating is done at night. Their work is often confined to certain portions of a field; this being the case, they may be destroyed in small fields by furnishing hiding quarters for them, such as small pieces of boards or stones. The snails will hide under these during the day time and may be destroyed by removing their shelter and killing them. Very likely many of them could be destroyed by scattering bunches of poisoned cabbage leaves or clover through the portions of the fields where they are making trouble. (See Cutworms.) Spraying is not to be recommended, as the cabbage are usually too near ready for harvest, and it would not be safe to use poison.

If there is a fair market for cabbage, it would be advisable to cut the portion of the field where the snails are at work and sell them; under the circumstances this has been found about as satisfactory as anything. The remaining portion of the plant will keep the snails from searching for food elsewhere.

If the cabbage are stored, some of the snails may be

carried into storage under the loose outer leaves; these seldom do much more damage unless the storing is done very early. Cabbage which have many holes eaten into them had better be sold as damaged stock, rather than be put into storage, as these holes will only furnish places for decay to start.

CHAPTER X

CABBAGE DISEASES

THERE are several diseases of the late cabbage that every grower should be familiar with for this reason, i.e., most diseases of the cabbage are contagious and have the power to live in the soil for a lengthy period of years. One of these diseases, known as "Wilt, or Yellows," has been known to live a period of fifteen years; most of the diseases cause a greater per cent of loss to the crop than diseases of other crops. Once they get a foothold on a crop, they sweep with unabated fury. I saw a neighbor who was an expert grower set 11 acres, using plants that showed only a little disease, and lose his entire crop. The loss did not stop with the present crop, but the soil is infested for years to come. Once soil is infested it is pretty hard to keep from spreading the disease to other fields through dirt on farm machinery; animals will carry it on their feet and with some of the diseases it can be spread by feeding the diseased plants to stock, then spreading the manure on new fields. Soil washing from one field to another is also a means of spreading disease.

CLUB ROOT

Almost every person who has had a garden to work with is familiar with club root on some cruciferous plant

he has grown (Fig. 21). The lower end of the main stem of the plant enlarges into an irregularly shaped mass; with



FIG. 21.—Club-root of cabbage.

the cabbage the plant grows little if any, and usually has a pinkish look.

It is a slime mold disease (*Plasmodiophora brassicæ*)

and has the power to live in the soil for a period of about six years only, if the ground is kept free from cruciferous crops during that period. It is more prevalent during wet seasons, and the disease will often develop on wet low ground.

Plants from a seed bed which show only a trace of the disease should not be used for setting, as they will only inoculate the whole field into which you set them.

Any means by which soil or water from a diseased field is transferred to a healthy one should be avoided. The best cure is a long rotation of the crop upon diseased fields, say about six years, and in the meantime keep the soil free from any cruciferous crop and from the weed, "mustard."

Lime greatly helps to hold it in check. The use of from 2 to 4 tons per acre of caustic lime, or its equivalent in other forms, is recommended. The application should be made at least six months before the crop is set; this will give it time to act upon the soil. It should be worked in the full depth of the furrows if possible.

If a field is put out to cabbage two years in succession the crop will be pretty apt to show the disease more or less the second year, even though none was present the first year. Low land along streams is subject to the disease, especially if it floods some time during the year.

Do not forget to rotate the seed bed; you cannot grow a healthy crop from plants raised in a diseased bed. The disease is widespread and causes the loss of a great many acres annually.

BLACK ROT

Black rot is caused by the bacteria *Bacterium campestre* (Pammel). This disease causes nearly as much loss to growers as does the club root; it is, as its name implies, a rotting of the plant; the plant may be affected while it is still in the seed bed. The disease is bacterial and usually enters the plant through the water passages which are found at the ends of the veins at the margin of the leaves. In a few cases infection takes place through the roots; the disease is also spread by dust in the air, insects, water washing from one field to another, dirt on animals' feet, manure when diseased cabbage have been fed, and it is very readily carried on the seed, if the seed is grown where the disease is present; it will stick to their oily seed coat and be transferred with them. (See Seed Treatment, Chapter IV.)

I have seen a great many acres of cabbage lost just because people were careless about the sources of their seed, or they neglected to treat it. (Fig. 22.) An affected plant first shows portions of its outer leaves turning yellow; later these portions turn brown and dry up. Take an affected leaf from a suspected plant and cut off the lower end of the midrib, and if the disease is present the water passages will look black; in bad cases the stump has a black ring just inside the woody portion; this may be seen by cutting a cross-section. The center of the stump or pith may be entirely rotten. The bacteria seem to follow towards the center of the plant as soon as they enter the leaves. Once the disease gets into the head, if there is one, rotten

leaves will be found scattered here and there, and often the whole head rots and falls off. Plants may be only slightly affected and the heads look perfectly sound, but after a period of storage the head will be rotten inside.



FIG. 22.—Field affected with black rot. Some plants look all right, but close examination shows the main stem affected.

There is no known cure for the disease. A rotation of about four years is necessary before cabbage are grown on diseased soil again, usually the bacteria will not live in the soil longer than this period. A cold, damp season seems to help propagate the disease very rapidly.

We find the disease more in the older sections, especially

where they have been growing seed for years. There is also a difference in strains of cabbage about contracting the disease; the strain I have been growing, so far, seems to be very resistant to the disease. (See Cabbage Seed, Chapter III.)

WILT OR YELLOWS

This disease is caused by a microscopic organism (*Fusarium* sp.)

It enters the plant through the roots and works up the stem to the leaves. The lowest leaf is the first to be affected; the whole or only part of the leaf may be affected. First it turns yellow, then brown, and finally drops off; this course is followed right up the plant, until only the head is left. The little buds on the stem often start to grow if the head is of much size, the same dying of the leaves is noticed if the plant is affected in the seed bed.

Browning of the woody portion of the stem is another characteristic; it spreads by any inoculative means, including disease on the seed. Water from a ditch out of a diseased field, if used for setting plants, will spread the disease. All seed should be treated, if their source is not known, as described in Chapter IV.

The duration of the disease seems to be much greater than that of the black rot, as fifteen years between two crops has not been long enough to cause the organisms to die.

Ohio and Wisconsin have had the most trouble with the disease, but it is fast spreading to New York State. Some of the seed-growing districts have it, so it is well to

be cautious. Many localities that paid no attention to it when it first started have had to give up growing cabbage entirely. Keep your soil free from this disease—it is surely worse than weeds.

BLACK LEG OR FOOT ROT

Black leg is caused by a fungus called *Phoma oleracea* Sacc. The infection takes place anywhere on the stem and also at the margin of the leaves, or anywhere there is a wound on the plant. The disease always works down and causes the decay of the root system; the leaves do not fall from the plant as is the case with the yellows. Infected portions look dead and brown, with many small raised specks scattered over them. From these little specks ooze out myriads of one-celled spores which are subject to the many means by which dust is scattered, and so infection is easily spread. Wet weather is exceptionally favorable to its spread.

Wilting of the whole plant is a characteristic symptom; also a purplish tint to the foliage just before the plant dies. Dark, heavy soils are subject to the disease. It will be well to note the following precautions: Treat all seed before sowing, rotate the crop; this disease is very bad to spread from an affected seed bed, therefore be very careful where you put your seed bed if the disease has been present on your place in the past.

DOWNY MILDEW OR BLIGHT

This disease is caused by a fungus, known to scientists as *Peronospora parasitica* DeBary. The mold on the lower surface of the leaves consists of fruiting bodies of the the fungus, while the vegetative portions of the fungus are within the leaves.

Downy mildew of cabbage attacks the leaves, producing pale yellow spots, more or less angular in shape and limited by the vein. The lower surface of the diseased spot is usually covered with a thin coating of downy white mold; usually these spots become brown and die. The disease is seldom destructive in the field, but does considerable damage in the seed bed.

Any plants found affected at setting time should be destroyed, not set. The plants should not be grown too thickly; then if the disease appears, spray the plants every week with Bordeaux mixture made by the formula, 4 pounds blue vitriol, 4 pounds lime, and 50 gallons water.

DAMPING OFF

This is a disease of very young seedlings and may be caused by one of several species of fungus. One will have very little trouble from this disease when plants are sown in the open and not crowded so as to cause them to be continuously damp, down among the stems. It is a common trouble in greenhouses when a high humidity is maintained and there is lack of sunshine or free circulation of air. The fungus attacks the stem of the young plant and

destroys the outer layer or skin, then the plant soon topples over and dies.

Prevention is the best remedy. Do not use soil where it has occurred previously and avoid excessive moisture conditions; do not water plants in the evening.

Some means of drying up the surface of the soil, such as spreading on a layer of heated sand, is to be recommended. If seedlings are very valuable, resetting is advisable; set them this time where there will be good ventilation and sunshine.

CHAPTER XI

HARVESTING CABBAGE AND ROUGHAGE

WHEN TO HARVEST LATE CABBAGE

THE time to harvest late cabbage will depend upon what you are going to do with the crop. If you expect to sell to some shipper or ship them yourself to the city for consumption in a few weeks or draw to a kraut factory, let the crop stand just as long as you dare and not have it get frozen or excessively ripe.

In the late fall the cabbage plant has its largest root system, and often gains in weight faster than any time in the whole season. If you expect to store the crop or sell for storage, you will not want to let it get quite as mature. When a cabbage head is over-ripe you will notice, by turning the head over, and looking at the point where the leaves which form the head start from the main stem or stump, there will be a dark streak. This dark streak shows that the leaf is about ready to separate. Sometimes you will find the leaves already loosened; cabbage where the leaves have loosened are not marketable, and should go in with the cracked heads. (Fig. 23.)

Very early setting, wide spacing, and a wet season are usually the cause for most over-ripe cabbage.

HARVESTING METHOD

When I think of harvesting a crop, I always want to do it the easiest and quickest way. The method I have used is as follows. Start at one edge of your field and count off twelve rows, then cut the next three rows of heads and

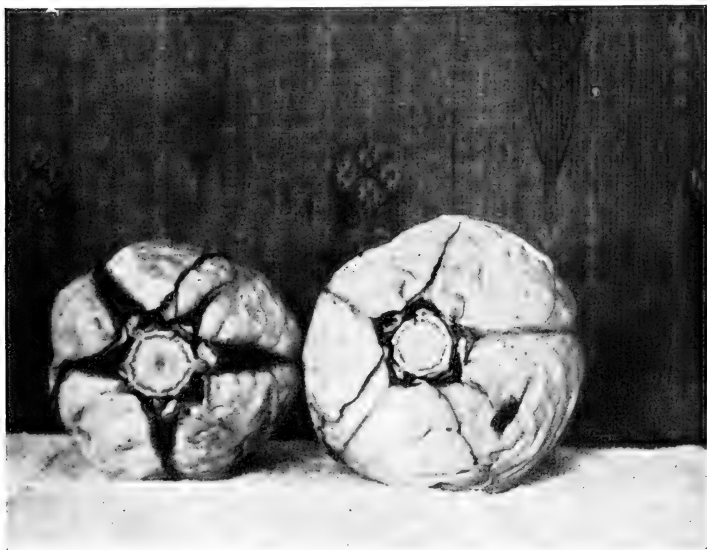


FIG. 23.—Over-ripe head. Note how the leaves have loosened from the main stem.

lay them to one side, also cut the stumps and leaves of these three rows and throw them to one side with a three-tined fork; this now gives a road in which to drive when loading. Follow the same order all through the field, the

work of dividing a field into lands of twelve rows each I always term "opening up." (Fig. 24.)

This allows a strip six rows wide for each side of the wagon, the same being far enough to toss a cabbage head to the man in the wagon.



FIG. 24.—Field of cabbage with roads cut through it. Now it is in shape to harvest the heads.

If cabbage are cut and left on the ground any length of time, place them stump end down; this will prevent them from drying out or freezing badly, should the weather turn suddenly cold. After the first land is cut, the men can start and load the wagon, while the teamster is unloading the men can cut more cabbage; this keeps all working, so there

is no lost time, it also gives the men a chance to change kinds of work. If the distance to market or storage is very great, perhaps several teams will work to best advantage. (Fig. 25.)



FIG. 25.—When there are State roads an auto truck or rig that will hold three or four tons greatly reduces the number of trips to market.

TOOLS FOR CUTTING HEADS

Of all tools to cut the heads out with, the one with the wide blade and T-handle shown in the center of the illustration (Fig. 26) suits me best; with this the head is cut and all trimmed at one operation. This saves a lot of extra work and time. The power required to cut the head comes direct from the shoulder and there are no lame

arms or wrists, as is often the case with a knife or many other devices. Some use a small hatchet, but the objec-



FIG. 26.—Harvesting tools. Left, tobacco shears for cutting roughage. Center, T-handled head-cutting knife. Right, Geneva head-cutting knife.

tion to this is that many heads will be cut into, while others will not be trimmed close enough.

There are none of these objectionable features when using the T-handle cutter. With the hand a man pushes down the loose outside leaves so that he can see just the

right place to put his cutter; a quick push will sever the head.

Cabbage to be stored do not want to be trimmed quite as closely as those for shipment; one or two outside leaves help to protect the head.

This tool is very simple and can be made by anyone from a piece of an old blade of a handsaw. The blade is about 3 inches wide and 4 inches long; this is riveted to a half-inch iron shank which is about 7 inches long, on the end of this shank is a wooden handle about 4 inches long. A piece of an old fork handle is about right size for the handle.

The cabbage cutter with the spading fork handle may work all right, but I could never get used to it. This is the one shown at the extreme right in the illustration (see Fig. 26). Cabbage cannot be cut and trimmed with accuracy with this tool.

FREEZING CABBAGE

A few light freezes seldom do any harm to a cabbage. Over-ripe heads will be damaged quicker than those that are not so mature. If a head freezes solid once and does not stay frozen very long, it is seldom damaged; a second freeze is apt to make it turn red in the center and it is then termed a red heart; such cabbage are worthless for market. Handling frozen cabbage is not advisable, as they will bruise readily.

Freezing the stump and center bud of a head does far more harm than freezing a few outside leaves. It is always advisable to place heads stump end down when cutting,

unless they are to be drawn immediately. If the weather turns suddenly cold, and a head is placed stump end down upon the ground, the warmth of the ground will prevent the stump from freezing, unless the weather is extreme.

COVERING HEADS IN THE FIELD TO PREVENT FREEZING

Often during cabbage harvest one wishes to keep part of his crop for a short period or he may be a little behind in his work, so there is danger of heavy freezing of the crop. Under these circumstances all hands can turn in and cut the cabbage, placing about six rows into one with the stumps down; now take the tobacco shears shown at the left in Fig. 26 and cut the roughage and throw it over this row of heads. Care should be taken to protect the sides of the row as well as the top. If the cabbage leaves or roughage are turned in a reverse way from that in which they grew, they will shingle over the row in better shape; cabbage protected in this way will stand quite severe weather. There is more danger from freezing if a heavy wind comes with the cold. The leaves or roughage over the heads hold the warmth of the ground from passing off, thereby keeping the heads from freezing.

Three men will cut and cover an acre or more in a day. If a light snow should come, this will greatly aid in protecting the heads.

HARVESTING ROUGHAGE

The roughage should be stored in such a manner that it will keep green as long as possible. In my locality nearly every one who does not turn his stock into a field cuts

the roughage with tobacco shears (see Fig. 26), and throws it into piles about the size of a large haycock. (Fig. 27.)

The work should be done if possible before the roughage freezes very much, as freezing injures its keeping qualities. At the same time it is best not to pile the roughage



FIG. 27.—Method of storing cabbage roughage. Piles will not be as large after they have stood a while.

until just about freezing weather, as it does not keep well when it is warm. A common three-tined pitchfork is the handiest tool to pile with. It also aids the piling if the leaves are not broken from the plants any more than is necessary.

Turning stock into a field of roughage always seemed wasteful to me. The stock will waste as much as they will eat. If it is intended to adopt this way of feeding, it is preferable to fence off a small portion of the field at a time, and let the stock clean this up before giving range to any more.

AMOUNT OF ROUGHAGE PER ACRE

On one acre of cabbage that cut 20 tons of heads, it is quite safe to say that there will be 15 tons of roughage. Surely no thinking dairy man or sheep raiser will waste this amount of feed.

If it is not intended to use the roughage for feed, plow it under as soon as possible; this will prevent it from drying up and blowing away. It is quite valuable as a fertilizer, as will be seen by looking at the table in Chapter VII, under the head of "Amount of Fertilizer Removed by One Ton of Cabbage."

CHAPTER XII

STORAGE

MANY cabbage growers as well as middlemen make it a point to store large quantities of cabbage to supply the city trade during the winter.

As cold weather in the fall approaches, the demand for large quantities of cabbage begins and usually continues well through the winter or until the early cabbage from the South comes into the northern markets. As the winter advances, it is safe to say the price of cabbage also advances, but, of course, with more or less variation. Prices range anywhere from \$3.00 to \$40.00 per ton. When cabbage are cheap the kraut factories put up large quantities. (Fig. 28.)

There are several successful methods of storing cabbage. Commission men or growers who store cabbage either cover them out of doors or have a house especially constructed for this purpose.

STORING CABBAGE OUT OF DOORS

Most cabbage that are not stored in a building of some sort are laid on the ground stump end down, and covered with straw, leaves, swamp hay, or any other handy material, to prevent freezing.



FIG. 28.—Sauer-kraut factory, Phoenix, N. Y.

The heads should be placed as closely together as possible, to economize covering material. (Fig. 29.)

They are placed only one head deep, unless some very sheltered spot is available and one does not expect to keep them a great while. Under such conditions they may be placed several heads deep. The covering material will have

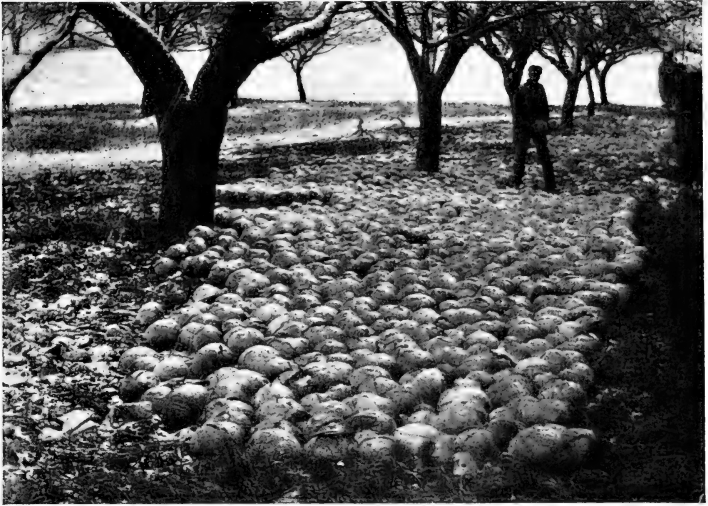


FIG. 29.—Storing cabbage outdoors.

to be thicker where heads are more than one deep, owing to lack of the warmth which the ground affords where all heads are placed directly upon it.

A protected location is to be desired; some place should be selected where the snow does not blow off, as the snow is a great aid to covering. Perhaps the most suitable spot

is in the woods. Get back into the timber far enough so that the wind does not blow the snow much. This will usually be from 5 to 8 rods. Very little covering will be needed in proximity to thick timber, whether large or small; the object in covering is simply to keep the heads from freezing. The cooler they can be kept and yet not freeze, the better. There are several advantages in storing in the woods that will not be found in the open; first, there is good drainage. The leaf mold is loose and light and lets off all surplus water. Do not store in any place where it is wet. The woods are always clean, so that the cabbage do not get all daubed up, as is often the case on plowed land. The timber catches the snow, and during warm spells it does not thaw as rapidly as in the open. Cabbage covered in an open field where the wind can hit them will freeze more quickly with the thermometer at 20 deg. F. than they will in the woods or some sheltered place if it goes down to zero, other things being equal.

Usually enough leaves can be raked in the woods to cover a small area, but if there are several acres, covering material will be needed from some other source. There is nothing better for covering than leaves, as they lay flat, forming a tight cover which holds down the warmth of the ground.

With the thin covering that is ordinarily necessary, they will not get too warm in the woods. There is danger in getting on too much covering material; an over-supply is apt to keep the heads too warm, and cause them to get slimy or decay on the outside. Cabbage in the open will need nearly twice as much as those in the woods, where

the ground freezes only a little, if any. Wherever stored out of doors, they need to be watched and more material added if extreme weather prevails. Cabbage for storage need to be handled with care, as bruises make the leaves turn dark, entailing more waste at trimming time.



FIG. 30.—Storing cabbage over a board-covered trench to allow ventilation when earth is used for protection.

Seasons and localities differ, so that there can be few set rules given; at any rate the work is not difficult and with a little practice the safety of the crop can be assured.

There is another method of out-of-door storage that is very successful, but is not as highly recommended, owing to extra labor involved. It consists in digging a trench $2\frac{1}{2}$ feet wide and 1 foot deep, across which are laid pieces

of 2×4; these are placed about 3 feet apart and support boards enough to cover the trench, leaving 4 to 5 inch cracks between the boards. The heads are now placed on these boards, making a cone-shaped pile. The pile may be wider at the base than just the width of the boards over the ditch; perhaps 4 or 5 feet will be the extreme width of the pile and 4 feet the height. The ditch furnishes drainage and air to the pile of cabbage. This pile is first covered with straw, then dirt is banked over it deep enough to prevent freezing. (Fig. 30.)

There is quite a little shrinkage in stored cabbage; some place it as high as 25 to 30 per cent. Of course this will differ according to the length of time they are kept, also the condition they were in when stored.

STORING CABBAGE IN A BUILDING (Construction of)

Scattered throughout the great Danish cabbage belt are a great many cabbage storehouses. Many of these belong to commission men, who buy from the growers and store for better prices, which are usually obtainable during the winter. There are also a great many growers who have on their farms storage houses of their own; these are usually constructed on about the same principle as those owned by the commission men.

These houses are constructed with a driveway through their center wide and high enough to admit a team and load of cabbage. The size of the house will, of course, vary to meet the demand of its owner. Some have capacity for 3000 tons; these buildings are fitted up with narrow

bins on each side, where the cabbage are stored, the bins are $2\frac{1}{2}$ to 3 feet wide, and extend from the driveway to about 1 foot from the side; this space is left for ventilation. They are constructed of narrow slats and have an air space of about 1 foot between them. The height of the bins will, of course, be governed by the height of the building.

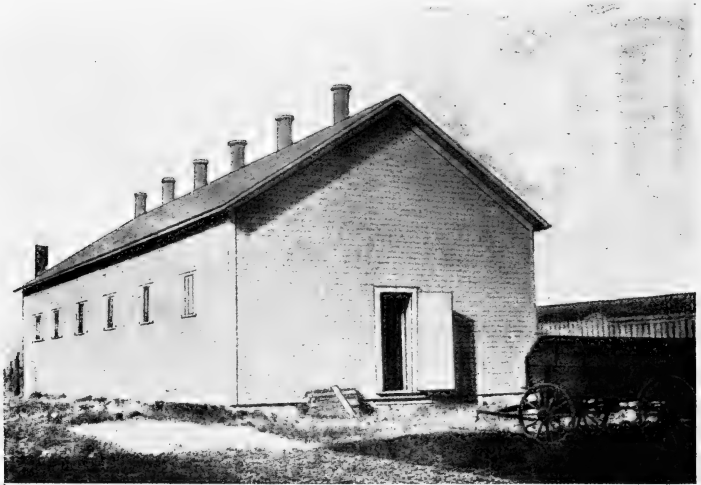


FIG. 31.—Frostproof farm storehouse.

It is not desirable to have the bins too high, as it is hard to get the cabbage up into the top of them. These buildings are double-boarded with an air space between, which greatly helps to keep them from freezing. There is always some system of ventilation provided which greatly aids in holding the proper temperature. Cabbage always keeps best when a temperature of just above freezing is main-

tained, with dry atmospheric conditions. This will often necessitate the opening of the ventilation system at night, also the doors of the house to let in the cool night air.

In the day time during warm spells the house is closed up to retain the cool night air which was taken in. There should be several thermometers in various parts of the building so the exact temperature will be known. Cabbage kept where it is too warm will decay on the outside causing considerable loss. (Fig. 31.)

SOFT-ROT AND LEAF SPOT AFFECTING CABBAGE IN A STORAGE HOUSE

SOFT-ROT (*Bacillus carotovorus*)

Soft-rot is caused by a group of very closely related bacteria which affect various crops, such as cabbage, cauliflower, turnips, radishes, carrots, and tomatoes. The principal damage done to cabbage is in the storage house, or when they are so covered as to keep them too warm out of doors. Infection takes place usually where the head has been bruised; if temperature conditions are favorable this will soon spread over the entire head, causing much loss, because all leaves showing disease must be trimmed off. Diseased stock has a slimy, rotten appearance; occasionally cabbage are affected while still in the field. The damage here is seldom very great, but after a period of storage the disease may gain a foothold, causing much loss. When the disease occurs in the field, rotation is the best preventive. If a crop that shows a little disease in the field is to be put into storage, be sure that the heads are

dry, as the disease is very sensitive to light and dry conditions. Handle heads carefully to avoid bruised spots for the disease to enter.

LEAF-SPOT (Leaf Blight) *Alternaria brassicæ* (Berk) Sacc

This disease attacks plants in various stages of their growth. L. L. Harter, of Washington, D. C., describes it as follows: The vegetative part of the fungus lives in the leaf tissues of the host and under field conditions forms roundish black spots marked with concentric brown zones; these spots vary from $\frac{1}{4}$ to $\frac{1}{2}$ inch or more in diameter. The fungus may also live as a saprophyte and cause considerable damage to cabbage in a storage house. To prevent loss from the fungus in the storehouse, the following suggestion should be observed: (1) Disinfect the storage house by spraying the walls and bins with Bordeaux mixture; (2) exercise care in handling, so as to minimize injury to the heads; (3) maintain a temperature 1 or 2 degrees above freezing; and (4) keep the humidity as low as possible by proper ventilation of the house with outside air.

CHAPTER XIII

LATE CABBAGE FOR THE DAIRY AND SHEEP FARMER

It has always seemed to me that of all classes of men to grow cabbage to the best advantage, the dairy farmer came first. There is always a market for his crop; even if he feeds them to the cows he gets a price out of them which pays him to raise them.

There is just as much to be gained by good marketing as there is by good production; it is encouraging to a man when he starts to grow a crop and knows there will be a market for it with a fair profit.

FEEDING VALUE OF CABBAGE

The tables on pages 106 and 107 will be found of interest in comparing the feeding value of cabbage to some other feeds which are used in some sections.

The following is an example of the results which I have found by feeding roughage. In a dairy that is giving 14 40-quart cans of milk, the cows each eating 40 pounds of silage, 25 pounds of cabbage roughage, 10 pounds of alfalfa hay, and 1 pound of 20 per cent protein grain for every 4 pounds of milk, if cabbage is replaced with silage or hay, the cows will shrink about 2 cans of milk. I have noted

these same results for four successive years. Most of these cows freshened from August to November.

Milk is usually worth about \$1.60 per can at this season of the year. At first thought this seems a big gain for feeding of 25 pounds of roughage per cow, but it must be taken into account that after roughage stands a few weeks

CABBAGE

Pounds of Food.	Dry Matter (Pounds).	Digestible Protein, Pounds.	Total Nutri-ment, Dig. Prot. Dig. Fibre. Dig. N. F. E. (Pounds).	Nutritive Ratio.
1	.100	.023	.084	1 : 2.7
5	.500	.115	.420	
10	1.000	.230	.840	
15	1.500	.345	1.260	
20	2.000	.460	1.680	
25	2.500	.575	2.100	
30	3.000	.690	2.520	

BEAN STRAW

Pounds of Food.	Dry Matter (Pounds).	Digestible Protein, Pounds.	Total Nutri-ment, Dig. Prot. Dig. Fibre. Dig. N. F. E. (Pounds).	Nutritive Ratio.
1	.911	.040	.501	1 : 11.5
3	2.733	.120	1.503	
5	4.555	.200	2.505	
8	7.288	.320	4.008	
12	10.932	.480	6.012	
15	13.665	.600	7.515	
18	16.398	.720	9.018	

PEA-VINE STRAW

Pounds of Food.	Dry Matter (Pounds).	Digestible Protein, Pounds.	Total Nutri-ment, Dig. Prot. Dig. Fiber. Dig. N. F. E. (Pounds).	Nutritive Ratio.
1	.929	.059	.536	1 : 8.1
3	2.787	.177	1.608	
5	4.645	.295	2.680	
8	7.432	.472	4.288	
12	11.148	.708	6.432	
15	13.935	.885	8.040	
18	16.722	1.062	9.648	

PEA-VINE SILAGE

Pounds of Food.	Dry Matter (Pounds).	Digestible Protein, Pounds.	Total Nutri-ment, Dig. Prot. Dig. Fiber. Dig. N. F. E. (Pounds).	Nutritive Ratio.
1	.232	.021	.170	1 : 7.1
5	1.160	.105	.850	
10	2.320	.210	1.700	
15	3.480	.315	2.550	
20	4.640	.420	3.400	
25	5.800	.525	4.250	
30	6.960	.630	5.100	
35	8.120	.735	5.950	
40	9.280	.840	6.800	

DIGESTIBLE NUTRIENTS IN 100 LBS. CORN SILAGE

Dry Matter.	Protein.	Carbo- hydrate.	Ether Extract.
26.3	1.1	15.0	0.7

it begins to shrink so that, on the whole, a dairy of about 30 cows would eat daily the equivalent of 1000 pounds. If there were a gain of 2 cans of milk at \$1.60 per can, or \$3.20, then the gross return for 1 ton of roughage would be \$6.40.

I wish to give here the figures obtained from a man



FIG. 32.— $36\frac{1}{4}$ quarts of 4 per cent milk per day from a grade Holstein cow fed on cabbage roughage.

who kept 24 cows; 23 of them were fresh in February and March, the other one freshened in October. He fed fodder corn twice a day from August 18 to October 1, and then began to feed cabbage roughage, moderately at first, and later all the cows would clean up twice a day until De-

ember 1; he also fed a light feed of hay night and morning—about 10 pounds.

The month before he began to feed cabbage roughage, which was September, his milk check was \$158.00; his October check was \$272.00; his November check \$236.00; this shows a gain for him in two months of \$192.00. Changes in price of milk were taken into consideration.

Surely the feeding of cabbage is a stimulus to the milk flow that is found in few other feeds. After this man's roughage was exhausted he began to feed silage, but the milk flow dropped very perceptibly.

It is the universal opinion of dairy men that the roughage will produce more milk than the heads. It seems as though a few acres of cabbage would be almost indispensable where there are no roots or silage to feed. For instance, in a bean-growing section, where stock is wintered on bean straw and other dry feeds, the cabbage would form a succulent part to the ration, which the farmer would never go without if he once tested its value. Often official records are made and cabbage used as the succulent food. (Fig. 32.)

CABBAGE FOR SHEEP

It seems as though every sheep-raiser, and especially those who grow hot-house lambs, would be interested in the production of a few cabbage. This crop should be as important to this class of men as the silage crop is to the dairy farmer of to-day.

Sheep are very fond of some green food, especially when being fed bean straw and the like. For sheep with sucking

lambs there is the same stimulus to the milk flow that there is to a milk flow in a dairy; the labor of raising, storing, and feeding is far less than a root crop.

TAINTING MILK BY FEEDING CABBAGE

A question very often asked is, Can you feed cabbage and not have it taint the milk? I will reply to this by giving my own experience. For years my milk has been retailed in the city of Cortland, and during that time I have never had a single complaint about a cabbage-taint in the milk. Right here I wish to say that unless you feed at the proper time and take proper care of the milk there may be trouble along this line.

The cabbage should be fed after milking, and the milk should be run over a milk cooler, which is in a separate room. Milk which is allowed to stand where there is a strong odor of cabbage—or any other strong odor for that matter—will absorb it. I probably feed cabbage five or six months in the year, starting as soon as the domestics are large enough and continuing until all roughage from the Danish is fed out.

If there is no market for the heads, one often feeds all winter. I do not recommend feeding cabbage to excess, especially where one is making butter.

FEEDING FROZEN CABBAGE

Feeding frozen cabbage does not harm an animal if you feed only a small amount until it gets used to eating them. Freezing cabbage once seems to do very little

harm, but freezing and thawing time after time soon spoils their feeding value. It does far less harm to their feeding value to freeze and let stay frozen than continued freezing and thawing.

Cabbage that are frozen hard should be drawn into the barn and the frost allowed partly or entirely to come out of them before one attempts to feed.

CHAPTER XIV

SEED RAISING

OF all the different phases pertaining to cabbage growing, in my opinion none is of more vital importance than the production of a good strain of seed from which to grow the crop. You may do everything else right about the crop and then use poor, low-yielding seed, and your efforts will be rewarded with only meager results.

Before one attempts to grow seed for himself, he must have a pretty fair idea of the proper kind of cabbage from which to grow seed. There are greater chances to run out a strain of cabbage than to improve it. You want a strain that is marketable, of good eating quality, and a good producer. The strain should not be an early ripener, nor of such tender quality that the heads will burst as soon as they commence to get hard. The heads should have the leaves fold well over the tops, and when they are cut open should look almost solid if fairly mature. (See Fig. 10, Chapter VII, and Fig. 33.) Cabbage having these last two qualities always weigh well; the stem of the cabbage should be medium length and small. It is not an easy matter to carry in mind from year to year a correct idea of the proper type, so that the best seed stock can be selected, because cabbage vary in different years, owing to

a difference in moisture supply and varying amounts of fertilizers, especially nitrogen.

It takes two years to grow cabbage seed; perhaps this

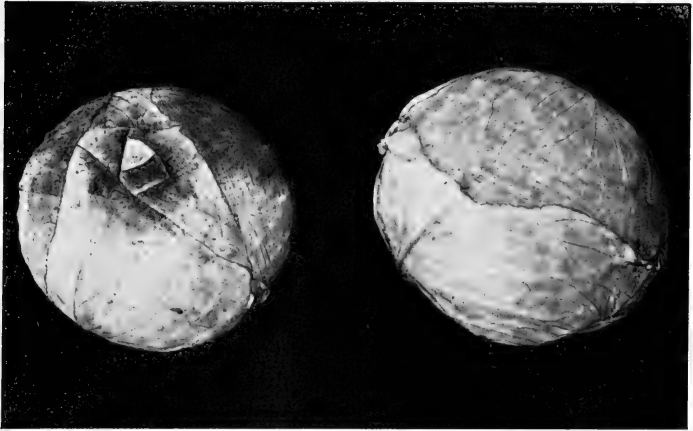


FIG. 33.—Head at the right shows leaves folding well over the head.
Head at the left shows poor folding.

is why so few have tried to do it. Cabbage seed that will grow good, hard heads cannot be grown in a warm climate.

IMMATURE HEAD SEED PRODUCTION

The cabbage head is grown the first year, and then carried over winter in a growing condition, and the seed are grown the second season.

There are two methods in practice of producing seed. One is called the mature-head method; the other the immature-head method. The immature-head method is

the one followed by most commercial growers, and does not permit of any head selection; therefore, there is no chance to breed up a strain. It is by far the easiest method and the most profitable to the seed grower.

Most commercial growing is done in some of the milder sections of the country, such as Long Island, and mild sections in Michigan and Oregon. Under this method, the seed are sown some time in July and the cabbage are grown up to a stage where they just commence to head. At the approach of cold weather, the entire plants are taken and three rows put into one; these rows are covered with soil, usually by plowing a furrow from each side over them, just deep enough to prevent freezing. In the spring these partly mature heads will throw up their seed stalks. Short stakes are set each side of the rows and binder twine is stretched along to keep the stalks from being broken by the wind. When the seed ripen, the stalks are cut and partially dried; then they are tied up in large sheets and stored in some loft until dry enough to thresh; often they are threshed in a common grain thresher, but small amounts are flailed out by hand.

Generally speaking, the seed is grown on a contract; in other words, seed men employ others to grow seed for them. It will be readily seen that all interest in quality is a secondary matter, no matter how a seedsman tries to have his growers produce good stock.

By this method there is no chance for yearly head selection, but seed is produced from everything that will grow it, many of the plants that produce seed would never have formed a marketable head.

Perhaps two neighbors side by side are growing seed, one growing early seed and the other late. Of course the two strains will cross. Or one may be growing Brussels sprouts seeds; the results of a cross in the latter case is a plant that will not head at all.

The price paid these growers is so small that they cannot afford to follow any method but the cheapest. Here is where the cabbage grower is to blame: as a usual thing he wants the very cheapest seed obtainable, and generally he gets it. If there was a general demand for a pedigreed strain at a price at which one could afford to produce the seed it would be produced; on the other hand, I have found in my pedigree seed production that once the people find what I have I cannot grow enough to supply the demand.

MATURE HEAD SEED PRODUCTION

The method I have followed for years gives some chance yearly to improve a strain. It is the mature-head method and differs from the other in that one goes through a field of full-grown cabbage and selects desirable heads for seed, instead of taking every plant. A grower who is particular will breed his seed for a number of years before he will take over one head in thirty from a field of cabbage to grow seed from.

The desirable heads are pulled and carried over winter, roots and all. Before deciding that a head is desirable, break down the outside leaves on one side, so that the shape and depth of the head from the side can be seen; this will also give you a better chance to judge whether the

plant has an oversupply of outside leaves, a feature which is not desirable.

STORING MATURE HEADS FOR SEED

The best place that I have found to carry over winter such heads is in the woods. Go back into the timber several rods, to be assured that the wind will not blow the snow off in the winter. Here place the cabbage so that the head rests on one side and the roots also touch the ground; place the first row so that the roots all project in one way; now the second row will fit in between the roots of the first row and so on until all are laid down. It is best to count the number of heads stored, so that you will know how large a seed plot to prepare for them in the spring. Be sure to cover sufficiently to keep from freezing.

RESETTING SEED HEADS IN THE SPRING

In the spring the heads are reset about early oat-sowing time, in rows 4 or 5 feet apart, the plants being about 2 feet in the row. The plants should be set a little deeper than they were in the field. Ground suitable for growing cabbage is all right for seed raising.

Windy locations are to be avoided on account of breakage of the plants when they get tall.

If the heads have not cracked in the winter, an X is cut in the top; this will allow the center shoot to come through more readily. Do not cut so deep that you will injure the bud from which the seed stalk grows, which is



FIG. 34.—Method of cutting heads to allow seed stalk to come through.

in the upper center of the head. (Fig. 34.) Many lateral shoots will start from the under side of the head, but these should be rubbed off. (Fig. 35.) The central shoot is the one which will give best results in seed. (Fig. 36.) Each head should have an iron or wooden stake driven down beside it to tie the seed stalk to during growth. (Fig. 37.)

Cabbage heads set out in this way will grow a shoot from 4 to 6 feet tall, and will produce several ounces of seed per head or plant. As the shoots commence to grow, the old head will loosen from the main stem or stump; this loosened head should be removed and not allowed to rot, as it will cause infection to the new plant.

FERTILIZATION AND CULTIVATION OF SEED PLANTS

The heads set for seed should be cultivated and kept free from weeds. It often happens that one will have to do the cultivating early in the morning when the plants are in bloom, owing to the numerous bees on the blossoms. Cabbage set for seed need a liberal fertilization; from 1000 to 1500 pounds is none too much per acre. The fertilizer should be about equal percentages of Phosphoric acid and Potash. These elements form seed and do not cause excessive growth, as the case would be if a quantity of Nitrogen were used. When cabbage rows are set as far apart as 4 or 5 feet, it is best to apply the fertilizer to each side of the row as well as in it.



FIG. 35.—Lateral shoots from the base of a head.



FIG. 36.—Cabbage heads throwing the seed stalk correctly.

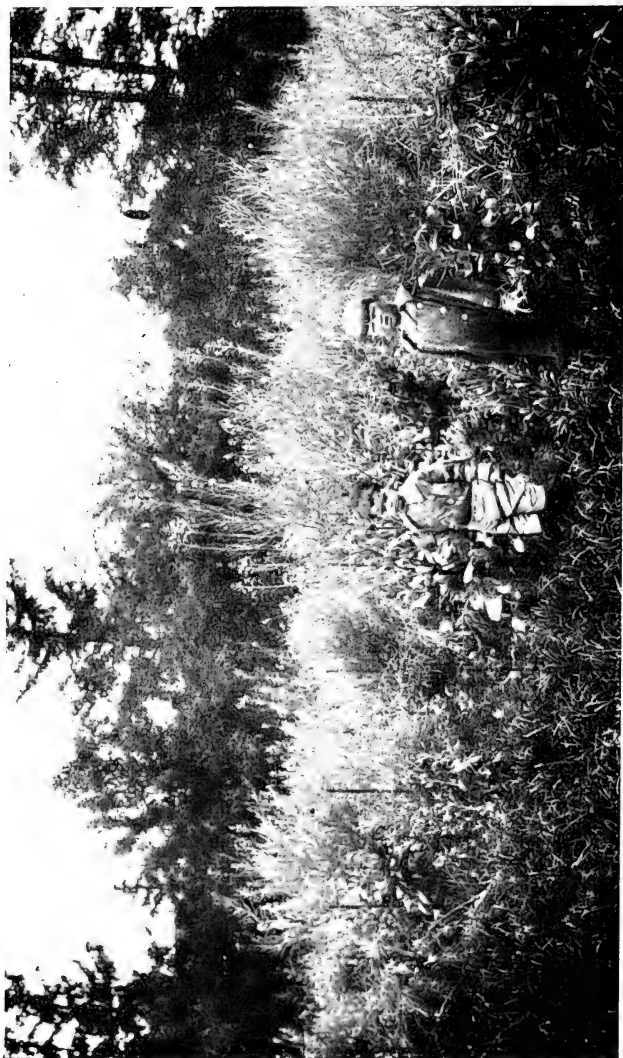


FIG. 37.—Field of cabbage seed. Note method of staking plants.

HARVESTING, CURING AND THRESHING

Usually the seed ripen some time in August. The plants should be allowed to grow as long as possible without loss



FIG. 38.—Cabbage plant with mature seed. Note the large thrifty seed pods.

from shelling of the more mature seed pods. (Fig. 38.) The pods will have a waxy yellowish appearance when ripe.

I usually cut low enough down on the plant to get all the seed shoots. They are then placed on racks made from 6-inch boards set up edgewise in the form of a square or rectangle; over this is stretched a 200-pound bran sack after it is ripped open; there will be no loss by shelling when placed upon racks of this kind. Set them in the sun so that the plant will dry as soon as possible; they should be carried under cover or piled up and covered if a shower threatens. The plants will dry much faster if turned on the racks occasionally. You will find them quite hard to cure, as a green cabbage growth does not dry readily. Do not store in a damp place, as the seed need to harden up; they will sprout very easily and need to be kept dry.

Once the plants are dry they may be threshed out in a regular grain thresher, or by hand with a flail. I made a thresher especially for the purpose. It consists of a large wooden box about 6 feet long, 3 feet high and $2\frac{1}{2}$ feet wide; the upper half of one end is taken out and there is suspended crosswise through the box a wooden cylinder about 8 inches in diameter into which are driven 20d. spikes; after the head is removed, these spikes protrude about $1\frac{1}{2}$ inches.

There are no concaves in the machine, but instead the feeding-table extends down under the cylinder. On one end of the shaft which passes through the cylinder there is a belt pulley. The machine can be driven with almost any power which may be upon the farm. The plants are fed into the machine top first and as the cylinder revolves it very quickly knocks the dry pods to pieces. The operator does not let go of the plant, but as soon as the

Pods are off it is thrown into a pile, and another plant receives the same treatment.

The top or cover to the machine is removable, so that the seed and pods may be taken out when it is full. The seed are now cleaned up in an ordinary fanning mill, special sieves being usually required.

Be sure your seed are thoroughly cured before threshing, otherwise they should not be run through the fanning mill, but stored, pods and all, until dry.

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