

NOTICE AS TO BULLETINS.

The Bulletins of this Station, issued quarterly or oftener, are mailed free to citizens of Connecticut who apply for them, and to others, as far as the limited editions permit.

Applications should be renewed annually before January 1st.

Citizens of other States desiring to secure the Bulletins regularly are referred to the notice below.

The matter of all the Bulletins of this Station in so far as it is new and of permanent value is made part of the Annual Report of the Director.

Bulletins earlier than No. 71 and Nos. 83, 93, 100, 101 and 102 are exhausted and cannot be supplied.

NOTICE AS TO STATION REPORTS.

The Station has no supply of its Annual Reports for the years 1877, 1878, 1879, 1880, 1881, 1883, 1887 and 1891 and will pay a liberal price for a number of clean copies of Reports for any of these years.

The Annual Report of this Station, printed at State expense, is at present limited to an edition of 7,000 copies, of which 5,000 copies are bound and distributed by the Secretary of the Board of Agriculture, T. S. Gold, West Cornwall, Conn.

After exchanging with other Experiment Stations and Agricultural Journals, the remaining Reports will be sent first to *Citizens of Connecticut* who shall apply for them. These copies will be supplied in the order in which the applications are received until the edition is exhausted, and if the demand in the State continues as heretofore, few or none will remain for distribution outside of Connecticut.

Extra copies can, however, be secured if called for before the printing-forms are broken up. Such copies will be struck off and supplied to *Citizens of other States who apply to this Station annually before February 1st, and who remit 25 cents per copy to defray costs.* This remittance will also secure to the sender a copy of each Bulletin issued by this Station during the following year.

Coin may be forwarded by Post at sender's risk with very small chance of loss, if properly mailed, as follows: Cut an inch hole in a card or scrap of thin paper-box that will just fit inside an envelope, fasten a twenty-five cent piece in the cavity by pasting paper over it on both sides of the card, write thereon name and Post office address, inclose within an envelope, and send as a letter prepaid in full. P. O. stamps cannot be accepted.

COMMON FUNGOUS DISEASES AND THEIR
TREATMENT.BY WILLIAM C. STURGIS, PH.D., *Mycologist*.

A year ago the demand on the part of the farmers and fruit-growers of the State, for a concise and untechnical statement concerning the more common fungous diseases, the means of recognizing them, and the methods of treatment, was answered by Bulletin 111. The science of economic mycology makes rapid progress, fungous diseases hitherto unknown in a certain locality become prevalent, and the experiments of a year may so far increase our knowledge, that in order to secure the best results from the use of fungicides, we must be prepared to keep abreast of the latest investigations, and modify our methods accordingly. It has therefore been decided to publish this revised edition of Bulletin 111, only such changes from the latter publication being made, as the experience of the past year has proved advisable.

DISEASES OF THE APPLE.

"SCAB." [*Fusicladium dendriticum*, (Wallr.) Fckl.]

This disease attacks the leaves and fruit of the apple, producing roundish or irregular blotches on the upper surface of the leaves, and on the fruit. These blotches are of a dark greenish-brown color, and of a more or less velvety texture. The growth of the fungus causing these blotches does not tend to produce any rapid or widespread decay in the fruit, but it does stunt and distort the fruit, rendering it to a greater or less degree unsightly and unmarketable. The "scab" should not be confounded with the diseases known as "bitter-rot" and "black-rot," both of which tend to produce rotten areas in the fruit.

Treatment.

Inasmuch as the "spores" or fruit of the "scab" fungus pass the winter in the fallen leaves beneath the trees or in the cracks and crevices of the bark, collecting and burning the leaves in winter is of great assistance in controlling the disease, and a winter treatment in the form of a strong wash or spray applied to the trees is most desirable. The material used is a strong solution of either sulphate of copper, 1 lb. to 25 galls. of water, or sulphate of iron, 1 lb. to 5 galls. of water. This application is best

made by means of some form of spraying apparatus, and should be used in early spring before the buds have begun to swell.

This should be followed up by a summer treatment, consisting in the application of either the Bordeaux mixture or modified Eau céleste. Formulas and directions for the preparation of these and other fungicides are given on pp. 17 to 19. The Bordeaux mixture presents one very decided advantage over the modified Eau céleste, in that it contains no ammonia, hence does not dissolve the arsenic compounds, and can therefore be used in conjunction with Paris green or London purple to prevent the attacks of the codling moth as well as of the "scab" fungus. The mixture should be made in the proportion of one pound of the arsenic compound (Paris green or London purple) to 100 gallons of the fungicide, the former being stirred to a smooth paste with a little water and added to the latter.

Time of application.

In applying fungicides for apple "scab," it should be remembered that early treatment is extremely important. The winter treatment with sulphate of copper or iron should take place late in March or very early in April, before the buds begin to swell. The first application in the summer treatment should be made just before the flowers open, a second as soon as the fruit is set (for this application and the following, Paris green may be mixed with the fungicide to destroy the eggs of the codling moth), and a third when the fruit is half grown. The winter treatment, followed by these early summer applications, if carefully and thoroughly made, will be found as efficient as a number of applications later in the season. Prevention is always better than an attempted cure.

DISEASES OF THE PEAR.

"LEAF-BLIGHT" OR "LEAF-SPOT." (*Entomosporium maculatum*, Lév.)

This disease attacks the leaves and fruit of both the pear and the quince, producing on the leaf yellowish or reddish spots marked in the center by minute black pimples. The affected leaves fall prematurely, generally by the first part of July, the tree suffers in consequence, and may eventually die from the effects of repeated premature defoliation. Upon the fruit the

spots produced by the fungus are not usually as prominent as upon the leaf, but the early falling of the leaves, and the presence of the fungus upon the fruit, causes the latter to become stunted, often badly cracked, and quite unfit for the market. In this State more damage is done to pears by the pear "scab," while quinces suffer more seriously from this "leaf-spot."

Treatment.

Collecting and burning the fallen leaves and fruit after harvest, and a treatment of the trees early in April with a strong solution of sulphate of copper as recommended for apple "scab," tends largely to check the spread of the disease. For the summer treatment either the Bordeaux mixture or the modified Eau céleste will be found effective. The superiority of the latter consists in its greater cheapness and ease of application, but as stated above it cannot be used in connection with the arsenical insecticides, without seriously endangering the foliage.

Time of application.

The winter treatment should be made early in April; the first spraying with the Bordeaux mixture or the modified Eau céleste should be made just before the blossoms open; a second, as soon as the blossoms have fallen; and either two or three more at intervals of ten days to three weeks according to the rainfall.

"SCAB." [*Fusicladium pyrinum*, (Lib.) Fekl.]

The fungus causing this disease is very closely related to that causing the apple "scab," and the effects of the two are very similar. Upon the pear, as upon the apple, the fungus produces dark brownish patches of a velvety texture on the leaves and fruit. Cool, damp weather is in both cases favorable to the spread of the disease.

Treatment.

A spray of sulphide of potassium, used in the proportion of one ounce to two gallons of water, has been recommended, but is probably not as effective as the Bordeaux mixture or the modified Eau céleste. The first application should be made when the flowers are beginning to open, a second when the fruit is about the size of peas, and additional applications every two weeks until five or six in all have been made.

DISEASES OF THE QUINCE.

“LEAF-BLIGHT” OR “LEAF-SPOT.” (*Entomosporium maculatum*, Lév.)

This is the same fungus which causes the “blight” or “spot” of the leaves of the pear, and the cracking of the fruit. In the case of the quince the most marked effect of the fungus is upon the leaves, which blight and fall prematurely, hence the first effect of remedial measures is seen in a vigorous, healthy leafage, and in severe cases a good set of fruit is only secured after spraying for two seasons.

Treatment.

In treating the disease as it occurs on quince trees, experience seems to show that in the end, and taking into consideration the much greater success attending its use, the Bordeaux mixture is preferable to any other fungicide. The use of the Bordeaux mixture is also to be recommended because it permits of admixture with Paris green as a remedy against the quince “maggot.” The Paris green should be mixed to a smooth paste with a little water, and then stirred into the Bordeaux mixture in the proportion of one pound of Paris green to 100 gallons of the mixture.

This treatment should be supplemented by the gathering and burning of the fallen leaves, and by the winter treatment with sulphate of copper or sulphate of iron as recommended in other cases, p. 3.

The proper times for making the applications are the same as in the case of the “leaf-spot” of the pear, p. 5.

“BLACK-ROT.” (*Sphaeropsis Malorum*, Peck.)*

This disease, which also attacks apples and pears, has only recently made its appearance on quinces in this State, but it bids fair to become a serious trouble to quince growers unless speedily checked. It makes its appearance in August, as a discolored spot, usually on the exposed side of the fruit. The spot spreads rapidly, both superficially and in the interior of the fruit, until the whole fruit becomes brown, decayed, and shrunken, and often badly cracked. The disease once seen, is unmistakable.

* See Bull. 91, N. J. Agr. Exp. Sta., p. 8.

Treatment.

The fungus producing the disease in question is nearly related to others which have been carefully investigated, so that it is fair to presume, although the presumption rests upon no definite experiments as yet, that a continuation through August of the application of Bordeaux mixture will effectually prevent the disease. If it is found that this mixture is liable to remain upon the fruit at the time of harvest, the modified Eau céleste or the ammoniacal solution of copper carbonate may be substituted for the Bordeaux mixture with probably quite as good results.

All diseased fruit should be gathered and burned at and after the time of harvest, and if apples or pears are grown in the neighborhood the disease should be carefully looked for upon them and no diseased fruit should be allowed to lie on the ground or remain upon the trees.

DISEASES OF THE PEACH.

Practically the only disease of peach trees which at present seriously threatens the fruit interests of Connecticut is that known as "yellows." It is impossible to give within the limits of the present Bulletin even a brief outline of the investigations which have been made on the cause or causes of this malady. It is sufficient to say that as yet no definite cause has been ascertained with any certainty, and no means have proved effective in checking the spread of the disease except rooting out and destroying by fire every tree which shows the first symptoms of the disease. Constant study has however, given us certain general facts relative to the disease.

(1)* The first manifestation of "yellows" is the premature ripening of the fruit. The moment this symptom is seen, though the tree is to all appearance sound and healthy otherwise, it must go, if the spread of the disease is to be checked. There are no authentic instances of trees recovering after the appearance of this symptom.

(2) The second evidence of a diseased condition is the premature development of winter buds, producing spindly growths and

* These conclusions are based upon the publications of Prof. E. F. Smith, referred to later, p. 8.

sickly green leaves. All the other symptoms of "yellows" are due primarily to these two.

(3) The period of incubation, i. e. the time elapsing between artificial inoculation and evident symptoms of disease, is considerable; after the appearance of symptoms the tree may live from one to five years, and even produce fruit during the early stages of the disease.

(4) The whole tree is affected when symptoms appear in any part of it, hence

(5) Pruning has little or no effect on the spread of the disease. If a single diseased tree is allowed to remain in the hope that it will bear fruit for at least one more year, not only are the adjoining trees endangered but the whole orchard and even adjoining orchards may become infected.

(6) There is no question that the disease can be communicated from one tree to another, though how it is communicated, that is, the nature of the contagion, is as yet unknown. It may be communicated even by apparently healthy buds when these are taken from diseased trees, but it is also conveyed in some other way than by bud inoculation, certainly in the case of old trees. Finally the trees are not infected through the blossoms.

(7) The use of special fertilizers has never cured a tree, though heavy fertilizing may, by increasing the vigor of the tree, enable it to withstand longer the effects of the disease.

(8) It is possible to grow healthy trees in the identical spot from which a diseased tree has been taken. This has been the practice of growers in Michigan and the disease has been almost completely eradicated. In other States however, notably in Delaware, the practice has not proved so advisable, and on the whole it seems to be at least unsafe to set out a new tree on the spot where a diseased tree has recently been rooted out.

For further details on this subject the reader is referred to Dr. Erwin F. Smith's exhaustive treatises, Bulletin No. 1, U. S. Dep't of Agric., Division of Veg. Path., and Bulletin No. 9, U. S. Dep't of Agric., Div. of Bot., to which publications we owe most of our knowledge concerning peach "yellows."

DISEASES OF THE PLUM AND CHERRY.

“BLACK KNOT.” [*Plowrightia morbosa*, (Schw.) Sacc.].

This disease attacks the smaller limbs and twigs of wild cherries and plums as well as of the cultivated varieties, producing on them jet-black, wart-like growths. At first these growths are small and do but little damage, but they increase rapidly in size; by inducing a morbidly active growth of the tissue of the branch on the side upon which they are growing, they produce a distortion of the branch; and finally, surrounding the branch completely, they produce death. It is not rare for a whole tree to be killed by this disease in the course of two seasons. The black “knots” are largely composed of the fruiting part of a fungus, the vegetative part of which is buried in the tissues of the branch, and occupies a distance of three to five inches above and below the “knot” itself.

Treatment.

After the disease has once obtained a good hold upon the larger branches of a tree it is well nigh impossible to eradicate it. Its spread can be stopped however, if it is taken in hand early, or when the “knots” are still small and few in number.

With a sharp knife the knots should be cut out, the portion removed extending three or four inches above and below the “knot” itself. The wound should then be washed, or the whole tree sprayed, with a strong solution of sulphate of copper, and then painted over with some oil paint.

In place of the oil paint, a paste made of kerosene and some colored pigment, or of turpentine and lime, has been used frequently with marked success even when applied directly upon the “knots” without cutting them out. It is always surer and safer however, first to cut the “knots” out and then to apply the paint or paste to the cut surfaces.

The spores of this fungus mature and are distributed from the latter part of December to February; the best season therefore for cutting out the “knots” is November or early in December. The young “knots” appearing in the spring, bursting through the bark in greenish swellings, may be cut out at that season. If the whole tree is badly diseased it should be cut down at once and burned; and the same applies to the individual “knots.” If

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allowed to remain on the ground they will infect healthy trees as readily as though they were still on a living tree. Wild cherries which are diseased should be subjected to the same treatment, or destroyed altogether.

“BROWN-ROT.” (*Monilia fructigena*, Pers.)

This disease attacks the stone-fruits, such as the peach, plum, and cherry, and sometimes the apple and pear. Its first effect is to induce a brown discoloration of the fruit accompanied by a copious production of ash-colored dusty tufts on the surface of the fruit; these tufts are the fruiting threads of the fungus. Later the fruit becomes shrunken and dry, and in this “mummified” condition may remain for a long time without decay. Not infrequently the whole fruit becomes encased in a layer of brownish dust consisting almost entirely of the spores of the fungus.

Treatment.

The most practical method of checking the spread of the disease is by burning all diseased or “mummified” fruit. It is in this dried fruit that the fungus threads pass the winter. With the advent of warm weather the threads produce spores in immense quantities upon the remains of the fruit, and the fresh crop of fruit becomes readily infected. Hand-picking and burning all diseased fruit, both on the tree and on the ground, is therefore the surest method of combating the disease. It occasionally attacks both the leaves and twigs as well as the fruit, and in such a case again the best remedy is picking and burning the diseased parts.

Merely as an adjunct to this method of dealing with “brown-rot,” treatment of the trees and subjacent ground with the simple solution of copper sulphate as recommended for apple “scab,” etc., would undoubtedly be of benefit. This treatment should be given during the last of March or the first part of April.

Note.

If Paris green in water is used upon plum-trees to prevent the destructive attacks of the curculio, the danger of burning the foliage can be avoided by adding lime to the insecticide, in the proportion of 1 lb. to 50 galls.

DISEASES OF THE GRAPE.

“BLACK-ROT.” } *Phyllosticta Labruscæ*, Thüm.
 } *Phoma uvicola*, B. & C.
 } *Laestadia Bidwellii*, (Ell.) Viala & Ravaz.

This well known disease usually appears first upon the leaves and young shoots, producing reddish-brown or blackish spots. About two weeks later the berries are attacked, the first evidence of this being a black or brownish spot at one or more points on the surface. Soon the whole berry turns brown, then black, and finally becomes hard and leathery, while still remaining on the stalk. A magnifying glass reveals on the surface of the diseased berries minute black pimples, within which the several forms of spores produced by the fungus are born.

Treatment.

Warm, damp weather is especially conducive to the spread of the disease, so that during such weather the vines will require constant care. The first precaution to be taken in the spring consists in ploughing or cultivating between the rows so as to turn under or cover any diseased grapes which may have fallen the previous year.

Treatment of the vines immediately after pruning, with the strong solution of sulphate of copper is advisable (p. 3); but more important is the summer spraying with the Bordeaux mixture.

Experiments conducted in 1891 by the U. S. Dep't of Agric. indicate that the Bordeaux mixture reduced to even one-sixth the usual strength, (see Formula 2, p. 17, of this Bulletin) is thoroughly effective against “black-rot,” and of course the expense is much less.

If the Bordeaux mixture is used throughout the season there is danger of some of the dried copper compound remaining on the berries when harvested, and this damages the appearance of the fruit, though the quantity of copper is too small to produce any injurious effects from eating the grapes. This staining of the fruit may be remedied by using the ammoniacal carbonate of copper for the last two sprayings instead of the Bordeaux mixture.

Time of application.

Early treatment is indispensable to success. The appearance of the first leaves should be the signal to begin spraying. Make the first application then, repeat it just before the vines begin to bloom, follow it up with a third as soon as the vines have finished blooming, and repeat at intervals of twelve or fifteen days according to the weather, until the berries are half grown. The most critical period in this climate is about the last of June; the spraying at this time should therefore be especially thorough and careful. According to the experience of the Department of Agric., "six treatments, the last two after the grapes were practically grown, gave little better results than four, the last being made when the berries were the size of bird-shot." Of course the frequency of the applications must depend largely on the weather.

"BROWN-ROT" OR "DOWNY MILDEW." [*Plasmopara viticola*,
(B. and C.) Berl. and De Ton.]

The fungus producing this disease is more disastrous to the vines themselves than the fungus of "black-rot," inasmuch as it attacks the leaves, causing them to turn brown and fall prematurely. Later it may attack the berries. The latter do not dry and shrivel as in the case of "black-rot," but they assume a grayish tint, the surface becomes discolored in places especially near the stem end, and finally, decay accompanied by a uniform brown color destroys the fruit. On the leaves the disease is readily recognized by the grayish, downy, or furred appearance produced on the under surface of the leaves by the fruiting threads of the fungus. This downy form of the disease may also attack the berries, and under such circumstances is unmistakable.

Treatment.

The same treatment is to be recommended for the "downy mildew" as for "black-rot." If the vines are treated for the latter the same treatment will suffice for both diseases.

"ANTHRACNOSE" (*Sphaceloma ampelinum*, DeBary.

This disease attacks the canes, leaves, and berries. On the leaves it produces small brownish spots with a slightly raised border. Later these spots become gray in the center and often

separate from the surrounding healthy portions of the leaf, leaving the latter full of round or ragged holes. On the canes the effect is similar except that the spots often become confluent, producing large elongated diseased areas of a grayish color and slightly flattened or depressed. On the berries the spots are more nearly circular, and their appearance, gray in the center with a reddish surrounding circle and a dark border, gives to the disease the common name of "bird's-eye rot."

Treatment.

The best remedy for "anthracnose" is to wash or spray the vines after pruning, and before the buds begin to swell in the spring, with a strong solution of sulphate of copper, using one pound to ten gallons of water. "Anthracnose" is not liable to do much damage in vineyards that are well treated for "mildew" or "black rot," especially if the vines are severely trimmed.

DISEASES OF THE RASPBERRY AND BLACKBERRY.

"ANTHRACNOSE." (*Gloeosporium necator*, E. and E.)

This "anthracnose" produces on the canes, small round or elongated whitish patches, slightly flattened and bordered with a ring of dark purple. These patches gradually increase in size and number, and finally destroy the new growth or stunt it badly. Upon the leaves it is often visible as very small yellowish spots surrounded by a dark border, resembling those on the canes but much smaller. The fungus producing the disease passes the winter in the diseased canes and leaves, a fresh crop of spores is produced from the old spots in the spring, and the new canes and foliage are readily infected.

Treatment.

As in the case of the grape "anthracnose," cutting out all diseased wood and burning it will gradually eradicate the disease. It should be cut out in winter or very early spring, below the lowest diseased spot. If the canes are then sprayed with a solution of sulphate of copper, using one pound to twenty-five gallons of water, and if necessary sprayed two or three times during the summer with Bordeaux mixture, very little damage is to be feared from the "anthracnose."

DISEASES OF THE STRAWBERRY.

"LEAF-BLIGHT." (*Sphaerella Fragariae*, Sacc.)

This disease is characterized by the appearance of reddish areas on the upper surface of the leaves. Later there appear in the center of these discolored areas gray or whitish spots, upon which in autumn and winter are developed several forms of the reproductive bodies or spores of the fungus which causes the discoloration of the leaf.

Treatment.

By annually renewing the settings, and planting only in deep and thoroughly drained soil, the loss from blight will be very largely diminished. Removing and destroying all the old leaves after harvesting, followed by cultivation, and the application of a quick fertilizer, is a process which has produced good results.

A more simple method which has been adopted with complete success by certain growers in this State, is as follows:—As soon as the berries are picked, run a mowing-machine over the bed, cutting all the leaves close above the ground. As soon as the leaves and old mulch are dry enough, set fire to them and burn the bed over. If necessary, loosen up the old mulch a little with a fork before burning and put on more where it is scanty, in order to secure as even a burn as possible. Unless a severe drought follows, the plants soon put up a new, vigorous, and healthy growth; mulch as usual in the autumn. In a dry season this method must be used with caution, but if the burning is followed by rain, the process has in all cases proved a complete cure for the "leaf-blight."

DISEASES OF THE ONION.

"SMUT." (*Urocystis Cepulae*, Frost.)

This disease attacks the onion seedling, appearing as dark spots or lines in the leaves. Later, and as other leaves develop and become attacked, those spots begin to crack open longitudinally, exposing the fungus with its spores as a black, powdery mass. If the disease is not checked by the natural withering of the leaf first attacked, it spreads throughout the plant, affecting even the

bulb, on which it produces black, linear elevations, running down to the base of the bulb and extending up into the leaves.

Treatment.

The only treatment, except rotation and transplanting, which has ever been recommended for onion "smut," is that suggested in the Reports of this Station for 1889 and 1890. It consists in sowing in the drill, with the seed, either a mixture of equal parts of sulphur and lime, or of sulphide of potassium and lime. The experiments which led to this suggestion were made on very smutty land, and increased the yield in a ratio of about 5 to 1. They were merely preliminary and therefore not decisive, but the result certainly seems to warrant a repetition of the experiment. The details will be found in the Reports referred to. It seems probable now that the measure of success attending this treatment will hardly warrant its very extended adoption, and that onion growers in this State, as elsewhere, will have to adopt the method of starting the plants from seed in cold frames, and transplanting to the field. This method is laborious, but the additional labor is compensated for by an earlier harvest, and very superior bulbs.

To lessen the danger of spreading the disease it should be noted that all implements used in smutty ground should be thoroughly washed before being used in clean ground; that all refuse left on the field from a crop infected with "smut," should be collected and burned; that when it is possible, onion land should be burned over in the fall; and that at the second and subsequent hand-weedings, all onions which show the "smut" should be pulled and burned at once.

DISEASES OF THE POTATO.

"BLIGHT" or "ROT." [*Phytophthora infestans*, (Mont.) DeBary.]

This disease first appears as a premature wilting of the tops of the vines. The color rapidly changes to yellow and then to a dirty brown. On the under side of the leaf in these diseased portions, is seen a delicate whitish mould, the fruiting threads of the fungus. The disease spreads quickly, inducing a very rapid and characteristic decay in the plants, and if not checked, the fungus causing the decay makes its way to the tubers and affects them, producing the well-known "rot."

Treatment.

If applied in time, the Bordeaux mixture is an effective preventive of potato "rot." It should be applied whether the disease appears or not, since it is a preventive rather than a cure.

Time of application.

The first application should be made when the plants are about half grown, and it should be repeated every ten or twelve days until the tops begin to wither. If it is desired at the same time to treat the vines for the "potato bug," Paris green may be used with the Bordeaux mixture by stirring the former to a smooth paste in water and adding it to the latter in the proportion of one pound of Paris green to 100 gallons of the mixture. As a rule treatment for the "potato bug" will have to be begun much earlier than for the "rot." It may be more convenient however, and it can do no harm, to begin treatment with the combined fungicide and insecticide at the earlier date when the "potato bug" first appears. There is no doubt that potato vines derive from the treatment with Bordeaux mixture, an increase of vitality beyond that due to the prevention of the "rot" alone, although it is not yet fully known to what the Bordeaux mixture owes this fertilizing quality.

DISEASES OF THE TOMATO.

"LEAF-BLIGHT." (*Cladosporium fulvum*, Cke.)

This fungus forms rusty-brown patches on the under side of the leaves, inducing a yellowing and wilting, usually followed by the death of the leaf attacked.

Treatment.

Inasmuch as warmth, moisture, and insufficient circulation of air are all factors in the spread of this disease, training the plants on sticks or trellises to keep them off the ground, and pruning away all the lower branches and leaves so as to allow of the free access of sun and air, will to a great degree prevent the disease. Should it still prove harmful however, either the Bordeaux mixture or the ammoniacal carbonate of copper will be found effective.

“POTATO-ROT.” (*Phytophthora infestans*, De Bary.)

This fungus which does so much damage to potatoes, frequently attacks tomatoes also. Its general effect is the same in both cases, and it may be controlled by the same means.

DISEASES OF CELERY.

“LEAF-BLIGHT.” (*Cercospora Apii*, Fres.)

This disease attacks the leaves of celery, forming upon them discolored spots and blotches. Sometimes almost the whole leaf becomes involved, the blotches presenting a more or less pale and watery appearance.

Treatment.

The ammoniacal solution of copper carbonate has been used with some success against this disease, but from our own experience we would recommend the use of sulphur. A warm, sunny day should be chosen, and the sulphur dusted upon the plants, at the rate of about 2 lbs. to 1200 plants for each application. The applications should be made four times, at intervals of ten days or two weeks.

NOTE.—The treatment should be begun as soon as the disease makes its appearance. Great care should be exercised in selecting seedlings. Seedlings already affected with the disease are frequently offered for sale by retail dealers. Buy only from reliable, first-class seedsmen.

THE PREPARATION OF FUNGICIDES.

BORDEAUX MIXTURE.

Formula 1.

Sulphate of copper (“blue vitriol,” “blue-stone”)	2½ lbs. or 6 lbs.
Quick lime	2 lbs. or 4 lbs.
Water	22 gals. or 45 galls.

Formula 2.

Sulphate of copper	1 lb.
Quick lime	1 lb.
Water	22 galls.

Pulverize the sulphate of copper and dissolve in 2 galls. of water heated to hasten the solution.* Dilute this solution with 14 galls. of water. Slake the lime (which should be fresh, i. e. not partly air slaked) with 6 galls. of water, adding the latter slowly and stirring to a smooth paste. Allow this mixture to stand a short time, then stir it and pour it slowly into the copper sulphate solution, stirring rapidly during the operation. Never pour in any of the coarser sediment which settles readily to the bottom.

This mixture should be made fresh for each application in order to secure the best results.

Formula 2 is, of course, cheaper than Formula 1, and is quite as effective against "black-rot," and "mildew" of the grape, "leaf-blight" of the tomato, and probably against "potato-rot" as well.

AMMONIACAL CARBONATE OF COPPER.

Carbonate of copper	5 oz.
Aqua ammonia (strong)	3 pts.
Water	45 galls.

Mix the carbonate of copper to a thick paste with water. Dissolve this paste with 3 pts. of ammonia, or if that is insufficient to dissolve all the carbonate, add a little more. Dilute with water to 45 galls.

The strong, undiluted solution may be made and kept in stock, to be diluted and used as needed.

The carbonate of copper can be made more cheaply than it can be bought by dissolving in one barrel $3\frac{1}{2}$ lbs. of carbonate of soda (sal soda) in one gallon of hot water, and in another barrel 3 lbs. of sulphate of copper in two gallons of hot water. When the solutions are complete, and *cool*, pour the sal soda solution slowly into the copper solution, stirring continuously. A heavy green precipitate will result, consisting of carbonate of copper. Now fill the barrel up with water, let the carbonate settle at the bottom, and then siphon off the clear water. Repeat the operation once. Finally, strain out and dry the carbonate of copper, of which there will be found to be $1\frac{1}{2}$ lbs.

Prepared in this way the copper carbonate will cost about 18 cents per pound.

* In case the larger proportions in formula 1, are used, double the amount of water must be used in each step of the preparation.

MODIFIED EAU CÉLESTE.

Sulphate of copper ("blue-stone").....	1 lb.
Carbonate of soda.....	1¼ lbs.
Aqua ammonia (strong).....	1 pt.
Water.....	25 galls.

Dissolve the sulphate of copper and the carbonate of soda in warm water in separate vessels. When completely dissolved and cool, mix the two, stirring continuously. Add the ammonia until a clear solution is obtained, and dilute with water to 25 galls.

COST OF MATERIALS.

The following are the approximate wholesale prices of the chemicals most commonly used as fungicides.

Lime	per bbl. (300 lbs.)..	\$ 1.65
Sulphate of copper (granulated)*.....	" (450 lbs.)..	18.00
Sulphate of iron.....	per lb.01
Carbonate of copper.....	"42
Carbonate of soda.....	"02
Sulphur (flowers of sulphur)	"02
Sulphide of potassium (liver of sulphur).....	"	about .12
Aqua ammonia (26°).....	"08

SPRAYING APPARATUS.

PUMPS.

For spraying on a large scale where a large portable receptacle is needed, a strong force-pump which can be mounted on a barrel and drawn from place to place, is a great saving of time and labor. A pump well adapted to this purpose is "Gould's double-acting spraying pump" fitted with couplings on both sides which allows of the simultaneous use of two sets of hose, and the spraying of two orchard rows at the same time. This pump, which is powerful, simple, and compact, is made by the Goulds M'fg. Co., of Seneca Falls, N. Y. An equally good pump for use under the same conditions is manufactured by W. & B. Douglas, of Middletown, Conn. The mixture may be kept stirred by means of a disk of wood screwed to the end of a broom-handle and inserted through a hole in the top of the barrel.

*The Nichols Chemical company, 45-49 Cedar St., New York City.

For spraying on a smaller scale, or where a mounted barrel cannot be driven, some form of "knapsack" sprayer is convenient if not essential. Many forms are advertised, all made on the principle of combining with a small force-pump, a tank or receptacle to be carried on the back. A very perfect machine of the kind is known as the "Galloway Knapsack Sprayer." The Messrs. Douglas, of Middletown, are prepared to furnish this sprayer, or one very similar to it.

If the area to be sprayed requires but six or eight gallons of the liquid, as e. g. in greenhouse work, or when only a few plants or vines are to be treated, a most serviceable pump for attaching to a pail is the Johnson pump, sold for \$4.50 by Cordley & Hayes, 173-175 Duane St., New York City. If the nozzle sent with this pump is removed and replaced by a piece of $\frac{3}{8}$ -in. hose, 6 or 8 ft. long, provided with a Vermorel nozzle, a most effective and convenient means of spraying on a small scale is procured.

NOZZLES.

It is hardly necessary to say, after so much has been written and said on the subject, that for the proper application of fungicides a rose nozzle or an ordinary sprinkler is not sufficient. Several spraying nozzles have been devised of which only two need be mentioned here, the Nixon and the Vermorel.

In the Nixon nozzle the liquid is driven through a fine gauze cap and issues in a copious, smoky spray. For use with clear liquids it is unsurpassed. With mixtures however, like the Bordeaux mixture which contains lime in suspension, this nozzle is liable to clog and is not readily cleaned.*

The Vermorel nozzle works equally well with clear solutions and with liquids having substances in suspension, it delivers a fine and abundant spray, and is on the whole the most serviceable nozzle for general work with which we are acquainted.

A very useful adaptation of the Vermorel nozzle, called an "Undersprayer," is manufactured and sold by Messrs. Wm. Boekel & Co., 518 Vine St., Philadelphia, Pa. The nozzle is attached to a brass pipe, 3 ft. long, by a union-joint, which allows of its being turned and the spray applied directly upwards or in any required direction. It is of special use in spraying grape-vines for "mildew." The advertised price of the "Undersprayer" is \$1.75.

* This nozzle may be procured of the Nixon Nozzle and Machine Co. of Dayton, Ohio, at \$1.00 each.

HOSE.

It is often necessary in directing a spray at some distance from the ground, to use a greater length of hose than would ordinarily suffice. The best kind for the purpose, as for any light discharge pipe, is what is known as $\frac{1}{4}$ -in. "linen insertion tubing." The hose should be attached to a light pole of sufficient length to reach above the foliage to be sprayed, so that the spray may be directed downwards upon it.

The following quotations for spraying pumps and accessories are furnished by Messrs. W. & B. Douglas of Middletown, Conn. The quotations are on goods ordered directly from their factories at Middletown, and the prices are *net* :

Double-acting Spraying Pump (similar to Gould's) with all brass piston and brass outer cylinder*.....	\$9.50
———Double-acting Spraying pump (similar to Gould's) with all brass piston and iron outer cylinder, fitted with leather valves	5.00
———The same, fitted with metallic valves	6.50
Three feet suction hose for same with couplings and brass strainer	2.25
Single couplings for $\frac{1}{4}$ -inch hose25
Y-coupling " "	1.00
Vermorel Nozzle (2 caps with coupling for $\frac{1}{4}$ -inch hose or with large standard coupling as desired).....	1.25
The Messrs. Douglas will also be prepared to furnish Prof. Galloway's Knapsack Spraying Pump with planished copper tank and copper cover, for about	11.00

Quotations for tubing given by the Goodyear Rubber Store, F. C. Tuttle, prop., 866 Chapel St., New Haven.

$\frac{1}{4}$ -inch linen insertion tubing (lots of 100 feet or more) per foot.....	.08
" " " " (lots of 50 feet or more) per foot.....	.10
" " " " (lots of less than 50 feet) per foot.....	.12
$\frac{5}{8}$ -inch heavy rubber tubing, per foot.....	.18

* For use with the copper compounds it is advisable to have all the parts of the pump, including the outer cylinder, made of brass, as these compounds corrode iron.

A PROVISIONAL SPRAYING CALENDAR.

The following provisional calendar is given here at the request of several fruit-growers. It is manifestly impossible to give with any degree of accuracy the exact dates upon which fungicides should be applied. The fact that we sprayed last year on certain dates, by no means presupposes that those dates will be suitable the coming season.

Seasonal variations between two successive years, and the varying conditions of rain-fall from one season to another, are often so great that the exact date of any farm operation cannot be known beforehand. The following table is therefore merely approximate, to be modified by the exercise of common-sense.

JANUARY AND FEBRUARY.

But little can be done during these mid-winter months in the way of spraying, though a great deal by way of preparation. If it has not been already done at the proper time, cut out and burn the "black knot" of plum and cherry now, and destroy all neighboring wild cherries which are knotty.

In the latter part of February do all necessary trimming of vines and fruit trees, unless this has been done in the autumn, as is often the case. Where "anthracnose" has previously attacked grape-vines, raspberries or blackberries, prune severely, cut out every trace of diseased wood or cane and burn it. The increased vigor obtained by the free access of light, air, and ventilation will compensate for the severe pruning.

In open winters, February is none too early to go over the orchard carefully and collect and burn all leaves and fruit from diseased trees, such as mummified cherries, plums and peaches, scabby or rotted pears and quinces, and all blighted leaves. Remember that on the first warm day the air will be full of the germs of plant disease from these fruits and leaves, if they are not destroyed. Do not use them for bedding or mulch, and do not throw them into the pig-pen.

MARCH.

The middle or end of this month will see everything ready for winter treatment (copper sulphate, 1 lb. to 25 galls. of water). Select a warm day, or if possible, several days of warm, melting weather. In some seasons winter treatment can hardly be made

before April. This treatment is especially good for diseases of apple, pear and quince, for "anthracnose," and for the "black-rot" of grapes. Where the latter has occurred the previous year, ploughing between the rows in order to cover up diseased berries will be found of great advantage. If plums and cherries suffer in summer from lice, spray the trees now with kerosene emulsion to destroy the eggs.

APRIL.

Put all spraying apparatus in thorough order. Clean and rinse pumps, oil all bearings, see that the valves work well, and test the tubing for leaks.

If the winter treatment has been deferred until this month, see that it is finished before the middle of the month.

MAY.

This is usually the flowering month for vines and fruit trees, and the first application of Bordeaux mixture or other fungicide should immediately precede the opening of the flowers. Use your own judgment. Apples are generally in bloom by the second week in May; quinces, pears and grapes usually not until somewhat later. The importance of these early treatments can hardly be overestimated. Watch to see when the petals begin to fall, and make a second application within a few days of that date.

During the last part of May examine carefully the plum and cherry trees. The young "black-knots," now of a greenish color, will be found bursting through the bark. Cut them out and burn them, and paint the wound over at once. A day spent on the "black-knot" in May and June is worth ten days' work later.

JUNE.

The first part of June usually marks the fall of the flowers of most fruit trees. Never spray while trees and vines are in full bloom. Make the second application as soon as the petals have fallen. This will be late in May or early in June for apples, a week or ten days later for other fruit-trees and grapes. Make the June treatment thorough. In spraying for apple-scab, add Paris green to the fungicide for this second application, and also for the third; this will act against the codling-moth. June is a critical month for all fruits and vegetables, especially for grapes.

They are most susceptible to "black-rot" between June 20th and July 10th; treat thoroughly and frequently.

A good general rule to follow after the second spraying, is to let each additional treatment be made from ten days to three weeks after the preceding one; the shorter interval if there are heavy, washing rains, the longer if the weather is comparatively dry.

It must also be remembered that the more adhesive a fungicide is (e. g. the Bordeaux mixture), the less frequently will the applications be needed.

JULY.

This month will close the treatment for most diseases. To avoid the spotting of grapes by the Bordeaux mixture, the two applications during the latter part of this month should consist of the ammonical solution of copper carbonate. Early in the month spray for the "black-rot" of quinces, and continue treatment every two weeks until the last of August.

AUGUST.

The spraying season closes this month. For "leaf-blight" of strawberries, mow the leaves late in July or early in August, and after allowing them to dry where they lie, set fire to them and burn the bed over.

Thoroughly clean and oil all spraying apparatus, and see that it is carefully stored.

SEPTEMBER, OCTOBER, AND NOVEMBER.

The months of harvest. When picking fruit, let one or two boys follow and clean the trees of all diseased and mummified fruit, collecting it in baskets to burn. At the same time gather and burn, as far as possible, all diseased fruit which has fallen.

In November clean the orchard thoroughly of fallen leaves, especially if disease has been prevalent, and burn them. Better to destroy them now than in the spring, when the fungous fruit will have come to maturity in and on the leaves.

DECEMBER.

The "black-knot" fungus matures during December and January; attack it early in the former month. Use the pruning-knife unsparingly, cutting out two or three inches above and below each "knot." Burn every "knot," and paint the wound over at once.



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