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SPRAY TREATMENT, ETC., for ORCHARDS.



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SPRAY TREATMENT, ETC., FOR ORCHARDS.

By W. E. BRITTON, *Entomologist*, and

G. P. CLINTON, *Botanist*.

This bulletin has been prepared to meet a constant and growing demand for information regarding the general spraying of orchards in Connecticut. More specific and detailed accounts of the various insect and fungus pests of orchards may be found in the Spray Calendar and in the reports of this Station, especially those of the Entomologist, the Botanist, and in "Tests of Summer Sprays on Apples and Peaches", Reports 1910, page 583, and 1911, page 347. Some of these are out of print and can no longer be supplied.

If the orchardist finds troubles not readily recognized by means of the publications just mentioned, or if they are new to him, he should send specimens to the Station for identification and for advice about treatment. All such specimens should be placed in a strong paper, wood or metal box, so as not to be crushed in the mails. All communications are answered when the sender's name and address accompany specimens.

WINTER TREATMENT.

PRUNING AS A CONTROL MEASURE.

In most peach and apple orchards it is the usual practice to prune before spraying the dormant trees, especially before the March spraying with lime-sulphur or with miscible oil. All surplus wood may then be taken out, thus leaving less bark surface to be covered with the liquid. If the trees are attacked by San José Scale or any other kind of scale insect, the worst infested branches should be removed. All branches showing injury from the attack should be headed back in order to get a stronger growth from fewer buds.

Winter pruning is even more essential for fungus troubles than for insects. Of course one of the chief reasons for pruning is to take out unnecessary and interfering branches and shape up the tree, with resulting improved dry air drainage whereby infection by fungi is lessened, but even more

important is the removal of dead limbs and twigs and those showing diseased areas and cankers in the bark, as all these are frequently the carriers of the winter stage of injurious fungi. When it is not advisable to remove the cankered branch or trunk, the infected area should be carefully removed by cutting clear to the healthy bark and scraping out all the intermediary tissues. These scraped areas and the cut ends of the larger branches should be painted over when dry with white lead or coal tar.

After this pruning has been done the tree should be thoroughly coated with spray. It is a good practice to burn all diseased or infected branches which have been cut from the trees.

For the blight on pear, also on apple and quince when they are seriously affected by this bacterial disease, winter pruning is especially desirable, since the re-inoculation of the germs in the freshly cut surfaces is then much less likely than during the growing season. Even in winter, however, it is best to cut off the branches some distance below the diseased parts and wipe the pruning tool frequently with a cloth moistened in carbolic acid or corrosive sublimate solution, to kill any accidentally attached germs.

For cherries and plums attacked by black knot, pruning in late fall or in winter before the winter spore stage starts to germinate is likewise desirable. Cutting *out* the knots has not been found very satisfactory, so all infected branches should be cut *off* several inches below any signs of the knot. When possible, it is best to commence this pruning with the young trees as it sometimes requires severe treatment to remove all knots. This should be kept up each year until the knots fail to reappear. In case the tree is severely cut back, additional pruning is needed from time to time to re-shape the tree, remove water sprouts, etc. The knots should be carefully gathered up and burned before spring. Watch should be kept of wild cherry and plum trees in the neighborhood, lest they serve as a means of infection.

WINTER SPRAYING.

Spraying of orchard trees, when dormant, was first made necessary in Connecticut from ten to fifteen years ago by the

prevalence of the San José Scale, which ruined many peach orchards and seriously damaged apple orchards. Winter spraying is practiced for the purpose of destroying insects rather than fungi, though one fungus, the peach leaf curl, may also be controlled by this treatment.

Besides the San José Scale, certain other pests, such as the leaf blister mite on pear and apple, the clover mite which may be found on any kind of trees, the pear *Psylla* on pear, the green apple aphid and the rosy apple aphid on apple, may all be wholly or partially controlled by the winter treatment.

For most of the insect troubles mentioned above, the trees may be sprayed as soon as the leaves drop in November, or just before the buds open in April. The fall application will probably kill more San José scales than the spring application, because they are not then protected by their winter covering and often the naked young may be seen crawling about until December 1st. Where trees are badly infested with San José Scale, it is usually advisable to spray twice, once in November and again in April, as the second will often cover parts of the tree that were missed by the first treatment.

For peach leaf curl, however, the early spring treatment is advisable, and some newly-hatched aphids will then be killed which were not present on the trees at the time of the November application.

WHAT TO USE.

Lime-Sulphur Mixtures.

The best all-round spray for peach, plum and all young and smooth-barked trees is the lime-sulphur mixture. In some of the larger orchards this is made on the place which, no doubt, is the cheapest and best way, if the size of the orchard warrants the outlay for the plant. In most cases, however, the owner will prefer to purchase his lime-sulphur, and he can buy the commercial liquid lime-sulphur in any desired quantity, ready to dilute and apply, and be fairly certain of procuring a good article. This commercial lime-sulphur should test about 33°B and it should be diluted at the rate of one part in nine parts of water.

There are now on the market several dry lime-sulphur mix-

tures which claim a great saving in freight by not shipping the water. Some of these are sulphides of basic elements other than lime, and they will probably prove good insecticides and possibly fungicides, without causing injury to the trees, but they are still more or less in the experimental stage.

Miscible Oils.

If one has large and old apple trees with rough bark and badly infested with San José Scale, he may be able to rid them of the scale quicker by spraying with one of the so-called soluble or miscible oils, such as "Scalecide", "Carboleine" or "Jarvis Compound" than with lime-sulphur, because the oils have a greater penetrating power and will go into the cracks and crevices. It will also moisten the pubescent twigs and "crawl" around them. These oils should be diluted at the rate of one part to fifteen parts of water.

Lime-Sulphur versus Miscible Oils.

The oils are not so good fungicides as is lime-sulphur and, when they do not mix freely with water, are liable to cause injury and should not be used. There is no danger of injuring dormant trees with the lime-sulphur mixtures. Moreover newly hatched scales will establish themselves readily on bark which was sprayed with oil preparations in the spring, but they do this very sparingly on bark treated with lime-sulphur; consequently, if any are present they are found on the new growth—twigs, leaves, or fruit.

At the Station farm, Mt. Carmel, in the old and neglected orchard of about fifty trees, some of which were badly infested, the San José Scale has been controlled satisfactorily for four years by the use of lime-sulphur,—no miscible oil ever having been used. The trees are now nearly free from scale, but for two years they were given both fall and spring treatments.

SUMMER SPRAYING.

APPLE.

In the average apple orchard only two summer spray treatments need be given, the first soon after the blossoms fall and the second from three to four weeks later, the spray being lead

arsenate (3 lbs. of the paste, or $1\frac{1}{2}$ lbs. dry, in 50 gallons of water) to kill the codling moth or apple worm which is always present; and usually combined with some fungicide such as commercial L. & S. ($1\frac{1}{2}$ gallons). The beginner should follow this simple treatment until he learns what special troubles he needs to control, and unless somewhat familiar with spraying practices, he may be confused by the more complicated combination formulas and directions for controlling the various pests. He should begin at the bottom and "work up".

For the orchardist more experienced in spraying and identifying insect and fungous pests, we recommend the following three treatments, or such as he may need, for controlling the particular enemies of his orchard:

(1). In certain localities and in certain seasons, canker worms, bud moths, tent-caterpillars and brown-tail moths may do great damage. In case any or all of these are present the worms feed on the unfolding leaves, and a spray of lead arsenate should be given before the blossom buds open, though not until there is considerable expanded leaf-surface to hold the poison. If scab and rust are prevalent, a fungicide, preferably Bordeaux mixture, 4-4-50, should be added to the poison for this treatment, or if the insects mentioned above are not troublesome, it may be used alone.

(2). After the blossoms fall the experienced orchardist will use a fungicide, preferably dilute lime-sulphur, $1\frac{1}{2}$ gallons in 50 gallons of water. Where there is little danger of russeting the fruit, weak Bordeaux mixture (which is a better fungicide) 1-4-50, may be used instead of lime-sulphur. Lead arsenate should be added in either case. If there is a prospect of considerable damage from aphids, leaf-hoppers, scale-insects, red-bugs, or pear *Psylla*, a 40 per cent. nicotine solution, $\frac{1}{2}$ pint per barrel, may be added to the combination without injury to the foliage and without impairing the insecticidal or fungicidal properties of the mixture.

(3). The combined fungicide-insecticides just mentioned may be used for the June or third spraying but the nicotine may not then be necessary. This third spraying takes care of the second brood of codling moth, late chewing insects, etc., also the sooty blotch, late scab and various fruit specks and rot fungi.

PEAR.

As a rule pears do not require so much summer spraying as apples and the treatments are given for specific troubles. It may be advisable to apply poison for codling moth, pear slug and other leaf-eating insects, and a fungicide, preferably Bordeaux, to control leaf blight and scab. Occasionally nicotine may be needed to control plant bugs or the pear *Psylla*. The applications should be made at the same three periods as for apples; namely, on the unfolding leaves before the blossoms open, just after the petals fall, and about three weeks later.

In case pear blight is serious despite the winter pruning, summer pruning, with especial care not to spread infection by means of the pruning tools, is sometimes desirable.

PEACH.

Peach foliage seldom needs to be sprayed with poison. In Connecticut orchards the peach sawfly has caused partial defoliation and in such cases one spraying with lead arsenate (2 lbs. paste in 50 gallons water) should be given about the middle of June. This may be added to the self-boiled lime-sulphur, which is the safest fungicide for controlling scab and brown rot.

Scab can usually be controlled by two treatments,—one on the young fruit about the middle of May, and another the middle of June, while rot is often largely prevented by two treatments about the middle of June and July. Three treatments, about the middle of each of these months, will take care of both troubles fairly well. Summer spraying is most advisable in case of such badly rotting varieties as Champion, etc., or when Elberta, etc., scab badly. It has hardly come into general practice in this state, but deserves more attention than has yet been given it. Atomic Sulphur has proved as satisfactory in our experiments as the self-boiled lime-sulphur in controlling these two fungi.

PLUM.

Plum orchards may need to be sprayed occasionally with poison to prevent damage from canker worms or other leaf-eating insects. Some writers recommend this treatment against

curculio, but probably the jarring method of control will usually be found more satisfactory.

For the control of brown rot the fruit should be thinned, and after harvest all mummies should be gathered and destroyed. While spraying is not entirely satisfactory, largely because the spray does not adhere readily to the smooth fruit, it may be desirable in certain cases. The first treatment should be made with self-boiled lime-sulphur on the fruit when about half grown, and be followed by a second, third, and possibly fourth spraying in case of late ripening varieties, at intervals of ten to fourteen days. The last spraying should be made about seven to ten days before picking, and can be made with commercial lime-sulphur, 1-150, if there is any danger of sediment on the fruit interfering with its sale. In case of leaf anthracnose, the spraying should be started earlier. See Cherry.

CHERRY.

Rarely is it necessary to spray cherries except for the control of brown rot on the sweet varieties, and for this purpose the self-boiled lime-sulphur should be used, the same as directed for plum.

In case the leaf spot "anthracnose" is troublesome, the spraying should be made earlier than for brown rot, the first application being made on the young leaves just after the petals fall, followed by one or two others at intervals of ten to fourteen days.

Occasionally there may be damage from the pear or cherry slug, in which case a weak lead arsenate mixture (say 2 lbs. in 50 gallons) may be applied. Unless the insects are present, however, it may well be omitted.

QUINCE.

Quince trees, like apples, should be sprayed with lead arsenate and a fungicide, preferably Bordeaux mixture. Three treatments, as for scab of apple and pear, are usually desirable. These help to control rust, black rot, leaf blight, and such chewing insects as are present. Summer pruning for the bacterial blight may be desirable in some cases.

DIRECTIONS FOR MAKING SPRAY MIXTURES.

Commercial Lime-Sulphur. Any of the commercial lime-sulphur mixtures on the market testing about 33° B. may be used for spraying fruit trees. For winter treatment these are usually diluted with one part of the mixture to 9 parts of water. For summer treatment the dilution is usually $1\frac{1}{4}$ to $1\frac{1}{2}$ gallons to 50 gallons water.

Self-Boiled Lime-Sulphur. This is a home-made mixture prepared as follows: Eight pounds of fresh lime are started slaking in a barrel with a little water (warm water preferably in cool weather), and when the mass has begun to heat, eight pounds of sulphur flour are quickly sifted in and thoroughly stirred with the slaking lime. This, at the consistency of a rather thick paste, is allowed to heat for fifteen minutes from the time the sulphur is added, when it is cooled down with additional water. The mixture is stirred and strained into the spray barrel, to remove the coarser sediment, and diluted to the fifty gallons.

Usually three barrel lots can be made at a time in an ordinary barrel by using three times the amount indicated above. This amount furnishes more heat and makes a little better mixture than when made up in single barrel lots. A third of the amount is then used with a barrel of water.

Bordeaux Mixture. Four pounds of copper sulphate are dissolved in hot water or by suspending the crystals in a coarse bag in a half barrel of water. Four pounds of fresh lime are slaked in a small amount of water, and then strained into the spray barrel about half filled with water. To this is then added the half barrel of dilute copper sulphate.

When several barrels are needed, stock solutions can be made up as follows: The copper sulphate is dissolved in a barrel at the rate of one pound to one gallon of water, and the lime, after slaking, is diluted so that it also contains one pound per gallon of water. Then, when needed, four gallons of the lime water, after stirring thoroughly, are strained into the spray barrel, this half filled with water, and four gallons of the copper solution, further diluted to make about half a barrel, are poured into this.

Lead Arsenate. This poison is manufactured in both paste and powder form. The paste form is generally preferred for orchard work, but it dries and becomes lumpy if kept from one year until the next. It also corrodes metal containers. The paste contains fifty per cent. water and should be used in the proportions of 3 lbs. in 50 gallons of water. It is best to first mix it thoroughly with a small amount of water before putting into the spray tank.

Dry or powdered lead arsenate will keep indefinitely in a dry place. In spraying, use just half as much as of the paste form, or 1½ lbs. in 50 gallons of water. The dry lead arsenate may be thrown into the spray tank after it has been filled with liquid, and it will be readily moistened and distributed.

Both paste and powdered lead arsenate may be used in connection with lime-sulphur, Bordeaux mixture, or nicotine solution and larger quantities of arsenate may be used if desired.

Nicotine Solutions. Several of these are now sold containing forty per cent. or more of nicotine, usually in the form of sulphate. For most kinds of aphids one-half pint to a barrel of water is sufficient, but the amount may be much increased or doubled without danger of causing injury. Nicotine solutions may be safely used in combination with lead arsenate, Bordeaux mixture, or lime-sulphur; with any one or with all of them.

Miscible Oils. Several brands are now on the market, and for dormant spraying each should be diluted at the rate of one part in 15 parts water. The contents of each original package should be thoroughly mixed or shaken before attempting to dilute any portion of it. As a rule, it is unnecessary and inadvisable to mix miscible oils with other spray materials. Such oils are chiefly used on dormant trees.

CAUTIONS.

Before beginning to spray, know what you are spraying for. If you have troubles which you cannot identify, send specimens to the Station and get information and advice.

Never spray any fruit tree while in bloom. It kills your best friends, the honey bees, which pollinate the flowers and

help to increase the yield of fruit. The spray will also injure the delicate floral organs, so that fruit will not set.

Be careful about using any kind of spray not advocated here, especially on peach and Japan plum foliage, which are especially susceptible to spray injury.

If miscible oils do not mix readily and thoroughly with water on diluting, they should be discarded, as there is danger of injuring the trees.