

The Value of Spraying in Fruit Culture.

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Thesis. — Outline.

I Introduction.

II History of Spraying

i. Origin.

2. Advancement

1. In foreign countries.

2. In America.

III Objects of Spraying.

IV Some Spraying Devices.

V Insect Pests

1. List injurious to Kansas fruits.

2. Means of combating them.

VI Fungous Diseases

1. List injurious to Kansas fruits.

2. Means of combating them.

VII Essential Points in Spraying

1. How to Spray.

2. When to Spray.

3. Why to Spray.

VIII Conclusion.

The Value of Spraying in Fruit Culture.

The present power of man to combat fungous diseases ^{and} insects injurious to fruits and fruit trees, is great. All that is necessary is for the fruit grower to make himself acquainted with the authoritative facts, ^{and} be able to apply the principles that some men by scientific investigations, by long ^{and} tedious experiments, have given him.

It has been truthfully said, that spraying is one of the most important factors in aiding the successful orchardists. To have been a successful fruit raiser, fifty or a hundred years ago, this might not have been essentially true, for then insect pests and fungous diseases were not so numerous because fruit plantations were widely scattered. The increased number of orchards makes more easy the rapid spread of insects from farm to farm. Mountains, oceans ^{and} rivers, natural barriers which once stopped their progress, fail to do so now. The enormous transportation of

of fruit ^{and} fruiting plants that takes place every year affords an easy means for the rapid spread ^{and} wide distribution of plant pests.

From the time that plants were first known, doubtless insects ^{and} fungous diseases to some extent have troubled the cultivator of fruits. While fruit raising was widely scattered, orchards being far apart, but little attention needed to be given to the destruction of fruit pests.

Remedies of some kind have, however, been applied for a number of years. Some of these remedies first applied are vinegar, rue, tobacco, lime, kaint, soap suds, soot, train-oil, sulphur, petroleum, lye, ^{and} many other liquids ^{and} semi-liquids too numerous to mention. These were applied more on account of their strong odor, bitter taste, and power to keep insects away, than for their poisonous qualities.

Some of these substances were mixed ^{with} water and sprayed; but generally they were powdered, then dusted or rubbed on the plant. An early remedy for plant lice was a solution of tobacco, several

handfuls of powdered tobacco being put in several liters of water in which lime has been slaked. Even powdered tobacco was sprinkled on the limbs, which, it is claimed, successfully rid the plant of lice. Soot, lime, ^{and} soap worked to a disadvantage, as they stained the fruit ^{and} leaves. Such substances as oils, turpentine ^{and} kerosene proved injurious to the plants sometimes killing them. Paints ^{and} washes in the early history of their use, for the treatment of plant diseases were applied by means of brushes or rags, and sometimes the limbs were washed with a rag and sponge. This almost outgrown method is still practiced in greenhouses, to some extent, in ~~greenhouses~~ to protect the foliage.

The great evolution in spraying received its first impulse in France, between the years of 1862 ^{and} 1882, when chemicals took the place of those substances which principally appealed to the senses. In 1862 Gironard sprayed grapes with a solution of acetate of potassium, four grains of acetate of potassium to one

liter of water, for the downy mildew. Powders as well as liquids were experimented with by the Frenchmen. In 1881, "Fungivore," a powder of sulphate of iron, was highly recommended as a preventive of anthracnose. Three or more applications were used to protect the plant well.

The grape-growers of France, not yet satisfied, worked steadily on. Previous to this time, some experiments had been made with salts of copper. The Bordeaux Mixture, which has become so famous as a fungicide had its origin in France, in 1883; - that is, experimental work to determine its value, was carried on at that time. It proved a very effective remedy for the treatment of the downy mildew on grapes. The mixture contained quicklime ^{and} copper sulphate in water. The proportions varied with the different vinyardists. Millardet, by various experiments in testing its action upon foliage ^{and} upon grapes, succeeded in getting a mixture that proved effective. It soon developed

that the Bordeaux Mixture was not only an effective remedy for the downy mildew on grapes, but was also a successful remedy for other fungous diseases of many plants, and was destined to work a revolution in fruit raising.

In 1886, the ammoniated copper fungicide, a mixture of ammonia and sulphate of copper with the addition of sufficient water to spray well, was experimented with, but did not prove a success. Experiment after experiment was carried out, until in 1887, fungicides almost reached perfection in France. Their value in ridding plants of mildew, anthracnose, black rot, etc., was no longer questionable, but a verified fact.

In France, the vineyards are sprayed from three to four times, the first time when in blossom or shortly after, followed by the second application in about four weeks, the third and fourth applications following the previous ones from three to five weeks apart, the time depending somewhat upon whether the weather is moist or dry. When wet,

the intervals of time are shorter.

The evolution of insecticides has not been so great in France as that of fungicides, the destructive pests being chiefly fungous diseases. Most of their insecticides were copied after the United States. Little need be said as to the progress made along these lines, in Italy. She has closely followed the footsteps of France.

In the application of fungicides and insecticides, the Germans also followed the principles laid down by the French. There is one notable exception. They do not apply the remedy when the plant is in blossom, but either before or shortly after the plant comes into bloom.

England was slow to adopt the principles ^{and} rules of spraying. It is only in recent years that she has made herself acquainted with the beneficial results that accompany spraying. No new rules or principles were developed by her. She simply copied after France ^{and} the United States.

It was not until about 1860 that the fruit-growers of the United States

became interested in spraying. On account of the terrible warfare waged on some plants by injurious pests, the potato beetle in the West ^{and} the currant worm in the East they became aware that it was necessary to use some means to combat these destructive insects. Hellebore ^{and} kerosene were known to them, but had proven but a partial success. This was due to lack of knowledge as to the use of these insecticides.

Between 1860 ^{and} 1870, Paris green appeared upon the scene as an exterminator of chewing insects. It originated in the western states, but the discoverer will probably never be known. It was first used on the potato, as a destroyer of the potato beetle. Paris green was mixed in different proportions and with many different ingredients, such as flour, plaster, ashes, etc., the proportion varying from two to twelve parts diluent to one of poison, and in later years from twenty-five to thirty parts diluent to one of poison. Only since the later improvements in spraying devices has it been used with water.

It was not until 1878 that the Codlin moth was successfully combated with Paris green.

London Purple, another arsenite, came into use shortly after Paris green. At first, it was not received with as much favor as Paris green, but was soon recognized as almost its equal.

The curculio, in 1870, was unsuccessfully treated with Paris green, but finally, London purple mixed ^{with} Bordeaux mixture, rid the sprayed fruit of this pest.

White arsenic, a mixture of one part arsenic to two parts lime diluted with one hundred gallons of water, came into use in 1880. Its success was rather uncertain, as the foliage was injured before a sufficient quantity to kill insects had been applied.

Arsenite of lead was used by Moulton, in 1872, for the Gypsy moth. Its work was satisfactory. One to two pounds to fifty gallons of water was used. Apple foliage was not injured by this spray. In 1889, milk of lime was added by some to this arsenite to overcome their caustic properties. It lessened the danger to which plant foliage was liable, except in

the case of white arsenic, where the injury was increased. From the experiments carried on, it was discovered that to lessen the injury by the addition of milk of lime, the arsenic must be in solution.

Caustic and non-poisonous insecticides destroy insects not from being eaten, but because they enter the body and death ensues as a result of closing these breathing pores, or by action of these agents on some vital organ. Some of these remedies are pyrethrum, kerosene emulsion, soap ^{and} resin, and such alkalis as soda potash. The pyrethrum is obtained from the flower of the pyrethrum plant, and is generally applied as a powder.

One of the recommended caustic solutions consists of one pound caustic soda in eleven gallons of water to produce the lye; two pounds of resin ^{and} one pound of tallow dissolved by boiling, at the same time adding one quart of lye and enough water to make five ^{and} one half gallons of the mixture.

In adopting the use of fungi-

cides, the Americans have been slow. Probably this is due to the fact that fruit-growers do not recognize the very injurious effects of fungous diseases. Saunders ^{and} Goff, in 1884, were the first to apply fungicidal remedies, of any experimental note. Three different remedies were recommended for the apple scab, and leaf blight of the apple, as follows: first, hydrosulphate of soda, a solution of one pound of soda to ten gallons of water; second, sulphide of lime, a mixture of two pounds of sulphur and one pound of quicklime, boiled in one gallon of water, stirring frequently; for use, the clear liquid after settling, being poured off; third, a mixture of one pound of sulphur to ten gallons of water.

In 1886, the American vinyardists commenced a warfare against the downy mildew ^{and} black rot. The remedies applied were of French origin. By the use of Bordeaux Mixture, in 1889, it was estimated from experiments by the government experiment station,

that over \$65 per acre was saved.

The object of spraying is to secure a better quality of fruit, this can be accomplished only by keeping the plant as free as possible from all pests. Plants that are defoliated produce an improperly developed fruit, small in size, more liable to decay, ^{and} poor in quality. Thus we spray to retain the foliage, which allows the plant a more vigorous growth ^{and} makes it better able to bear its fruit.

With the advancement made in spraying, or rather the necessity for it, different devices for spraying have been invented. Some of the earliest methods of application were, sprinkling liquid, dusting the powder on by hand, ^{and} by washing the limbs with a brush or rag. This was slow ^{and} tedious. These methods were followed by the use of small hand pumps of very simple construction consisting of a tube enclosing a piston in which a piston rod is worked. The solution was expelled from the same opening it entered. Later, they were made

with a valve, the solution was expelled from a different opening from that which it entered. In 1880, the knap-sack pump was introduced from France. This kept the liquid stirred by means of air forced in from the bottom. Now we have many spraying machines that work with ease, ^{and} keep the liquid well stirred.

The value ^{and} lasting qualities of a spraying machine depend upon how it is made, what it is made of, the ease with which it is run, ^{and} how thoroughly it keeps the solution stirred. All the working parts should be made of brass. Other metals are more liable to rust, thus lessening the durability of the sprayer. Leather, or the best of rubber, which may be easily replaced, is used in the valves and in packing. The barrel portion may be either of iron or brass. The cylinder, especially of a barrel spray pump, should not be less than two and one-half inches in diameter. To drive the liquid with force through the nozzle, the handle should be about thirty inches in length, and

from pivot to piston, four inches. This affords an easy stroke, ^{and} the liquid is thrown with great force. By all sprayers, a uniform sprayer is recognized as the best. To make the sprayer complete it should have an agitator, one that will keep the liquid thoroughly stirred.

Insect Pests ^{and} Treatment.

Apple.

Aphis (Aphis Mali.) This little insect, generally known as the plant louse, is found on the young shoots ^{and} leaves. It injures the plant by sucking the juices. Treatment. Spray in early spring with an alkaline wash; second, spray at opening of the buds with kerosene emulsion; third, two weeks later, apply kerosene emulsion.

Flat-headed Borer (Chrysobothris femorata) and Round-headed Borer (Saperda candida.) Not controlled by spraying. Best treatment is to dig out the larvae with a knife or run a wire into the cavity. An alkaline wash, one gallon of soap-suds with one ounce of carbolic acid is applied as a preventive.

Bud-moth (*Timetocera ocellana*). The adult moth measures about three-fourths inch across fore wings. Color of moth, ashen gray, with fore wings somewhat lighter. Eggs generally laid in June. Larvae hatch from one week to ten days. After feeding on foliage about two months, they enclose themselves in a silken case, from which they emerge the following spring.

Treatment. Two sprayings with Paris green before blossoms open is generally sufficient.

Fall Canker-worm (*Anisopteryx formosaria*) and Spring Canker-worm (*Polecista vernata*). Usually known as measuring-worm. The female is wingless. In spring, she crawls up the tree to deposit eggs.

Treatment. Spray with Paris green. First application before buds open; second and third following the previous one about seven days. The ascent of the female is prevented by some sticky substance like tar, and by traps or a wire screen fastened tightly around the tree near the base.

Cigar-case Bearer (*Coleophora fletcherella*). Adult moth steel-gray. Eggs deposited in June.

and July. Larvae soon hatch, feed upon the foliage, ^{and} then enclose themselves. The case has the shape of a cigar, and is made from the leaf. They appear again in the spring ^{and} commence to feed upon the young tissues. Treatment. Make the first application of Paris green before blossoms open, this with two applications after they have fallen is sufficient.

Codlin Moth (*Carposapisa pomonella*). Moth about one-half inch long. Color, grayish brown, with wings marked ^{by} irregular transverse streaks. The larvae feed upon the fruit. Treatment. Spray with a mixture of Paris green and Bordeaux Mixture. First application just after blossoms have fallen; second time, from a week to ten days later.

Fall Web-worm (*Hypophantria cunea*). Moth is pure white. Eggs laid on foliage in early summer. Full-grown larvae is covered with various markings. Head is black and a dark line extends along the back. It feeds upon the foliage and in the fall descends ^{and} spins its cocoon, the adult appearing next spring.

Treatment. Spray with an arsenite. If spraying is neglected, the larvae collect in a large web; take out this web ^{and} burn.

Tent Caterpillar (*Colisicampa americana*). Moth about three-fourths inch long. Color is generally brown. Eggs laid in July but do not hatch until following spring.

Larvae soon hatch, feed upon the foliage and in a few days, commence to spin their web.

Treatment. Spray with Paris green, first, before buds open, ^{and} second time about two weeks later. If spraying is neglected, remove the caterpillars with the web ^{and} burn.

Woolly Aphis (*Schizoneura lanigera*)

This insect is a small yellow plant louse and is found upon the roots ^{and} branches. It is protected by a woolly covering. The plant is injured by the sucking of the juices.

Treatment. Spray early with an alkaline wash, following this about a week later with kerosene emulsion. Those on the roots may be destroyed by removing the earth pouring on hot water at a temperature of 100 Fahr.

Apricot. The principal insect foe is the curculio, treated same as plum.

Cherry.

Cherry-leaf Aphid. The first treatment is an alkaline wash, before the buds open. The second application is kerosene emulsion when aphids appear. The canker-worm and curculio are treated the same as the canker worm of apple and curculio of plum.

Currant.

Imported Currant-borer (*Sesia tipuliformis*). Moth about three-fourths inch across expanded wings. Color, bluish-black, with three yellow bars across the abdomen. Larvae feed upon the fruit.

Treatment. Cut out infected canes ^{and} burn.

Imported Currant worm (*Nematodes ventricosus*). The adult is a four winged fly. Deposits the eggs in early spring on the under side of leaves. The eggs soon hatch ^{and} the worms feed upon the foliage. The young larvae are whitish, but before pupating are spotted. From two to four broods appear annually. Treatment. Spray with Paris green in Bordeaux Mixture before flower buds open.

Second application, one week to ten days later. The rest of the applications are made with hellebore when worms are present.

Current Leaf hopper (*Empoia alboscripta*). These insects are true bugs. They are rather slender, ^{and} of a light-green color. They suck the juices from the under side of the leaves.

Treatment. Use insecticides which kill by contact, as kerosene emulsion, and Pyrethrum when the insect is present.

Goose-berry.

Goose-berry Fruit-worm (*Pachrura convolutella*). Moth pale-gray. Eggs deposited on berry in early spring. The larvae enter the berry. Treatment. Spray with Paris green in Bordeaux Mixture before the leaves expand, followed by another application in one week using hellebore, the third when worms appear, using hellebore.

The Imported Current-borer, Imported Current worm, and Current leaf-hopper, insects which attack the current, also attack the goose-berry. Treatment same as for current.

Grape.

Leaf hopper (*Erythroneura vitis*).

Insect is about one eighth inch long, of white color marked with three red bands. Passes winter in adult state. Beetles in early spring feed upon buds. In about a month, eggs are laid on leaves and the larvae, hatching, feed on the juices. Treatment. Spray with Paris green when the beetles first attack the vine, ^{2d} again when larvae appear. Two applications each time are sufficient.

Grapevine Elm beetle (*Graptoidea chalybea*). Insect passes winter in adult form. Beetle in spring feeds upon buds. Eggs laid on under-side of leaf; upon hatching, larvae feed upon the foliage.

Peach.

Black Peach-Aphis (*Aphis Persicae* *Niger*). These plant lice are shining black. One form with wings, another without. They feed upon juices of leaves limbs ^{and} roots. Treatment. Spray with alkaline wash before buds open. About two weeks later use kerosene emulsion. The peach-borers and the curculio are treated the same respectively as the borer of the apple ^{and} the curculio of the plum.

Pear.

The Borers, Budmoth, Cigar-case bearer ^{and} Codlin-moth are the same as those which affect the apple. Treatment also same.

Plum.

Curculio (*Conotrachelus nenuphar*).

This insect is a beetle about one-fourth inch in length. Grayish-black in color, with a long curved snout. Eggs are laid in filums. The larvae, upon hatching, eat to centre of filant.

Treatment. Spray with Paris green with Bordeaux Mixture before buds open; second time when fruit is set; third about one week later. Another way is to jar the adult off the tree upon something spread under the tree. Then collect ^{and} destroy.

Borers, Bud-moths, ^{and} Canker worms, are treated the same way as for the apple.

Blackberry ^{and} Raspberry.

Cane-borer (*P. verecumbinae*). It is a slender black beetle. During June, eggs are laid in young shoots. The larvae on hatching, burrow downward in wood. Treatment. Dig up affected canes ^{and} burn.

Strawberry.

Leaf-roller (*Phoropteris comptoni*)

Insect, a small brown moth.

Lays its eggs in early spring on the leaves.

Treatment. Spray with Paris green in early summer; second time about three weeks later. In July, mow plants, rake up and burn.

Fungous Diseases ^{and} Treatment.

Apple.

Bitter-rot (*Glucosporium fructigenum*). It generally attacks the earlier varieties of apples at almost any stage of growth.

Treatment. Apply Bordeaux Mixture. First application before expansion of leaves; second after apples have set. Third, ~~third~~ two weeks later, followed by fourth in a month.

Rust (*Puccinia pirata*) It attacks the foliage appearing during May ^{and} June as yellow spots.

Treatment. Remove diseased leaves. Spray as soon as leaves open with copper sulphate. Second application from eight to ten days later with Bordeaux.

Mixture. If necessary, this may be followed by a third application of Bordeaux Mixture.

Scab (*Fusicladium dendriticum*). It attacks both fruit ^{and} foliage. On fruit, it forms dark spots from $\frac{1}{2}$ to $\frac{1}{4}$ inch in diameter. Shape is circular. Its appearance on leaf is similar.

Treatment. First application of Bordeaux Mixture before buds open; second, before blossoms open, third and fourth following at intervals of ten days.

Cherry.

The Black Knot ^{and} Leaf Blight of the cherry are treated the same as for the plum.

Currant.

Anthracnose (*Glaesporium Ribes*)

It appears in June ^{and} July on the upper side of the leaf as brownish-black spots. Apply Bordeaux Mixture early in the spring.

Rust, or Leaf Spot (*Septoria Ribes*). This appears as brown spots in early summer.

It is sometimes abundant ^{and} covers large areas.

Treatment. First spray with ammoniacal carbonate of copper about middle of June. Then apply Bordeaux Mixture after picking fruit.

Grape.

Anthracnose (*Sphaeceloma Ampelinum*). This disease attacks leaves, fruit and stem. The parts diseased become darkened, and sunken spots are noticeable.

Treatment. Spray first with copper sulphate before buds open; second, spray with Bordeaux Mixture when leaves are about half size; third, when fruit is set; fourth, about two weeks later.

Black and Brown Rot. These two diseases are first sprayed with copper sulphate before buds open; second, with Bordeaux Mixture before blossoms open; third, when fruit is set.

Peach.

Black Spot (*Cladosporium carpophilum*). This fungous generally attacks late varieties. It forms a small brownish spot. Proves very severe.

Treatment. Spray with Bordeaux Mixture about the first of July. This should be followed by a second and third application, beginning in August.

Brown Rot (*Monilia Fructigena*).

It attacks early varieties of peaches.
The fruit rapidly rots about the time
of ripening.

Treatment. Spray with Bordeaux Mix-
ture when buds are swelling; second
application just after blossoming; third,
when fruit is set.

Plum.

Brown rot of plum is treated
same as in peach.

Blackberry ^{and} Raspberry.

Anthracnose (*Glaeosporium*
necator). This disease appears in latter
part of June, attacking the young canes.
Treatment. Spray first with copper sulphate
before the buds start; second time, apply
Bordeaux Mixture ten days later; third
after old canes have been cut out.

Rust. Treatment same as Anthracnose.

Kerosene Emulsion.

Kerosene, 2 gals.

Water, 1 gal.

Soap, $\frac{1}{2}$ lb.

Dissolve soap well by boiling; add
kerosene while water is hot, stirring well.
One part mixture to 15 parts water.

Spraying Compound.

Paris green, 1 lb. Water 150 to 200 gals.
For spraying trees, add about one pound lime.
In using Paris green dry, use one pound
to 50 lbs. of flour.

Pyrethrum. For use, mix with
about four times its weight in flour.

Bordeaux Mixture.

Copper Sulphate, 4 lbs.

Quick Lime 4 lbs.

Dissolve the copper sulphate in hot
water. Slake the lime and strain it.
Mix with 50 gals. of water. Combined with
Paris green, it makes a valuable insecticide.

Copper Sulphate Solution.

Dissolve 1 lb. of copper sulphate in hot
water and then add 25 gals. of water.
Spray only when trees are dormant.

Alkaline Wash. All the washing
soda that the water will dissolve is
put in, afterwards adding soft soap
until thickened. Adding carbolic acid
in sufficient quantity gives a stronger
odor. Apply to base of tree, only.

Since we know that spraying
is valuable, we must determine

what machine is best for our use, and the kind of solution to use, ^{and} when to apply it. It is evident the work should be done so as to secure the best results at least cost, and with least expenditure of labor. To be successful, we must make ourselves acquainted with the habits of the insects. Find out by observation and study when it comes to the plant to feed or deposit its eggs, when the eggs hatch, and when the larvae commence their depredations.

It is, or should be, evident to all that most of our chewing insects may be killed by the use of arsenites; that kerosene emulsion will kill nearly all sucking insects, and that copier solution will kill or prevent the growth of most fungous diseases.

May the time come when every fruit-grower will recognize the fact that spraying is a vital principle, and that he is the one to apply it, if he hopes to keep pace with the onward march of civilization.