

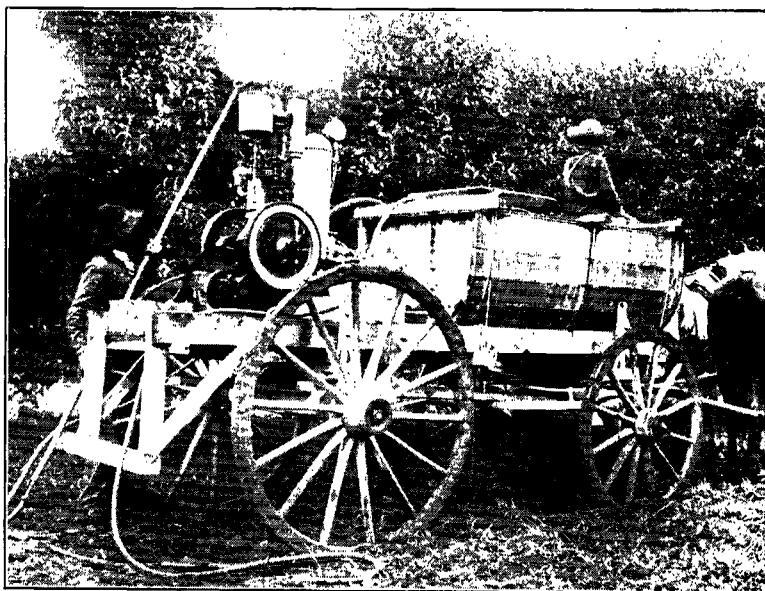
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Kansas State Agricultural College

Agricultural Experiment Station

Spraying



BY

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MANHATTAN

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Spraying

By Albert Dickens and Robt. E. Eastman

The work done by the Horticultural Department of the Kansas State Agricultural College Experiment Station in testing spraying machinery and materials has extended over a number of years. Since the first experiments in 1887 the bearing orchards and vineyards have been regularly sprayed. Results have varied somewhat in different seasons and with different mixtures, but it is gratifying to state that the later operations have been more uniformly successful than earlier ones.

Nearly all fruit plants are subject to insect attack and injury from fungus. A combination spray is desirable and is practicable, but in many cases only one or the other is necessary and advisable.

MATERIALS

For insecticides, Paris green, London purple and arsenate of lead have been most used. Paris green has been found to be somewhat variable in composition, and liable to cause injury by burning the foliage and fruit. From eight to twelve ounces to one hundred gallons of water has been found to be effective, the larger amount used when canker-worms had attained considerable size before spraying. Four pounds of quicklime, well slacked, added to one hundred gallons of water has greatly decreased the danger of "spray burn."

Paris green has sometimes been found to be adulterated, in which case it is of no value.

London purple has been less uniform in composition and more liable to cause "**spray** burn." It is usually stronger in arsenic, and six ounces to one hundred gallons is about the maximum used.

Arsenate of lead has been the most satisfactory insecticide. It has been less liable to cause injury, and has adhered to foliage and fruit very much longer. It is rather more expensive than Paris green, but it has been well worth the difference in price. The commercial brands of arsenate of lead sold as "Disparene" and "Target Brand" have proved satisfactory. The cheapest and at

the same time a very satisfactory form of arsenate of lead was largely used at Hutchinson during the season of 1906, and was made by combining acetate of lead with arsenate of soda in the proportions of three pounds of arsenate of soda to seven pounds of acetate of lead. This mixture was satisfactory in every way.

The most satisfactory fungicide is the Bordeaux mixture, composed of sulphate of copper (blue stone, blue vitriol) and lime. Various proportions have been used, but the formula five pounds sulphate of copper and five pounds of quicklime to fifty gallons of water has been most used in late years.

Copper sulphate varies somewhat in composition, and Bordeaux mixture should be tested before using in order that any excess of copper, which is liable to cause injury, may be detected and neutralized with more lime. Blue litmus paper has been used to make the test. If it remains unchanged it is safe. If it turns red, more lime should be added. Ferrocyanide of potassium is one of the most satisfactory tests. After the mixture has been thoroughly mixed, a sample is taken from the tank and a few drops of the ferrocyanide added. If a reddish brown precipitate appears the mixture has an excess of copper, and lime should be added until the drops of ferrocyanide remain unchanged.

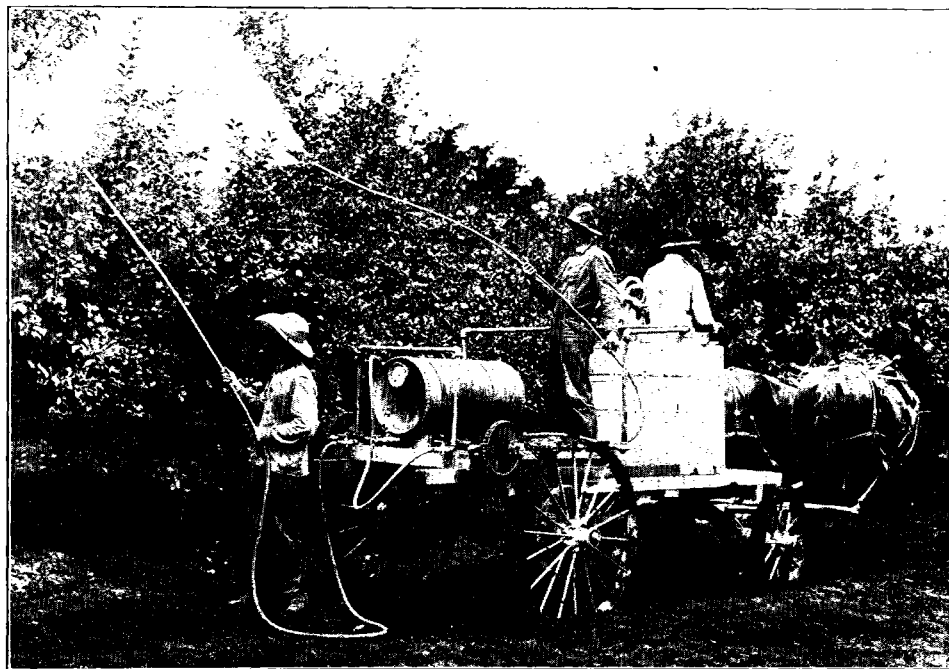
The most satisfactory combination of insecticide and fungicide is the Bordeaux mixture and arsenate of lead. No ill effects have been noted in this combination.

PUMP AND POWER

A good spray pump must have sufficient force to cover the plant treated with a very fine mist. The pump must have force, and a good nozzle must be used. There are several good forms of nozzles. The Vermorel, Demorel and Mistry have all given good service and satisfaction.

The number of nozzles used, and consequently the rate of spraying, depends upon the power. Any good hand pump operated by a strong man should furnish power for a double nozzle upon a single lead of hose. The hand pump is a good spray machine for the small grower. It should be a good one, with working parts (plunger, valve, air-chamber and cylinder) of brass. A pump of this kind has been used ten years with entire satisfaction. About the cheapest arrangement is that of mounting the pump upon a barrel and placing this with other barrels containing water and chemicals in a wagon, but where trees are low-headed it is often difficult to get the wagon in the best position for spraying.

The department has for many years used a copper-lined tank



Compressed Air Sprayer.

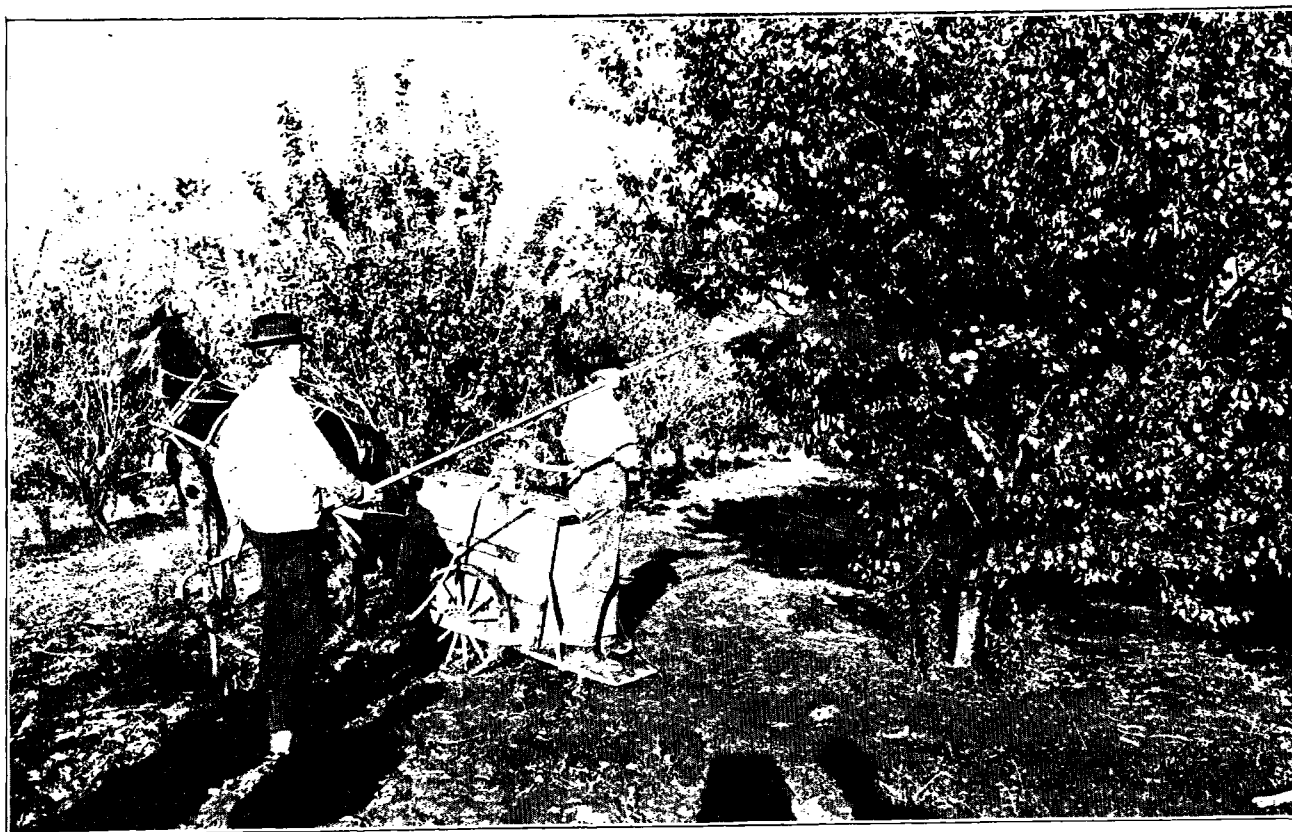
fourteen inches wide, three feet deep, and three feet long, mounted upon low wheels with shafts. It is so balanced that a man's weight upon the small platform projecting from the rear takes the weight from the horse's back. This has proved very useful in the vineyard, small fruit plantations, gardens, and orchards of small trees.

With a barrel pump and wagon two men should spray from seven to fifteen trees per hour, depending upon the size of trees and the convenience of water-supply.

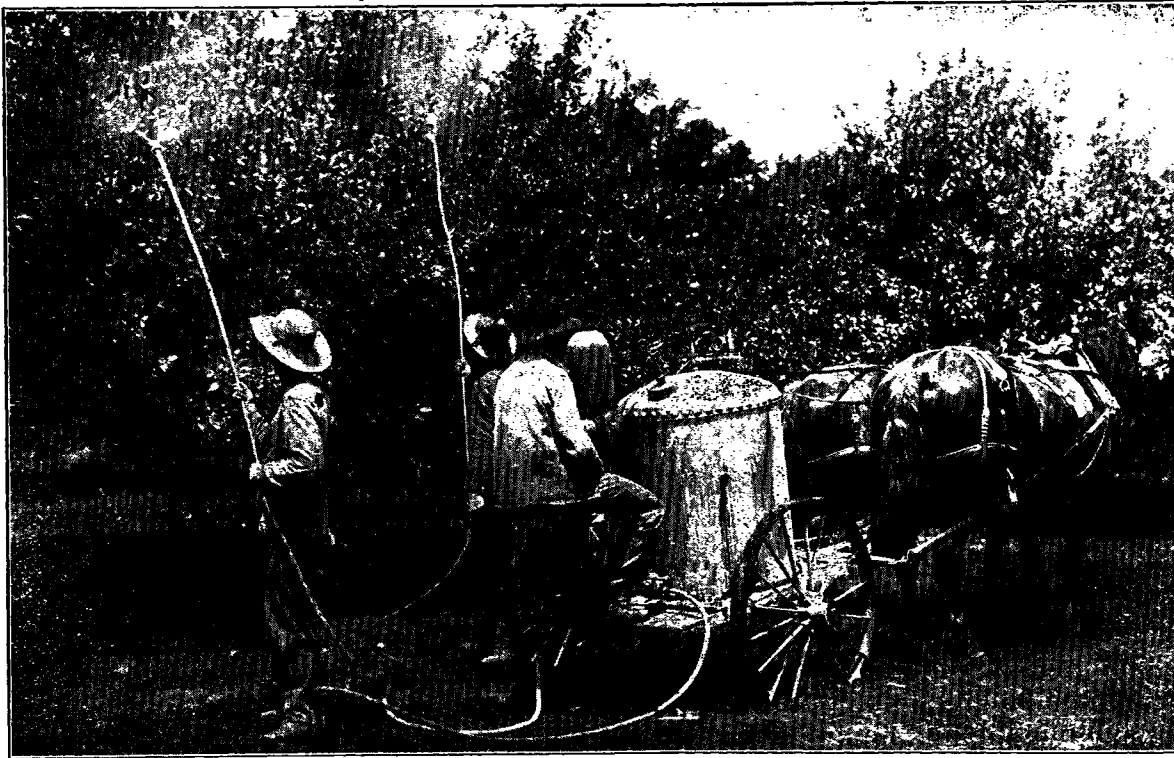
A spray pump operated by air pressure, secured by a sprocket attached to the hind wheels of a wagon, which operates an air pump which compresses air in a storage chamber, has been used by the department during two seasons work. It requires a drive of some little distance, usually several hundred yards, to secure pressure for spraying. We have tried to keep the pressure about eighty pounds, and have set the safety-valve at one hundred twenty pounds. In spraying very large trees we have found it necessary to spray alternate trees in order to maintain pressure. Care must be taken to keep all valves and joints tight, but any man of ordinary acquaintance with machinery should be able to keep the machine in good order. The variation in pressure and the occasional necessity of spraying alternate trees, which causes a loss of time, are the only objections noted.

A form of sprayer operated by liquid carbonic gas has proved satisfactory in operation. The acid is obtained in fifty-pound drums, and has been obtained from manufacturers of chemicals. The cost has been five cents per pound. A pound of the liquid is sufficient power to spray an average of eighteen gallons of spray mixture, sufficient for nine average-sized fifteen-year-old trees. The apparatus is fairly simple, and the only difficulty noted has been the leaking of gas from a poorly soldered tube or a poor valve. It is easy to operate, and with good valves well tightened is convenient when operations are not continuous. The use of power which must be obtained at distant points has some obvious disadvantages.

For extensive operations a pump operated by a gasoline engine has been most satisfactory when everything is considered. The gasoline engine is a rather delicate machine, and some delays have been occasioned by failure of the engines to work. This department has used this engine four seasons, and with some repairs it will evidently be useful for many more. It is essential that the engine be covered in some way to protect it from the spray materials. In one instance an unprotected engine gave



A Convenient One-Horse Sprayer.



Liquid Carbonic Gas Sprayer.



Gasoline Engine Sprayer.

serious trouble before it had been in use one season. The chemicals used in spraying had so seriously corroded some parts of the dynamo used for a "sparker" that they had to be replaced. It is perhaps needless to say that any spraying machinery should be thoroughly cleaned before it is stored after each spraying, and especially so after the season's work is completed.

Preparations for spraying should be made sufficiently early in the year to insure the obtaining of materials in sufficient quantity and of guaranteed quality, and the perfect condition of machinery. It is economy to provide extra nozzles, leads of hose, rods, and parts that are most liable to injury.

Convenient arrangements for dissolving and mixing materials should be made. An elevated platform is a great help where large operations are undertaken. Upon this should be placed tanks or barrels for dissolving materials and for holding stock solutions.

The chemicals used are most readily dissolved by suspending them in the upper part of the water in the tank or barrel. Clean cotton sacks have been found best. Burlap sheds some fiber. The use of one pound of the chemical to one gallon of water makes a solution that is convenient when computing the proportions of mixtures. Stock solutions should always be well stirred before using, and all materials should be carefully strained between the dissolving barrel and the stock tank and the tank of the sprayer.

It is best to use all materials directly after their preparation. Bordeaux mixture that has been prepared for some days has caused spray burn that could not be accounted for in any other way than that the mixture had changed during the time it was standing. Thorough mixing of all materials is essential. Some method of stirring is an essential part of spray machinery.

Apples have been sprayed especially for canker-worm (*Palecrista vernata*), codling-moth (*Carpocarsa pomonella*), scab (*Venturia inaequalis*), and bitter rot (*Glomerella ruformaculans*).

Only once has the canker-worm been present in the College orchard in sufficient numbers to cause injury. They were noticed just as the blossoms' buds were swelling, and a thorough spraying was given. The later spray, just as the blossoms fell, answered for both canker-worm and codling-moth.

In an orchard near the College the canker-worms were not noticed until they had caused partial defoliation. The department's help was solicited and several sprays were tested. Arsenate of lead in form of disparene, three pounds to fifty gallons of water, was the most effective, but eight ounces of Paris green to one hundred gallons of water was fairly satisfactory.

Spraying for codling-moth is begun when the petals are fallen, and should be given as soon as possible after that stage. The calyx leaves are well open and are uppermost, and it is essential that poison be deposited there as the greater number of the early brood enter the small apple at the calyx.

The small apple grows rapidly and the second spraying should follow the first in at least ten days. The larvae that escape the first spraying will be mature insects within a short time after the first apples drop, and a spray should be given to protect the fruit from the second brood. At intervals of about two or three weeks, spraying for later broods has proved profitable.

For bitter rot or scab, Bordeaux mixture applied before the buds open destroy spores upon the bark and twigs. It should be combined with the second and fourth sprays for codling-moth, and if the disease has been very serious one or more later spraying will be profitable. Other insects and diseases have not been noted as serious where spraying for codling-moth and bitter rot have been applied.

In some instances a single spraying has secured a very great increase in the quantity of sound fruit, but in most cases a single spray has not been successful in proportion to repeated sprayings. The proportion of sound fruit on sprayed trees as compared with unsprayed trees has varied in different seasons, but an average for the past six years is nearly fifty per cent number one fruit from sprayed trees, and less than ten per cent from unsprayed trees. The per cent of marketable fruit, including the second grade, has shown slightly greater differences in favor of sprayed trees.

The cumulative effect of spraying has been noted in the greater freedom from insects and diseases of the Experiment Station orchards and vineyards compared with neighboring plantations which have not been sprayed. The orchards have suffered no injury from canker-worm, leaf-crumpler or tent-caterpillar, which have been very numerous in neighboring orchards during several seasons. The protection from fungus has been fully as valuable. During the seasons **1905-1906** practically no loss has been occasioned by bitter rot, scab, or rust, while unsprayed orchards in this locality have suffered seriously.

In spraying peach trees to prevent brom rot and leaf curl the first spray should be applied before the leaf buds open. The foliage of the peach is much more easily injured than is that of the apple, and after the trees are in leaf the Bordeaux mixture should be reduced to half strength.

As the fruit reaches maturity the use of Bordeaux is liable to discolor the fruit. The colorless ammoniacal solution of copper carbonate has been used during ripening, but has been less effective than Bordeaux.

The plum varieties differ considerably in their liability to spray burn, but as a rule the Bordeaux should be diluted to half strength for plums.

The spraying of the vineyard to prevent mildew (*Plasmopara viticola*) has been uniformly successful. The crops from unsprayed vines have in several seasons been almost total failures when the sprayed vines have given fair crops.

In the spring of 1906 the Experiment Station assisted in an advisory way in some very extensive spraying operations carried on by the apple growers at Hutchinson, Kan. Interest in spraying there was aroused by the very serious injury to the crop of 1905 by the codling-moth. Notes from the work there follow:

The orchards of Mr. Hadley and Mr. Wm. Newlin were visited the entire day, May 22, 1906. Mr. Hadley has an orchard of eighty acres—4800 trees, ten, eleven and twelve years old. Mr. Newlin has thirty-five acres. The varieties in the two orchards are practically the same—about one-third each of Ben Davis, Missouri Pippin, and Winesap. Mr. Newlin has one hundred each of York, Imperial, Grime's Golden, and Jonathan. Mr. Hadley also has one hundred Jonathan, seventy-five Maiden Blush, 150 Red Romanite. The ground is uniformly level, comparatively smooth, a good fertile soil, though somewhat sandy. The trees are, as a rule, remarkably thrifty. This is especially true of Winesap and Ben Davis.

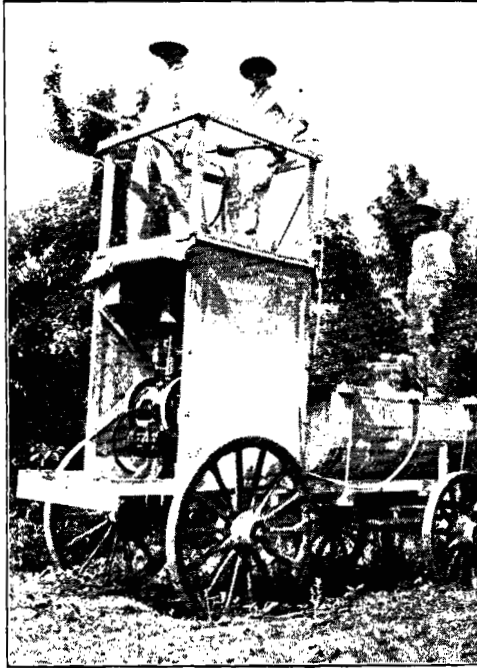
Very little blight is present in these orchards. Very little evidence of curculio was seen. The egg and larvae of the codling-moth were frequently seen. This is especially true of Missouri Pippin and Winesap. All larvae seen were very small, and all entered through the side of the apple. The codling-moth seemed to be very unevenly distributed, some trees having many while others apparently had none.

These orchards were never sprayed before this year. This year they were sprayed, first, before the buds opened, with Bordeaux mixture and arsenate of lead; second, after or at time of going out of bloom, with lead; third, beginning May 22, with Bordeaux and lead. The five pounds copper sulphate, five pounds lime and fifty gallons water formula for Bordeaux was used. The

lime and copper sulphate were weighed and the water measured. The arsenate of lead was made by dissolving :

15 pounds arsenate of soda in 15 gallons of water.
35 pounds lead acetate in 35 gallons of water.

Two pounds of this arsenate of lead was used for fifty gallons of water.

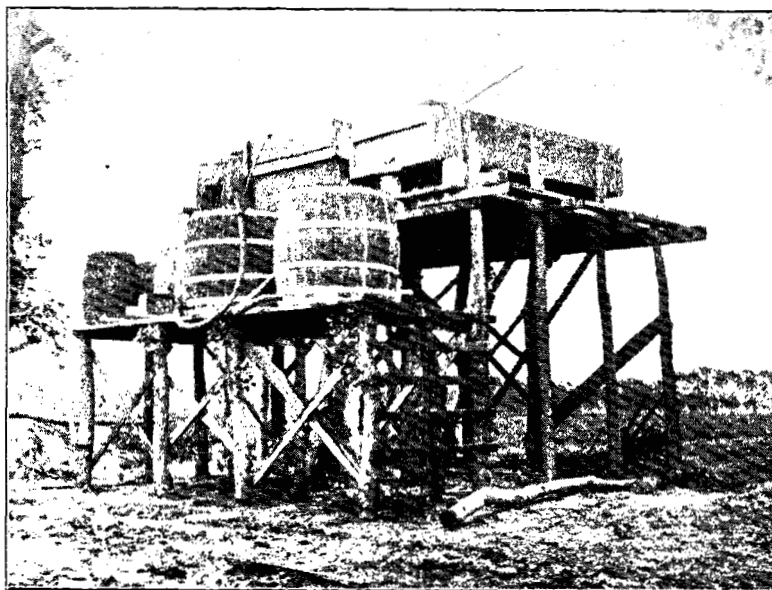


Gasoline Sprayer Equipped with Tower.

Mr. Newlin has a new and well-equipped Deming spray outfit, consisting of a one and one-half horse-power Perkins gasoline engine, a 200 gallon half-round tank, all mounted on a broad-tired wagon. The engine occupies the back part of the outfit, the tank in front. A tower about eight feet high is built over the engine, a cover three feet from the top makes a floor for the men to stand on and a cover for the engine. For further protection the engine is enclosed on the sides by heavy black oil-cloth. These side covers are fastened by buttons to the frame and are easily removed or rolled up. Two canes of four Demorel nozzles each are used at 140-pound pressure. Both men stand in the tower. Four horses are used to pull the machine, driving very slowly, to six

trees per minute and never stopping. As but one side is sprayed it is equal to three trees per minute.

Mr. Newlin has a very good mixing platform with the necessary tanks and barrels. The main platform is ten feet wide, ten feet high, and about fourteen feet long. To support this platform there are three **rows of** cottonwood and catalpa posts set about five feet apart each way. On or against one side of this main platform is a smaller one, a bench five feet high, five feet



Platform and Mixing Tanks.

wide, and as long as the first. On the higher and larger platform are placed the lime stock solution tank, water tank, and copper sulphate stock solution tanks (barrels in this case). On the smaller lower side of the platform are placed the dilution tanks for lime and copper sulphate and also the insecticide tanks or barrels. The water tank is two and one-half feet deep, four feet wide, twelve feet long; the lime tank is two and one-half feet deep, three feet wide, and ten feet long. The dilution tanks are large casks, each holding over 250 gallons. The lime is slaked on the upper platform in a special slaking box. The slaked lime is run through a finely screened gate into the stock lime tank. The stock lime tank is filled with a given number of pounds of lime and the same number of gallons of water. When used to make Bordeaux it is

stirred up and a given number of gallons are taken. The required amount of the concentrated copper sulphate solution is put directly into the copper sulphate dilution tank and the required amount of water, 100 or 200 gallons, is then run in from the water-tank. The lime dilution tank is similarly filled with lime and water. In the dilution tanks stand graduated sticks that indicate the number of gallons. When the two dilution tanks are thus filled, the contents of the two are run into the spray tank through a two-inch rubber hose. Both run at the same time, and both are equally diluted, so the best possible mixture for Bordeaux is made. After the Bordeaux is thus made the poison is added. In all cases of transference of liquids they are strained. Each of the stock solutions are strained again as they enter their respective dilution tanks. The water is pumped from a well by hand to the water-tank. One or two men are kept at the mixing tanks, pumping water and mixing, getting ready for the spray wagon.

In December, 1906, Mr. Newlin made the following statement in answer to inquiries made by the department: "In 1905 the older trees were infected with scab and bitter rot and full of codling-moth; so badly infected that we practically lost the 1905 crop. All of the 110 acres was sprayed in 1906. Part we sprayed twice, part three times, and part four times. Blue vitriol and lime (Bordeaux mixture) for the scab and bitter rot, and arsenate of lead for the codling-moth. We sprayed the old orchard three times, part of the balance four times, and part only twice. The effect of the late sprayings has been to double the amount of good apples, with but little bad effect noticeable to the foliage of the trees. However, I would say that the spraying done in exceedingly hot weather does cause the foliage of the trees to drop, especially on the Ben Davis and Jonathan varieties. I would like to make this fact plain: that where we sprayed four times we picked twice as many No. 1 apples as where we sprayed twice, and they were freer from fungus. Our spraying cost us about three cents per tree per application. That portion of the orchard which was sprayed four times produced about seventy-five per cent of No. 1 apples, and in a nearby adjoining orchard where no spraying was done we have noticed that there were very few sound apples picked in 1906."

The orchard of Mr. Homer Myers, situated about six miles southeast of Hutchinson, in Lincoln township, was visited Friday, May 18, 1906. The orchard consists of 3000 trees, set in 1890. Most of the trees are Missouri Pippin, Ben Davis, and Jonathan,

with about 125 Winesap. The orchard is uniformly level, being a few feet higher at the northwest.

From evidence given by a great quantity of mummy apples beneath the trees on the ground, and the description of Mr. Myers regarding those mummy apples, it appears that bitter rot is very bad in this orchard. No extensive search was made for canker spots, from which the disease might spread.

Mr. Myers has never sprayed until this spring. He now has a new Deming one and one-half horse-power "Bonanza" gasoline sprayer, having a 200-gallon home-made tank, **all** mounted on a wagon truck. The engine, with hose, nozzles, canes, and necessary fixtures, without tank, cost \$176. He runs two canes, of two nozzles each, running at 120 pounds pressure. The engine runs remarkably well and is thoroughly effective, and I think wholly satisfactory. The engine is not covered. The tank is a half round, long, and occupies the front end of the wagon. One man sprays from off the ground, the other from the tank. The double "Demorel" nozzle, with cap having larger aperture, is used. Mr. Myers had sprayed this orchard twice this season, the first time just before or as the buds were opening, with Bordeaux. A part of the orchard was sprayed at this time, using one pound of arsenate of lead to fifty gallons of Bordeaux. The orchard was sprayed again just before and after April 31, using arsenate of lead at the rate of one and one-half to two pounds per fifty gallons water. Mr. Myers makes his own lead, using three parts sodium arsenate to seven parts lead acetate. The arsenate costs twelve and one-half cents per pound, the acetate ten and one-half cents. The required quantities of lead acetate and sodium arsenate for his tank are each dissolved separately in a small quantity of water and then poured into the spray tank, which was filled before with water.

In looking over the orchard no great evidence of previous spraying was shown, although it could be seen that the trees had been sprayed. He put on approximately two gallons per tree. **No** evidence of burn could be detected. Mr. Myers estimated that it required four days to spray his orchard.

The set of fruit in this orchard was not much above medium — not as large as it should be.

In making Bordeaux, Mr. Myers put the lime solution in the tank before he put in the copper sulphate. He weighs all his materials, lime as well as the copper, and does not use a test.

In December, 1906, Mr. Myers made the following statements in answer to inquiries made by the department:

"In 1905 apples nearly all fell off on account of worms. Some

scab on Missouri Pippins. In 1906 we sprayed the whole forty acres. Used Bordeaux mixture and arsenate of lead, six pounds acetate of lead, two pounds arsenate of soda, 200 gallons water. The lead was mixed in buckets. For Bordeaux we used high tank and barrels with gravity system. We used the Deming gasoline engine and pump and sprayed three times — the first as the buds came out, the second after the petals fell, the third when the fruit was the size of marbles. It cost us \$12 for the lead and \$17 for Bordeaux for each application for 2400 trees, and the cost of labor was \$30. The last spraying we used both mixtures.

"I will acknowledge that I fell down on the spraying. I should have sprayed twice more later in the season. I intended to go over them about July 10, but could find no worms or any indication of them and, being very busy with other work, let it go. In sorting they made 60% No. 1, 20% No. 2, and 20% culls. It is my intention to be more thorough this year and see if it will have better results."

The Yaggy plantation was visited Wednesday, May 23. Only a hurried inspection of a small part of the orchard was made. In the brief time considerable evidence of codling-moth and some curculio was found. Most of the larvae entered from the side. One cluster of apples bore five eggs on the smaller leaves, the largest number I had yet seen. The orchard had been sprayed once when going out of bloom. The leaves showed some evidence of the spray, but, as we would expect, the apples showed none.

The Yaggy Brothers are now spraying the second time, using Bordeaux and arsenate of lead. They have five of the Perkins gasoline spray engines. All have towers, 200-gallon tanks, using eight nozzles, 140-pound pressure. They have one man spray from the tower and one from the ground.

The Yaggy Plantation Company's plans differ from the others in that they mix the dissolved chemicals in the wagon tank of the sprayer. The water is supplied from wells conveniently located in the different orchards. A centrifugal pump is used, which throws the water with considerable force into the wagon tank. The copper sulphate solution is emptied into the tank as it fills, and when nearly full the lime is added. This adds the lime to a dilute solution of copper, and no serious curdling was noticed. A mechanically operated agitator, worked by the gasoline engine, is kept in motion all the time. Every tank is tested with the ferrocyanide of potassium solution. This orchard was carefully observed in August, and little evidence of any spray burn was noticed.

In December, 1906, **Mr. Yaggy** made the following statements in answer to inquiries made by the department:

"The 1905 crop of apples showed little or no fungous injury. About fifty per cent wormy (codling-moth). We sprayed 700 acres. About fifty acres of scattering trees. First application, arsenate of lead, ten pounds to 200 gallons water. Second application, arsenate of lead with Bordeaux mixture. Third application, arsenate of lead. We used Deming engine outfits and Duplex hand pumps —five engines and threehand pumps —and made three sprayings, all after the blossoms fell. We believe late sprayings to be very efficacious against codling-moth. The cost of spraying is roughly estimated at two cents per gallon. Sprayed orchards produced above eighty per cent sound apples, except where hail struck the orchard. Unsprayed orchards in this vicinity produced so small a quantity of sound apples as to be no factor at all in the apple market.

The arsenate of lead referred to above was prepared by ourselves. It did not cost above eleven cents per pound **f. o. b.** Hutchinson, Kan., and was absolutely free from the adulterants found in ordinary brands of arsenate of lead. It proved to be adhesive beyond our wildest hopes, adhering to the foliage after the heaviest of rains. We believe the arsenate of lead to be far superior to Paris green or any other form of arsenic yet offered."

The operations of **Mr. W. H. Underwood** were the largest of any undertaken. Four hundred acres were sprayed and fifty acres were unsprayed. His report is as follows:

"In 1905 the crop was very bad, worms in almost every apple. In 1906 we sprayed four hundred acres, leaving fifty unsprayed.

"We used Bordeaux mixture and arsenate of lead. We take thirty pounds arsenate of soda and suspend it in a linen or cotton sack (**so** that no fibre will come off) in thirty gallons of water. We then suspend seventy pounds of acetate of lead in another sack in seventy gallons of water. When these are dissolved we run them together into a tank holding one hundred gallons set lower than the two stock tanks so it will run in by gravity. When these two colorless liquids come together they make a chemical combination which looks like milk or lime. We then stir thoroughly, and have it stand at least two hours before using. It precipitates very little, but before using we stir thoroughly and then take out from six to eight gallons of this mixture, which is a pound to the gallon, to put into our 200-gallon spraying tank, giving six to eight pounds of the poison to 200 gallons of water. The government chemist tells us that our mixture is some twenty per cent to

twenty-five per cent stronger than the commercial brands of arsenate of lead on the market, and we can mix it cheaper than we can buy the trade arsenates, and have a stronger article. I think we must have been right, because we secured such excellent results, having changed our crop of year before last of **all** wormy to about ten per cent wormy this year.

"I cannot answer the question as to what it cost to spray. We have had all in one lot Bordeaux, poison, labor, machinery, wagons, tanks, and our whole spraying operation has been charged against the crop this year so as to get it out of the way and forget about it. Even by doing that we made three times the money this year that we ever did before, and I believe the spraying did it. This year from the *unsprayed orchard no apples were picked or even sold from the ground*. From the sprayed orchard we packed forty per cent to fifty per cent extra fancy, twenty-five per cent No. 1, balance No. 2 and culls."

Spray Calender

Apple

INSECTS

Spring canker-worm. —Spray with arsenate of lead or Paris green as soon as or soon after worms appear. If this is not enough, subsequent sprays applied as for the codling-moth should hold the insect in check.

Codling-Moth-Spray with arsenate of lead or Paris green as soon as petals have fallen from flowers. Repeat in ten days. Repeat fifteen to twenty days later. Repeat about middle or latter part of July.

Curculio.-Rake together and gather infected fallen apples. (Cultivate beneath and about trees.) Spray with arsenical poisons as for codling-moth and canker-worm.

Leaf Roller. —Spray with second and subsequent sprays as for codling-moth.

Borers. —Dig borers out with knife or wire. Wax the wounds.

DISEASES

Scab, Bitter Rot, Leaf Spot, Rust, Etc. —Spray with a solution of copper sulphate, or use Bordeaux mixture before buds open. Spray with Bordeaux two or more times after blossoming, about ten to twenty days apart.

Blight. —Remove and burn all affected branches. Make the cut about six inches below the point where the bark is dead. Disinfect the pruning tools.

Peach

INSECTS

Borer.-Dig out borer with knife or wire in spring and in fall. Compel the female moth to lay her eggs higher up on the tree trunk by mounding up with earth about the base of tree.

Curculio.-See plum.

DISEASES

Leaf Curl.-Spray before buds open with a solution of copper sulphate, Bordeaux mixture, or the lime sulphur wash.

Brown Rot. —Spray first as for leaf curl. Later spray the green and growing fruit two or more times with Bordeaux mixture (2+4+50), or use the ammonical copper carbonate solution. Thin the fruit. Gather and destroy all the affected and mummy (dried) peaches.

Plum

INSECTS

Curculio. —Catch the beetles by jarring them from the trees onto sheets that are spread beneath the tree on the ground. Go over orchard twice a week in early morning. Gather and destroy all affected fruits. Cultivate soil beneath and about the trees.

DISEASES

Black Knot.-Cut off and burn affected parts; spray with Bordeaux as for brown rot.

Brown Rot. —See peach.

Shot Hole Fungus. —See brown rot.

Cherry

Curculio. —See plum.

Black Knot. —See plum.

Brown Rot. —See peach.

Grape

INSECTS

Leaf Hopper. —Remove all trash from about vines and burn; spray one or more times with kerosene emulsion when insects are present.

Berry Moth.-Spray with arsenate of lead or Paris green before leaf buds open, and again just after blooming.

DISEASES

Downy Mildew, Powdery Mildew and Black Rot. —Spray three to five times during growing season. Use Bordeaux mixture. First application before buds open; second after blooming; other applications at intervals of ten to fifteen days until fruit is half or

nearly grown. In the fall gather and destroy leaves and trimmings and dried affected bunches of grapes.

Anthracnose.—Can be controlled partially by the above treatment. A strong solution of iron sulphate applied to vines in winter is helpful.

Raspberry and Blackberry

INSECTS

Cane Borer and Cane Maggot —Cut off and burn affected canes.

DISEASES

Anthracnose.—Cut out and burn old canes immediately after fruiting. Spray with Bordeaux mixture in spring before flowers appear. Spray new shoots two or more times during summer, after harvesting fruit, with Bordeaux.

Leaf Spot. —Spray as for anthracnose.

Orange Rust. —Dig out and burn the leaves, branches, and roots of affected plants.

Strawberry

INSECTS

Leaf Roller.—After fruiting, mow the strawberry bed and burn. Spray one or more times, after fruiting, with an arsenical poison.

DISEASES

Leaf Spot or Blight. —Spray with Bordeaux in spring soon after growth begins. Spray again before blooming and once after the renewal plants have made a good growth.

Cabbage

INSECTS

Cabbage Worm.—Spray once or twice with the resin lime mixture, or use Paris green, Pyrethrum powder, or Hellebore.

Cucumber

INSECTS

Striped Cucumber Beetle. —Apply tobacco dust and spray with Bordeaux. Bordeaux acts as a repellant. Destroy old vines and other trash.

Squash

INSECTS

Squash Bug. —Spray nymphs (immature bugs) with kerosene emulsion, strength one to eight. Gather bugs by trapping under small boards placed beneath the vines. Gather and destroy the eggs. Destroy all trash where bugs may collect to hibernate.

Potato

INSECTS

Colorado Potato Beetle and Others.--Spray one or more times with arsenate of lead or other poison.

DISEASES

Blight. — **After** vines are about eight inches high, spray at intervals of about two weeks until growth stops. Use Bordeaux mixture.

Scab.—Soak seed potatoes one and one-half hours in a solution of two ounces of corrosive sublimate to sixteen gallons of water; or soak them two hours in a formalin solution, using one pint of formalin to thirty gallons of water.

Tomatoes

INSECTS

Worms or Beetles. —Hand pick worms, or spray with Paris green or arsenate of lead.

DISEASES

Right.—**Spray** with Bordeaux about every ten days.

Celery

DISEASES

Blight. —Spray with Bordeaux mixture about every ten days. Best to begin before disease appears.

Formulas

INSECTICIDES

Arsenate of Lead:

3 parts of arsenate of soda,
7 parts of acetate of lead;

Or take

15 pounds arsenate of soda dissolved in 15 gallons water,
35 pounds acetate of lead dissolved in 35 gallons water.

Pour the two together into a third vessel. Use four to six gallons of this for 100 gallons water.; or, if desired, use 100 gallons of Bordeaux mixture in place of the water.

Paris Green:

1 pound to 150 or 200 gallons of water,
2 pounds lime,
5 to 8 ounces to 50 gallons Bordeaux,
1 pound to 20 pounds flour, as a dry spray for cabbage, etc.,
1 pound to 40 pounds lime dust.

Resin Lime Mixture:

5 pounds resin,
1 pound concentrated lye,
1 pint fish oil,
5 gallons water.

SPRAYING

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Prepare stock solution by melting the resin with the fish oil and one gallon of water in a kettle over a fire. Add the lye and about half of the water and boil about one hour, or until the mixture will unite with cold water. Then add slowly enough cold water to make a total of five gallons. When spraying take one gallon of this solution and add three gallons of milk of lime, four ounces of Paris green, and sixteen gallons of water.

Kerosene Emulsion:

$\frac{1}{2}$ pound soap,
1 gallon water,
2 gallons kerosene.

Dissolve the soap in water over fire. Remove from fire and add kerosene. Stir violently. Use one part of emulsion to eight to fifteen parts water.

FUNGICIDES

Bordeaux Mixture:

(a) 5 pounds copper sulphate,
5 pounds lime,
50 gallons water.

(b) 2 pounds copper sulphate,
4 pounds lime,
50 gallons water.

Dissolve the blue vitriol, one pound to one gallon of water. Slack the lime. Dilute both the lime and the copper sulphate to half the total number of gallons of Bordeaux to be made, and pour the two through a strainer into a third vessel. The product in this third vessel is Bordeaux mixture. If the mixture turns blue litmus paper red, add more lime. If it turns a drop of potassium ferrocyanide brown, add more lime.

Copper Sulphate Solution:

1 pound copper sulphate,
25 gallons water.

Ammoniacal Solution Copper Carbonate

Dissolve 5 ounces copper carbonate in
3 pints ammonia, add 45 gallons water.

Lime Sulphur Wash:

20 pounds stone lime,
15 pounds flowers of sulphur,
50 gallons of water.

Slack the lime in the cooking receptacle. With a little water make a thin paste of the sulphur. With about ten gallons of water add the sulphur to the slacked or partially slacked lime and boil, preferably by steam, one hour. Add enough water to make fifty gallons. Strain when putting into spray tank. Use while warm if possible. Apply in fall, winter or spring on dormant trees before leaves appear. The best known remedy for scale insects.

PROBABLE COST OF MATERIALS

	Cents.
Arsenate of lead.. .. .	13 to 15
Paris green.. .. .	18 to 24
Acetate of lead.. .. .	12½ to 14
Arsenate of soda.. .. .	10 to 12
Copper sulphate.. .. .	7½ to 8½
Flowers of sulphur.. .. .	3
Lime.	

SPRAYING

COST OF BORDEAUX

	Cents.
5 pounds copper sulphate.	40
5 pounds lime.....	3
50 gallons water.....	0
Total.....	<u>43</u>

BORDEAUX WITH PARIS GREEN

	Cents.
5 pounds copper sulphate	40
5 pounds lime.....	3
50 gallons water.....	0
6 ounces Paris green.....	9
Total.....	<u>52</u>

BORDEAUX WITH ARSENATE OF LEAD

	Cents.
5 pounds copper sulphate.....	40
5 pounds lime.....	3
50 gallons water.....	0
3 pounds arsenate of lead.....	40
Total.....	<u>83</u>