UNIVERSITY OF THE STATE OF MISSOURI.

COLLEGE OF AGRICULTURE AND MECHANIC ARTS.

AGRICULTURAL EXPERIMENT STATION.

BULLETIN NO. 31.

Spraying Orchards and Vineyards.

COLUMBIA, MISSOURI.

JULY, 1895.

E. W. STEPHENS, Printer, Columbia, Mo.

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By J. C. WHITTEN, Horticulturist.

SUMMARY OF RESULTS.

Spraying experiments on a commercial scale, with different kinds and strengths of solutions, against Apple Scab, Bitter Rot, Plum Rot, Black Rot of Grape, etc., have been carried on at this Station during the past two years. The results, briefly summarized, are as follows:

1. The first season (1894) apple scab was very much less injurious to the fruit on trees sprayed with Bordeaux mixture than on unsprayed trees. By continuing this spraying a second season very few traces of scab could be found on sprayed trees.

2. The second crop of scab, almost universal on unsprayed trees, was entirely absent from sprayed trees.

3. Four applications of Bordeaux mixture proved to be more efficacious than three.

4. In unsprayed orchards apple scab was somewhat worse in 1895 than in 1894. In orchards sprayed both seasons scab was less in 1895.

5. Orchard trees sprayed both seasons with a one pound solution, showed very little scab in 1895.

6. Check, or unsprayed trees, if surrounded by sprayed trees, showed less scab in 1895 than in 1894.

7. Bitter rot began first on unsprayed trees and developed more extensively than on sprayed trees.

8. Bitter rot was less on trees sprayed with the six pound solution than on those sprayed with the weaker solutions.

9. There was no material difference in the injury from codling moth where arsenites were used in the mixture, and where trees were unsprayed. (This is no doubt due, not to the non-efficacy of arsenites in exterminating codling moth, but to a probable later brood of the moth, hatching in this latitude after spraying with arsenites had ceased. It is hoped that observations in 1896 may settle this point.)

10. In an orchard pastured with hogs for successive years, very few apples are affected with codling moth.

11. Plum rot was less on trees sprayed with Bordeaux mixture.

12. The curculios were not so numerous where Paris green was added to the mixture used in spraying.

13. On plum trees that were sprayed weekly during the ripening period of the fruit, a smaller amount of rot developed.

14. The ammoniacal copper carbonate solution was the most satisfactory solution for spraying fruit while it was ripening, as it left no sediment to mar the appearance of the fruit.

15. Black rot, which was quite prevalent, and for a time developed very rapidly on unsprayed grape vines, was hardly noticeable on sprayed grapes.

16. Bag worms were easily killed on evergreens by spraying (as soon as they hatched) with Paris green, at the rate of one pound to 300 gallons of water.

17. Bag worms that were two thirds grown were not killed by successive sprays of Paris green at the rate of one pound to 160 gallons.

18. Evergreens were easily injured by Paris green when their new growth was immature and the weather was wet. The first spraying with the 160 gallon mixture did not injure evergreens when their wood was ripe and the weather dry.

SOME COMMON MISTAKES IN SPRAYING.

1. The use of impure chemicals.
2. Improper mixing of the solutions.
3. Not spraying at the right time.
4. Not repeating spray after it has washed off by rains.
5. Using the wrong spray. (Two instances have come under my notice this season of using a fungicide for insects, and one of using Paris green for apple scab.)
6. Using coarse nozzles, so the mixture is applied in blotches instead of in a fine fog.

As an example of the use of impure chemicals, last June we received a letter from a fruit grower who said he had carefully sprayed his trees according to directions, but that the scab was worse on sprayed trees than on the unsprayed. We carefully examined his fruit and found it very badly burned, undoubtedly by bad chemicals or too strong a mixture, but there was no trace of scab in the "rusty" appearanc that he called scab.

PREVALENCE OF FUNGOUS DISEASES.

Careful observations during the past season show that immense losses were sustained by the fruit growers of the state, that, in many cases, might have been greatly lessened by more careful and more general spraying. The immense apple crop gave ample opportunity for noting the prevailing diseases, and made the percentage of loss conspicuous.

THE APPLE SCAB (*Fusicladium dendriticum*) has caused greater loss than any other disease. Very few apples, except from sprayed orchards, have been brought into the markets, free from this disease. It may even be seen, beginning development, upon the choice apples, selected from vigorous young orchards, for our show tables. No orchard that is not carefully sprayed with Bordeaux mixture is secure from its eventual encroachments. Its destructive effects are much greater than they seem to be to the casual observer. The scab not only attacks the fruit itself, rendering it small and misshapen, but it also attacks the twigs and leaves. Frequently the leaves are so injured by it that they are incapable of assimilating enough food to develop a good crop of fruit, even though the fruit itself was not directly attacked. Much of the low vigor and meager annual growth of some orchards is due to the presence of the scab fungus in the twigs and leaves. This fact is not sufficiently taken into account by the grower who looks only at the fruit in estimating the prevalence of scab. Another very important point is that some varieties are much more susceptible to its attacks than are others, and varieties that would be very profitable if protected from scab, are sometimes superseded by other varieties, whose only recommen-

dation is that they are less injured by scab. Hon. N. F. Murray, one of the most successful fruit growers of north Missouri, reports that twenty years ago the White Winter Pearmain was one of the most popular and most profitable varieties grown in his locality; and that its susceptibility to scab [which might be largely controlled by spraying] has caused it to be almost entirely discarded.

THE BITTER ROT (*Gloeosporium fructigenum*) caused more damage than usual, in this state, the past season. Reports, from various parts of the state, show that it was quite general about the time apples were being gathered. One grower, in Boone county, who usually markets a fine lot of Fameuse apples, said that though his trees set full of fruit, he was not able to market any of it on account of bitter rot. A great many growers report this disease to have been more destructive than apple scab, the past season. It must be borne in mind, however, that the bitter rot attacks only the fruit, and this shortly before it begins to ripen, and hence does not injure the leaves or twigs of the tree as does the scab. The Willow Twig is, in some places, reported to be so susceptible to the attack of bitter rot, that other varieties, less affected by rot, but otherwise less desirable, are superseding it. The Willow Twig is one of our largest and finest apples. Exempt from bitter rot it is one of the best keepers in the state. For this reason it is particularly desirable to take measures to prevent the rot and render the growing of this variety profitable. The bitter rot is destructive, not only on account of the amount of fruit it destroys, before gathering, in autumn, but, in many cases, fruit from infected orchards, and having the spores of this rot present, is hurriedly made into vinegar, or immediately sold at very low prices, since the grower has no assur-

ance of its keeping, except under the favorable condition of cold storage. One buyer told me, lately, that he bought fruit last autumn, at sixty cents per barrel, in the orchard, shipped it east to cold storage, and is now shipping it back and selling it at from ninety cents to one dollar a bushel. This forced marketing of fruit could partly be avoided by taking proper precautions for stamping out the bitter rot.

THE BROWN ROT OF THE PLUM (*Monilia fructigena*), affects nearly all our cultivated plums to a greater or less extent. With the possible exception of the curculio, it is the most serious hindrance to plum culture in the state. It is the only drawback to growing such varieties as the Lombard. It also attacks the peach, causing peach rot, and, altogether, is a serious disease.

THE BLACK ROT OF THE GRAPE (*Laestadia bidwellii*) is the most serious disease of the grape in this state, and yet, it can be more readily controlled than any other fungous disease with which we have experimented. It attacks the leaves and tender shoots as well as the fruit, hence the application of fungicides should begin early and be frequently repeated. This disease should be subdued, not only on account of the loss of the berries, which actually rot before the fruit is picked, but also for the following reasons: when a few berries in a bunch are decayed, or shriveled, it injures the appearance of the whole bunch; grapes taken from a vineyard, even slightly affected with black rot, may have spores present, that render their keeping uncertain, so that rot may set in after they are picked for shipping; the black rot, affecting the leaves and twigs, prevents proper growth and nourishment of the vine; every season that the disease is neglected, it gets a stronger foothold, and is liable to infect other vineyards. The grapes of best quality are fre-

quently affected worst, and inferior sorts are sometimes grown, simply because they resist the rot. One extensive grower of grapes on the Missouri river says that spraying for black rot has, with him, reduced the cost of producing grapes from seventeen cents to three cents a basket. Before spraying, an eighty acre vineyard had become unprofitable, and now he can grow grapes for one sixth the former cost, rendering it highly lucrative.

THE ORANGE RUST OF THE BLACKBERRY (*Cæoma nitens*) is a disease that is quite prevalent upon both wild and cultivated plants of this class. The successful culture of the blackberry demands both sanitary and spraying methods to prevent this disease. It does not directly attack the fruit, but, destroying the leaves, it renders the plant unfit for producing fruit, and finally destroys it. It is a bimorphic form, that is, it exists in two stages. The orange-colored powder or spores that form as red rust, early in the season, germinate upon the blackberry leaves and form the autumn rust known as Puccinia. If allowed to go on, unchecked, this disease will soon completely destroy a plantation.

There are other minor plant diseases with which the Station is experimenting, but those above are expressly mentioned, in order that the need of concerted action, in stamping them out, may be better appreciated, and the reasons for the methods pursued in spraying may be made plain.

METEOROLOGY AND SPRAYING.

Through the courtesy of the State Board of Agriculture and Mr. A. E. Hackett, of the United States Weather Bureau, the Station is furnished the following tables, showing temperature, rainfall, and other meteor-

ological conditions for the six growing months of the past two years:

1894.

MONTH.	TEMPERATURE.		RAINFALL.				WEATHER.		
	Highest.	Lowest.	Greatest in 24 hours.	No. days with.	Total.	†Above or ‡below mean.	Clear.	Partly Cloudy.	Cloudy.
April...	90 (29th)	30 (11th)	.88 (14th)	17	2.02	2.38‡	10	7	13
May...	89 (16th)	36 (20th)	1.87 (9th)	13	4.33	1.12‡	7	13	11
June...	97 (21st)	43 (6th)	1.05 (25th) (26th)	12	3.04	1.25‡	15	12	3
July....	105 (25th)	50 (23d)	.74 (4th)	9	1.20	2.96‡	14	11	6
August.	105 (10th)	44 (4th)	.63 (20th)	7	1.29	2.03‡	18	8	5
Sept....	96 (8th)	62 (12th)	3.84 (15th)	11	6.85	3.40†	5	9	7

1895.

MONTH.	TEMPERATURE.		RAINFALL.				WEATHER.		
	Highest.	Lowest.	Greatest in 24 hours.	No. days with.	Total.	†Above or ‡below the normal.	Clear.	Partly cloudy.	Cloudy.
April...	90 (30th)	32 (3d)	0.35 (16th)	10	1.04	4.17‡	7	8	15
May....	91 (9th)	33 (14th)	1.09 (1st) (2d)	17	6.09	0.27†	12	9	10
June ...	92 (3d)	52 (6th)	1.90 (17th)	14	5.78	1.47†	8	12	10
July ...	96 (16th)	50 (11th)	1.60 (29th) (30th)	11	4.93	0.10†	6	9	16
August..	97 (17th)	52 (21st)	1.08 (25th) (26th)	9	2.30	0.59‡	7	12	12
Sept....	98 (15th)	26 (30th)	0.96 (16th)	6	1.48	2.47‡	16	10	4

Since the condition of the weather has a very decided effect upon the development of fungous growths it is of interest to study the above tables in connection with spraying experiments herein reported. More frequent sprayings are required during rainy times, as

the mixture washes off the leaves during heavy, constant rain.

Other interesting facts may be shown by comparing these tables with the spraying data given later on. In other words, there was a rainfall of 18.73 inches during the growing season of 1894 and a fall of 21.62 inches during the corresponding six months of 1895, or nearly three inches more than in 1894. Careful counting of unsprayed apples in the autumn of 1895 showed that a larger proportion was affected with scab than had been affected in 1894. General observations in unsprayed orchards and observations of fruit brought into town show that scab is worse in wet seasons.

DETAILS OF THE EXPERIMENTS.

In the spring of 1894 the spraying experiments at this Station were re-outlined and broadened with a view to extending certain experiments over several years. These experiments were outlined for the purpose of answering the following questions:

1. Can fungous diseases be prevented from gaining a foothold in orchards by spraying the trees with Bordeaux mixture from the time they are started as grafts in the nursery?
2. What is the most economical strength of Bordeaux mixture to be used in an apple orchard for scab?
3. How many sprayings are necessary during an average season in Missouri?
4. What are the comparative results of spraying during dry and wet seasons?
5. Can the codling moth be controlled by using arsenites in the second and third applications of Bordeaux mixture?
6. What are the common difficulties in the way, which cause many practical cultivators to report *failure* as the result of their spraying experiments?

7. What effect have these sprayings with Bordeaux mixture upon the autumn bitter rot of apples?

8. Does spraying with Bordeaux mixture lessen the cracking of such varieties as Jenneting?

To make the results of these experiments more conclusive, and particularly to answer question 6, spraying was done on a commercial scale in the orchard of Mr. T. C. McIntyre, of Boone county, as well as upon the College farm and upon the Horticultural grounds.

In bulletin 27 of the Station will be found the results of these experiments for 1894, and also a treatise on the theory of spraying and the best practical methods to be pursued. In 1895 these experiments on the apple were continued, several additional experiments have been tried, and several more conclusions reached.

TRIALS IN 1895.

APPLES—*On the Station grounds*, the apple trees were divided into six groups as follows:

1. A new apple orchard just set to thirteen varieties of one year old trees, and a nursery containing 250 varieties of one year old apple trees, were sprayed five times with a four pound *solution of Bordeaux mixture. They were also sprayed once, before the buds burst in March, with a two pound copper sulphate solution. They have been sprayed in this manner since they were started as grafts. To the last four applications of Bordeaux mixture Paris green, at the rate of one pound to 200 gallons, was added, to prevent any leaf-eating insects from getting a foothold among the trees.

No trace of fungous diseases or of leaf-eating insects could be found in them during the season. They made remarkably fine growth and are in first-

*For making the various solutions see the accompanying spray calendar.

class condition. This is all the more remarkable when we consider the great number of varieties, many of which are peculiarly susceptible to disease if not sprayed. It seems not to be generally understood that spraying should be begun when the trees are first started, to prevent diseases from getting a foothold among them. Too much stress can not be laid upon the fact that it is easier to *prevent* than to *cure*.

2. Four rows of old trees of various varieties were sprayed with a four pound solution of Bordeaux mixture.

3. One row of similar trees was left unsprayed, as a check.

4. Two rows of old Ben Davis and Lowell trees were sprayed with a two pound solution.

5. A miscellaneous lot of apples and pears set in sod were sprayed with a one pound solution.

6. A row of twenty-one varieties of apples and a row of five varieties of pears were sprayed with a five pound solution.

To the above lots arsenites were applied in the three sprayings, subsequent to the dropping of the blossoms, for codling moth.

At the time of gathering the fruit the sprayed Rambos were all affected with codling, a sprayed Maiden's Blush was free from them, Ben Davis were one half affected and other varieties averaged three fourths free from codling moth. We had no unsprayed Maiden's Blush to compare with the sprayed one, but, in general, no difference could be seen in the number of codling moth upon sprayed and unsprayed trees. (For probable explanation see summary, p. 4.)

No sprayed trees were affected with scab. Even those to which the one pound solution was applied were free from it.

The only unsprayed trees that produced fruit were a Bailey's Sweet and an Early Harvest. The former had 20 per cent of its fruit scabbed and the latter 5 per cent. These same varieties were among the sprayed groups which were free from scab.

Altogether, five bushels of fruit were counted for these results. Out of the five bushels only five apples were affected with bitter rot at the time of gathering. Very little bitter rot, however, occurred in unsprayed trees.

On the College Farm young orchards of Jennetings and Ben Davis were separated into five groups. Four of these groups, containing three rows each of mixed Jennetings and Ben Davis, were sprayed five times with two, three, four, and six pound solutions respectively, to which arsenites were added for the codling moth. The fifth group, consisting of two rows of the same varieties of apples, was left unsprayed for a check. At the time of gathering, in autumn, all sprayed fruit was free from scab. Of the unsprayed fruit twenty-one per cent was affected with scab.

This orchard has been pastured with hogs for the past few years and codling moth has not been very numerous in it. The past season no difference could be detected between the number of codlings in sprayed and the unsprayed trees.

In the McIntyre Orchard two, four and six pound solutions were applied five times during the season to selected trees of Fameuse, Lowell, Willow Twig, and Jenneting. The last two named varieties did not fruit this year. The Lowell's were free from scab at the time of gathering. The best results were secured from the Fameuse variety which fruited heavily. This variety was affected with bitter rot, which gave excellent opportunity to test the efficacy of spraying for this disease. Arsenites were added for codling moth.

The following table shows the results of spraying the Fameuse variety, one half bushel being taken at random from each tree treated:

STRENGTH OF SOLUTION.	Times Sprayed.	Clean.	Blemished.	Old Scab.	New Scab.	Codling.	Bitter Rot.	Whole number counted.
Six pound solution...	5	54	32	2	0	15	22	86
Four pound solution.....	5	38	55	3	0	5	53	93
Two pound solution.....	5	59	44	2	0	3	43	103
Not Sprayed...	0	15	80	14	60	17	80	95

It may be seen from the above table that scab may be almost entirely controlled by spraying with the Bordeaux mixture. The second crop of scab was entirely prevented on sprayed trees.

Bitter rot was reduced one half on sprayed trees. Examinations in the orchard during late summer showed that it began first on unsprayed trees. The strong solution was much more effective than the weaker ones in checking bitter rot.

There were no significant results regarding codling moth.

In a group of three isolated Fameuse apple trees, badly affected with bitter rot, two were sprayed with ammoniacal copper carbonate solution shortly before gathering. The ground under the tree was thoroughly wet with the solution. This was for the purpose of noting the effect of late spraying upon the bitter rot next season.

One of the most interesting results of spraying for apple scab in 1895, is that trees which were sprayed in 1894 were easily kept free from scab during 1895, even with the one and two pound solutions, and that

unsprayed or check trees in the sprayed orchards, where they were surrounded by sprayed trees, showed, also, a smaller percentage of scab than in 1894.

This is particularly significant when it is remembered that scab was very bad in unsprayed orchards during the past year.

GRAPES.—An old vineyard of mixed varieties, on the Horticultural grounds, which had been previously affected with black rot, was sprayed with a four pound solution of Bordeaux mixture. Two rows on the west side were left unsprayed for a check.

About the middle of May, some very warm, moist weather occurred, and on May 18, black rot was seen starting on the foliage of a few plants on the the lowest ground of the unsprayed rows. It spread rapidly along the unsprayed rows and occasionally gained a slight foothold on the adjoining sprayed rows. The sprayed vines were, however, for the most part, free from infection.

At the time of ripening of the fruit, about one third of the fruit in the unsprayed rows was destroyed by the black rot while very few traces of it could be found on sprayed vines.

PLUMS.—Twenty varieties of plums and as many varieties of peaches, all of fruiting age, were sprayed for fungous diseases and for the curculio. The sprayed peaches had all their fruit buds killed during the previous winter and no fungous diseases developed on either the sprayed or unsprayed. The one pound and two and one half pound solutions of Bordeaux mixture were used. From the time of setting of the fruit until three or four weeks prior to ripening, arsenites, at the rate of one pound to 300 gallons, were added for the curculio. Where there were several trees of a variety one was left unsprayed for a check.

At the time of fruiting, observations and countings showed that an average of three fourths of the unsprayed and only one fourth of the sprayed plums were affected with the curculio.

The only fungous disease that affected the plums was the brown rot. Shortly before the ripening of the fruit it began to appear, first on unsprayed trees and then, to some extent, on those that were sprayed. The experiment with the Lombard variety will illustrate the effect of spraying.

On July 26th the fruit on an unsprayed tree was rotting very badly. A tree sprayed with the one pound solution was almost as bad. Two trees sprayed with the two and one half pound solution were showing some rot, but not nearly so much as the first two.

On July 26, August 3, and August 10, the tree that had been treated with the one pound solution was sprayed with a two and one half pound so ution of Bordeaux mixture. On the same dates the two trees that had received the two and one half pound solution throughout the season, and were in the best condition, were sprayed, one with the ammoniacal copper carbonate solution and the other with a two and one half pound solution of Bordeaux mixture. From these last two trees, all diseased fruit was picked at each spraying. This was done mainly to test the effect upon the next season's crop, for since the spores of the fungus were developing at this time it was hoped to destroy them and thus prevent the spread of the disease for the next season.

The treatment had a marked effect upon the immediate crop. On the unsprayed tree nearly all the fruit rotted. On the tree that was sprayed but did not have its fruit picked, nearly one half the fruit was saved. On the other two trees over one half the fruit was saved.

There was no perceptible difference between the effect of the Bordeaux mixture and the copper carbonate solution, but the latter did not discolor the ripening fruit, while the Bordeaux mixture applied at the time of ripening rendered the fruit unsalable unless washed.

BAG WORMS OR BASKET WORMS.

A number of complaints of this pest have come to the Station the past season. They are particularly destructive to evergreens, poplars, and to young nursery stock. A grower in St. Louis county reports the loss of hundreds of fruit trees from their attacks.

Where there are but few the bag containing the eggs may be hand-picked in winter. Experiments that we have carried on show that they may be quite readily controlled if spraying with arsenites is resorted to as soon as they hatch, but that they are very difficult to manage if they are neglected until they reach considerable size.

Evergreens are very easily injured by arsenites except in very dry weather, after the new wood has become nearly mature. In July, 1894, we sprayed an arbor vitae and a European larch tree, that had been neglected until the worms had reached good size, with Paris green at the rate of one pound to 160 gallons and repeated the spray for four successive days. The arbor vitae was badly injured, but the larch showed no bad effects of the Paris green.

The worms continued on the trees, very few being killed by the poison, until the end of the fourth day, when they had nearly all crawled away and attacked unsprayed trees of all kinds. Dozens of them could be seen crawling across hot gravel walks when the thermometer was in the nineties. Many of them scattered

in the grass and it seemed impossible to poison them after they reached such size as enabled them to crawl easily.

Trees sprayed late in May and early in June, when the worms first hatched, gave us better results. Two sprayings of an arbor vitae hedge and of several Irish junipers, at this time, almost completely rid them of the tiny worms which were hatching by the hundreds. For these, early sprayings of Paris green at the rate of one pound to 300 gallons were used. Even at that strength, when repeated three times, the spray slightly injured the junipers. Comparing this effect with the trees sprayed later in the summer shows that trees are much more liable to injury from Paris green when the new growth is tender and when the trees are frequently wet with dews or rains than when the wood is more mature and the season dryer.

It is essential that sprays for bag worms be applied when the worms first hatch. Since they cover themselves with a bag composed of bits of leaves and bark from the tree, woven into their web, it is very difficult to see them until they reach good size, and it is too late for successful spraying. To avoid taking the time for careful search for them it has been found convenient to gather a few bags containing eggs in winter and place them where they can be conveniently watched for their hatching. If placed in some glass receptacle in the open air they will hatch at about the time those hatch from the bags on the trees. If a few bits of bright red cloth are put with them they will immediately begin shredding it to make their bags and these bits of bright color can be readily seen as the minute creatures crawl about behind the glass. It is then time to spray trees infested with them.

MISSOURI AGRICULTURAL EXPERIMENT STATION.

SPRAY CALENDAR.—March 1, 1896.

Arranged by J. C. Whitten, Horticulturist.

PLANT.	FIRST APPLICATION.	SECOND APPLICATION.	THIRD APPLICATION.	FOURTH APPLICATION.	FIFTH APPLICATION.	REMARKS.
Apple—Scab, bitter rot, biting insects.	When buds begin to swell, copper sulphate solution	Just before flowers open, Bordeaux.	As last flowers are falling, Bordeaux and arsenites.	10 to 12 days later Bordeaux and arsenites.	10 to 15 days later Bordeaux.	If bitter rot appears, am. copper carbonate or potassium sulphide every ten days until fruit is picked.
Cabbage—Worms, aphis, Harlequin bug.	When insects are first seen, kerosene emulsion.	10 days later repeat if not heading.	10 days later hot water, 130 deg. if heading.	Repeat third when necessary.		Plant catch rows of radish or mustard, and spray with strong kerosene emulsion as insects gather.
Currant, Gooseberry—Mildew worms, aphis.	When leaves appear, Bordeaux.	10 days later, Bordeaux. Hellebore for worms, quassia and tobacco for aphis.	Repeat second when necessary.	Ammoniacal copper carbonate after fruit is one half grown.		
Evergreens—Bag Worms	When bag worms first appear, arsenites (1 lb. to 300 gals.)	Repeat first if necessary.	If worms persist until wood is ripe and weather is dry add more arsenites.			Pick bags containing eggs in winter. To tell when worms hatch, hang bags containing eggs in bottle in conspicuous place, with bits of colored cloth.
Grape—Fungous diseases, biting insects.	When buds begin to swell, copper sulphate solution.	Before flowers open, Bordeaux and arsenites.	When flowers have fallen repeat second.	10 to 14 days later Bordeaux.	If rot appears after fruit is half grown, am. copper carbonate.	Sacking bunches in manilla sacks gives finer specimens for show table.
Nursery Stock—Fungous diseases, Bag worm and May beetle.	When buds begin to swell, copper sulphate solution.	When leaves appear, Bordeaux and arsenites.	14 days later repeat second.	14 days later repeat second.	14 days later, repeat second.	Cut out and burn fire blight if it appears.
Peach, Nectarine, Apricot—Fungous diseases.	When buds begin to swell, copper sulphate solution.	Just before flowers open, Bordeaux.	When flowers have fallen, Bordeaux. Arsenites may be added for curculio.	10 days later repeat third.	Am copper carbonate every 10 days for rot after peaches are nearly grown.	Jar trees for curculio during early morning or evening after fruit sets.
Pear—Leaf blight, scab, biting insects.	When buds begin to swell, copper sulphate solution.	Just before flowers open, Bordeaux.	When flowers have fallen, Bordeaux and arsenites.	10 to 12 days later repeat third.	10 to 15 days later, Bordeaux.	Cut out and burn fire blight if it appears.
Plum—Fungous diseases, curculio.	When buds begin to swell, copper sulphate solution.	Just before flowers open, Bordeaux and arsenites.	When flowers have fallen, Bordeaux and arsenites.	10 to 14 days later repeat third.	12 to 15 days later repeat third.	Jar tree for curculio morning or evening after fruit sets. Am. copper carbonate solution every week from the time the fruit reaches full size until gathered.
Potato—Scab, blight, beetles.	Soak seed for scab in corrosive sublimate solution, 2 oz. to 16 gals. water, for 1½ hrs.	When beetles appear, arsenites.	When vines are one half grown, Bordeaux. Arsenites for beetles.	10 to 14 days later repeat third.	10 to 14 days later repeat third.	

Quince—Fungous diseases, biting insects.	When buds begin to swell, copper sulphate solution.	When fruit has set, Bordeaux and arsenites.	Two weeks later, Bordeaux.	Two weeks later repeat third.	Two weeks later repeat third.	If rot appears at time of ripening, spray with am. copper carbonate solution. Clean up and destroy all decayed fruit.
Raspberry, Blackberry, Dewberry —Fungous diseases.	When buds begin to swell, copper sulphate solution.	When leaves are opening, Bordeaux, Cut ou all rusted canes that appear.	Two weeks later, (when not in flower) repeat second.	Before fruit is full size, am. copper carbonate solution.	After fruiting, Bordeaux.	Spray freqnently with Bordeaux for fungous diseases that appear after fruit is gathered.
Rose—Fungous diseases, slugs.	When leaves appear, am. copper carbonate.	If slugs appear, Hellebore.	If fungi appear, repeat first. For slugs repeat second.			Indoor roses may be treated with kerosene emulsion(very dilute) for aphis. Tobacco smoke may be used for same purpose.
Strawberry—Rust.	When flowers first begin to open, Bordeaux.	When first fruit sets repeat first.	Before fruit ripens am. copper carbonate.	When last fruit is harvested, Bordeaux.	Repeat fourth if necessary.	Young plants not in bearing may be treated throughout the season.
Tomato—Rot, blight.	At first appearance of fungus disease, Bordeaux.	Repeat first every two weeks if necessary.				

DO NOT SPRAY WHEN PLANTS ARE IN BLOOM.
FOR APHIS USE KEROSENE EMULSION OR QUASSIA AND TOBACCO.

KEROSENE EMULSION FOR SCALE INSECTS IN WINTER, AND IN SUMMER WHEN YOUNG SCALES ARE HATCHING.

FORMULAS.

Ammoniacal Copper Carbonate.

Copper carbonate.....6 ounces
Ammonia, 26 deg. Baume, enough to dissolve copper, *no more.*
Water.....40 to 50 gallons

Dissolve the copper carbonate in the ammonia (it will take about three pints of the stronger grade) and dilute with water to 40 or 50 gallons.

For fungous diseases. It does not discolor fruit and may be applied even when the fruit is ripening. Often used for apple bitter rot.

Arsenites.

Paris green or London purple.....1 pound
Water.....160 to 400 gallons

Make a paste of either Paris green or London purple with a little water, gradually dilute it by adding more water. When it is of liquid consistency pour it into the water. If the poison is put dry into a barrel of water it will collect in lumps and can not readily be stirred into the water.

For insects that chew. The Paris green is less liable to burn foliage, so it is sometimes preferred to the London purple. The London is more readily kept in suspension in the water, however. In applying either of these poisons the liquid should be kept stirred so they will not settle.

These poisons are generally applied in Bordeaux mixture instead of water.

Bordeaux Mixture.

Copper sulphate.....4 pounds
Lime (unslacked).....4 pounds

Dissolve the copper sulphate by putting it in a sack and suspending it over a tub of water (at least 4 gallons) so the bottom of the bag just touches the water. When it is dissolved dilute to 25 gallons. Slake the lime and dilute to 15 or 20 gallons, then pour these two together and add water to make fifty gallons. Do not fail to dilute both lime and copper sulphate before they go together, or chemical action will injure the solution.

The Bordeaux Mixture is used for most fungous diseases, and is our best general fungicide. The sediment from it remains on the plant for some ttme, so fruit should not be sprayed with it near the time of ripening.

The amount of copper sulphate and lime may be increased to 6 pounds each, or diminished to 3, 2, or even 1 pound each. (The weaker mixtures have proven about as successful with us, for everything except bitter rot, as the 6 pound solution.)

Hellebore.

Fresh white hellebore.....1 ounce
Water.....3 gallons

Apply when thoroughly mixed. This poison is not so energetic as the arsenites and may be used a short time before the sprayed portions mature. For insects which chew: It is the best remedy for rose slugs.

Kerosene Emulsion.

Hard soap.....½ pound
Boiling water.....1 gallon
Kerosene.....2 gallons

Dissolve the soap in the water, add the kerosene, and churn with a pump for 10 minutes. Dilute 10 to 25 times before applying. Use strong emulsion for all scale insects. For insects which suck, as plant lice, mealy bugs, red spider, thrips, bark lice or scale. Cabbage worms, currant worms, and all insects which have soft bodies, can also be successfully treated.

Potassium Sulphide Solution.

Potassium sulphide (liver of sulphur)..1½ pounds
Water.....40 to 50 gallons

Dissolve the potassium sulphide in the water.

For bitter rot of apples and for currant and gooseberry mildew.

Quassia and Tobacco Solution.

Quassia chips.....1½ ounces
Tobacco stems.....3 ounces
Water.....about 3 gallons

Soak the quassia chips and tobacco each in a separate bucket containing one gallon of water, over night. The next morning boil the quassia for 15 minutes in the water in which it has been soaking. Pour the quassia and tobacco water together and dilute to three gallons.

For plant lice. It has, with us, given best satisfaction for plum aphis.