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# UNIVERSITY OF IDAHO

# Agricultural Experiment Station

## Department of Botany

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## Some Experiments with Fungus Diseases in 1903

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By the Botanist

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The regular bulletins of the Station are sent free to all citizens of Idaho who request them. Late Bulletins are:

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## Some Experiments with Fungus Diseases in 1903

BY THE BOTANIST

The three most serious diseases of fruits in the neighborhood of the Idaho Experiment Station are, in proportion to the damage done the trees or fruits:

1. The Fire Blight of the Pear.
2. The Apple Scab.
3. The Powdery Mildew of the Gooseberry.

A few experiments were undertaken by the writer during the growing season of 1903 for the following purposes:

1st. To test the efficiency of the gasoline spraying engine on our Palouse hills.

2nd. To test the value of two sprayings with Bordeaux mixture for the scab. This is important, as it is doubtful whether in our dry summer climate more sprayings are profitable, and it is also doubtful, if they could be shown slightly more profitable, whether the average apple-raiser can be induced to employ more.

3rd. To test the Liver of Sulphur or Potassium Sulphide spray for the Gooseberry Mildew with sprayings varying in number as well as in the amount of material used.

4th. Pruning for the Fire Blight of the Pear.

### The Gasoline-Engine Sprayer.

We do not feel that an experience of but one season is sufficient to enable one to speak authoritatively on this

method of spraying, but some observations cannot but be of value.

Unless one has a large orchard the saving of time in using this method over the hand pump would not compensate for the outlay in money, or the difference in cost between a power and a hand sprayer.

It is also doubtful, if the orchard be situated upon a steep hill-side, as many of our orchards are and of necessity must be in this very rolling country, whether an engine driven by gasoline or by steam can be used to advantage. The mechanism seems much more liable to stoppage or to getting out of order in such localities.

Lastly we would advise no one to buy such a machine, unless he has an acquaintance with the gasoline or other engines, or will go to the expense of hiring such assistance during the spraying season. Even then the delays connsequent upon a "break-down" and repairing the disaster will often cause less spraying to be done in a day than with a good hand pump.

Whenever these difficulties are not present or can be done away with—that is when the land is not too steep, when a competent man is running the engine, and the engine is in good running condition before it leaves the hands of the manufacturer or the middleman—the cost of the engine should not be considered, for the saving in manual labor, the uniform pressure behind the spray rendering it finer, more powerful, and less liable to clog in the nozzle, and the greater rapidity with which a tree can be covered, make the possession of one of these engines most desirable.

In conclusion I may say that our observations of this sea-

son have led us to doubt whether the gasoline engine will prove a success in the majority of the orchards of the Palouse Country. The continued use of this machine through several seasons may cause us materially to modify this statement.

### Experiments with the Gooseberry Mildew.

Eight or ten rows of gooseberries were planted on our station grounds several years ago, and I am perfectly safe in saying that from that time till 1903 not a single crop of fruit was gathered, owing to the presence of the mildew. As most are probably aware, the trouble is due to a fungus which lives entirely on the SURFACE of the berry, leaf, and shoot, and for this reason is very amenable to the proper spray, especially in its early stage. This fungus, like many others, has an early stage or form of spore to enable the plant rapidly to spread itself, and a late stage of spore-form, which carries the disease over the winter. The first stage appears as a white, powdery covering on the affected parts of the plant, while the second or "winter-stage" appears, under slight magnification, as a quantity of dark round bodies scattered over and through the white fungus covering. If one of these round bodies be examined under a high power of microscope, it will be found to be hard-shelled and containing many little sacks which in turn hold the winter-spores of the fungus. While it will thus be apparent that these little spheres are well adapted to withstanding the cold and rain of winter, it will also be apparent that they are well calculated to KEEP OUT ALL SPRAYS. To be effective, therefore, the spraying should be resorted to early, and, since the spores may develop any time during the growing season, should be continuous. The main purpose of this experiment was to test, not the

efficacy of the Potassium Sulphide spray alone, for this has already been proved by many experiments, but the number of sprayings and the strength of the material best adapted to our climate.

Eight short rows were selected, cut out, trimmed, weeded, and cultivated. From one to four main stalks were left to each plant, but they were trimmed in such way that light and air could strike nearly every part of each plant. The spray used was of two strengths, viz: Formula 1, ½ oz. of sulphide to each gallon of water. Formula 2, 1 oz. sulphide to each gallon. Rows I, II and III were sprayed with formula 1 on April 14th, just as the young leaves were pushing out from the bud.

On April 23rd, rows IV, V and VII were sprayed with formula 2, row VI was left unsprayed as a check, and row VIII was left unsprayed till the flowers should be well developed.

On May 7th row VIII, then in full flower, was sprayed with the weaker formula, as well as row I. On May 12th rows II and III were resprayed with the weaker spray, as was row I for the third time; rows IV, V and VII were sprayed with the stronger solution. On June 12th all of the rows except the check were resprayed, rows I, II and III with the weaker spray, rows IV, V and VII with the stronger. This was the last spraying, and by this time the rows had received the following treatments:

Row I had been sprayed four times with formula 1.

Rows II and III had been sprayed three times with formula 1.

Rows IV, V and VII had been sprayed three times with formula 2.

Row VIII had been sprayed twice with formula 1.

Row VI had not been sprayed at all, but pruned.

It was discovered later in the season that rows VII and VIII were of the small American type, the other rows of the European.

At the date of the last spraying, June 12th, no mildew could be found on the sprayed rows, while row VI showed much on berries and twigs. On July 20th, while berries and twigs on the check row VI were infested by the mildew, now in the second or "winter-stage," not a single trace of the disease could be found, after most diligent search, on any of the sprayed rows except on ONE end of ONE bush, where a thick overhanging branch had shaded and kept off the spray from a lower one. On this latter, one cluster of berries and leaves was badly affected, proving rather than discrediting the efficacy of the spray.

At this time the berries were hanging large, perfect and abundant upon the vines. It is well known that the American varieties are less subject to the disease than the European, and it might seem that it would have been better to have discarded them altogether from the experiment. On examining some vines at no great distance away, all of the small red American type, it was seen that they had suffered much this year from the mildew, hardly a good, clean berry being seen on the vines. For this reason rows VII and VIII can well be considered as forming a useful part of this experiment.

On October 8th the rows were again examined, and

though as stated the fruit had been perfectly preserved, THE TIPS OF THE YOUNG SHOOTS showed considerable mildew of the early or conidial form.

This proved just what the writer had in mind before the experiment was tried viz:

1st. That the Potassium Sulphide or Liver of Sulphur treatment is as efficient in this state as elsewhere in preventing the Powdery Mildew of the gooseberry. It is easily made, easily applied, and cheap.

2nd. Two sprayings seem just as good as more in our country for saving the crop, and the weaker as good as the stronger. I say SEEM, as the spring of 1903 was a poor one for fungus diseases generally, though the check row VI showed abundant mildew. Probably if the spring had been WARMER and MORE RAINY, a larger number of sprayings might have been found necessary. This experiment will be continued.

3rd. In order absolutely to STAMP OUT the disease the spraying should continue later into the summer. A spraying in the latter part of July would probably prevent ALL of the fungus growth.

In conclusion I may say IT PAYS to spray for gooseberry mildew, even though the price of the crop may not be high, and for two reasons: 1st, the cost of the sulphide is little; 2nd, without it, practically NO European gooseberries can be raised. The amount of sulphide used in these sprayings was 2 lbs. 6 oz., at about 30 cents per pound.

The sulphide dissolves much more rapidly if water quite warm is employed; while from the nature of the solution no

clogging occurs in the nozzle. The time actually employed in mixing and applying the spray during the 5 applications was 7 hours.

## Experiments with Apple Scab.

Two orchards, each within a mile of town, were selected for these experiments. One has about as high an elevation as can be found within three miles of Moscow. This was the small orchard of Mr. James Fogle, a mile west of town.

The other, owned by Mr. Claus Peterson and situated a half mile south of town, has rather a low elevation. In this way it was hoped a better average could be obtained than if both orchards were of the same elevation or only one had been selected. The part of the Fogle orchard selected for the experiment consisted of 56 trees of mixed varieties, mainly Ben Davis, Wolf River, Winesap and Walbridge. This part of the orchard is nearly level, so that after many vexatious delays had occurred in getting the gasoline engine to work properly, no further difficulties arose in having it run continuously and well. Spraying was commenced on the 27th of April. Several checked trees were left here and there, and these were sprayed at no time during the work except as the mist, applied to an adjacent tree, but driven by the high winds that prevailed during the entire work here, would be carried unavoidably to the check.

The spray used was the Bordeaux Mixture. As the lime was very good and gave an almost perfect milk when slacked, two strengths were used, one the 6-4 formula, or 6 lbs. of blue stone, 4 lbs. of lime and 45 gals. of water, the other, applied to but a few trees, an unusually strong solution, or 8 lbs. of

blue stone, 4 lbs. of lime and 45 gals. of water. Stock solutions were made of both the blue stone and the lime, 40 lbs. of the former being left overnight in 10 gallons of hot water. In the morning some of this blue stone had not dissolved. Also, at the time of completing this first spraying, 64 lbs. of blue stone were suspended in a gunny-sack in 15 gals. of hot water, and at the time of our second spraying many lbs. of this solution had re-crystallized on the bottom and sides of the wooden tub. This shows that in both cases too much blue stone had been put in the water to make a good and permanent solution. It would have been better had I placed only 20 lbs. of the copper sulphate in the same number of gallons of hot water, when a good and permanent solution is made.

The first application, owing to delays in getting the engine running (which were at times so protracted as to force us to use the hand pump) as well as to occasional rains, consumed all of the time from April 28th to the afternoon of May 1st.

The amount of scabby fruit which grew on this orchard in 1902, taking into consideration the high elevation, had been remarkable. Mr. Fogle assured me that there was scarcely any salable fruit on the place. My own eyes were a partial witness to the fact this spring, for the scab spots were thick upon the leaves, while the culls which had been buried on the place to protect from frost were so covered and distorted by scab as scarcely to be usable. All of these culls Mr. Fogle buried deep in the earth, while he raked up and burned the leaves, concluding by giving the orchard several good cultivations during the spring and summer. This must be carefully borne in mind while weighing the results.

The orchard was again sprayed June 3-4, shortly after the petals had fallen, and in this application, owing to the quite serious work of the codlin moth the previous year, ½ lb. of Paris green was mixed carefully, after having been made into a thin paste with water, in each two barrels of spray the engine-truck carries. The engine, after having been carefully over-hauled, and a capable engineer put in charge of it, ran without a hitch, and the same amount of trees was sprayed in one day as had taken us 2½ days at the first application.

The same trees, which had been sprayed with the more concentrated spray the first time, were treated with the same spray this time.

At the conclusion of this spraying, no scab was in evidence. The trees were all heavily laden with fruit.

In the first week of October, before the apples had been picked, the orchard was revisited. No scab nor codlin moth could be found on any of the sprayed trees.

On the other hand NO SCAB and but few worm-holes could be found on any of the checked trees, or on any of the other unsprayed trees in the orchard. In one sense, therefore, the experiment was a failure, judged from the side of spraying alone. The absence of scab from an orchard that was so badly affected the previous year I can attribute only to two causes. The first was that the spring of 1903 was very poorly adapted to scab. The season was in the main a cold, dry, and late one. The trees were slow to bloom, and even far after blooming the country was visited by late and heavy frosts, so heavy in fact that it is a wonder any fruit matured, to say nothing of a full crop.

The second cause for so little scab in this orchard I cannot but think due to the splendid care it received from Mr. Fogle. Not only were all rotten and gnarled fruit, but all INFESTED LEAVES, CAREFULLY BURNED OR BURIED. I firmly believe that more can be accomplished by carefully disposing of this rubbish in the fall, and thus obliterating the main source of infection, than by the more tedious and costly method of preventing the spread of the disease by spraying. Further attention will be directed to this as my report proceeds.

The effect of the concentrated spray was as I had expected. The fruit upon these trees, and especially upon the Ben Davis, was badly rusted by the excess of the copper salt. Even the Ben Davis treated with the common mixture, or the 6—4 formula, had many of their apples rusted by the spray.

### Experiment in the Claus Peterson Orchard.

Mr. Peterson stated in the early spring, that while the greater part of his 40-acre apple orchard had been visited by little scab in 1902, two blocks of trees in a LOWER place in the orchard had been quite seriously attacked. The apples in these two adjacent blocks were the Rome Beauty and the Yellow Newtown varieties. I therefore determined to limit my sprayings to these trees, consisting in the aggregate of 75 of the latter variety and 100 of the former. There were seven rows of the latter, the Newtowns, and 8 rows of the former, the Rome Beauties. A few checks were left scattered about in the block of trees, while the three eastern rows of the Rome Beauties were left entirely unsprayed.

The trees were sprayed twice, May 5-6, and June 4th.

Only one day was consumed in the work the second time, for so many of the trees were devoid of fruit, owing to the late frosts, that it was judged a loss of time to spray such a second time.

The sprays used, during this experiment, were of two weaker solutions, the 6-6 formula, and the 4-4, that is 6 and 4 lbs. of blue-stone respectively to 4 lbs. of lime. Little rusting of the fruit could be observed when the examination took place in October. The ground on which this part of the orchard is planted consists of a rather steep slope from an almost wet ravine or "swale." Consequently much more trouble was experienced with the gasoline engine,—so much so in fact that the last part of the first spraying was concluded with the Bean hand-pump. The engine ran successfully through the whole of the second spraying on June 4th, though often with difficulty and much heating.

On October 7th I carefully inspected not only the two blocks of trees selected, but the whole of the orchard. This was rendered necessary for two reasons:

1st. While but little scab could be found on the sprayed and checked trees, NONE could be found on the three unsprayed east rows of the Rome Beauties.

2nd. The little scab found amongst the Newtowns, and the ONLY scab found on the two blocks of trees, was upon those at the NORTHWEST CORNER of the sprayed tract.

This seemed to show conclusively that all of the scab upon the sprayed trees had drifted in with the prevailing northwest winds during the summer and early fall. The ex-

amination was therefore extended over the whole orchard with the following results:

The fruit on the trees just to the north and west of the treated trees was quite, but not very scabby. On many parts of the orchard owing to slightly susceptible trees or better air-drainage, no scab was found. On other parts, notably upon the Winesaps, quite a goodly proportion of the fruit was scabby, but not badly enough to be distorted and unsalable.

Again my experiment appeared at first sight to have failed.

On making further inquiries of Mr. Peterson, I found out that the orchard had received very poor attention in 1902. During the whole of the present season the weeds had been kept down and the ground thoroughly cultivated. In October almost no weeds were to be seen over the entire tract. Though in this case also the season had much to do with the absence of scab, there is no doubt that the careful cultivation the orchard had received had been largely responsible for its suppression, and for the following reason: On the other side of the road and less than a quarter of a mile distant from Mr. Peterson's orchard, is another. This orchard, partly from the age of the gentleman owning it, partly from the many poor varieties and seedlings in it, partly from the great age of the trees (for it is the oldest orchard in this part of the country) has been suffered to run down and almost out. It was not cultivated for years, thickets of seedlings have been allowed to grow up, and only the last year was it plowed up and seeded to clover and grass. It has consequently been a veritable hot-bed for scab, and no doubt has been the main distributing point for this disease for miles around. I had visited this orchard last year, when scab was quite bad

all over the Palouse country, and had found fully 90 per cent of the fruit more or less diseased. It was with much interest, therefore, in view of the scanty scab in the two orchards given in this report, that I revisited this orchard the present October. ALMOST EXACTLY THE SAME STATE OF AFFAIRS PREVAILED, the scab being scarcely less in evidence than during the past year.

I consider this conclusive proof, as before stated, that the care given an orchard in the matter of cleaning up or plowing under rubbish, old fruit, and leaves, followed by good clean cultivation, has as much to do with the suppression of scab as has spraying.

## Experiment with Lime-Sulphur-Spray in Suppressing Apple Scab on the Station Grounds.

It has long been the opinion of many of our horticulturists that the spray so commonly used for San Jose scale was also a preventive of scab, though as far as I am aware this belief is more or less of an empyrical nature. There are about 20 trees in all. A few of these were left unsprayed, a few more sprayed with the Bordeaux mixture, while the greater part were treated to a liberal coating of the lime-sulphur wash. This was mixed in the proportions recommended by Prof. Chas. V. Piper, and consequently called the "Piper Formula." He had highly recommended this formula for treating trees infested with scale, claiming to have used it very successfully for this pest. It is as follows:

1 lb. of lime, 1 lb. of sulphur, 4 gals. of water.

Six pounds of lime were carefully slacked to a fine milk, and poured through a wire strainer into a boiler. 6 lbs. of

flour of sulphur were added, and the whole boiled with 10 gals. of water for about 1½ hours. At this time it had a fine dark amber color. Water was then added to make 24 gals. in all, or the proportions of 1-1-4. On April 21st, when the buds were well developed but no leaves expanded, the south 14 trees of the 21 were sprayed. The compound does not clog in the least, but the only objection to the MECHANICAL effect of this spray is that the trees when dry never show that fine whitewashed appearance they do when more lime and sulphur are used. On June 5th the remaining unsprayed 7 trees were sprayed with quite a concentrated solution of the Bordeaux, as they only had one spraying, viz. the 8-4 formula, or 8 lbs. blue stone and 4 lbs. of lime in a barrel of water. On October 5th the trees were carefully inspected. As no plat of this orchard exists, many of the varieties are unknown. Many are summer or early fall apples, and the fruit had been picked before the examination was made.

Very little scab was to be found on sprayed or unsprayed trees.

Of the trees sprayed with the Bordeaux, only two had any scab upon their leaves or fruit, though the fruit on several was rusted or burned by the spray.

This, with the evidence from the Fogle orchard, shows how important it is that the spray NEVER exceed the formula 6—4, though it is much better to use either of the formulas 6—6 or 4—4. Of the trees sprayed with the lime-sulphur wash, little can be said. It had seemed, when the trees were examined in July in company with the Director, that the spray had been very efficacious, but when viewed in October, especially when we keep in mind the scanty scab that generally

prevailed this year, no very accurate conclusions could be drawn. There was enough evidence, however, to state conclusively that ONE spraying with the lime-sulphur spray will NOT kill out all the scab-spores, nor prevent subsequent infection in part. Some of the trees were scabby, some little so, many not at all. More evidence in a better year is needed, and these experiments will be continued in some larger orchard the coming season, WITH and WITHOUT the addition of salt.

### Fire Blight of Pear.

This is without doubt the worst orchard disease with which the fruit-growers of Northern Idaho have to contend, and this year it has been reported quite generally from Southern Idaho. It has been conclusively proved that it is a bacterial disease, works along the cambium, young bark and wood, and consequently cannot be successfully combatted with sprays. The only successful treatment thus far recommended is severe pruning, and this well below the regions of visible infection. The cuts should then be painted to prevent re-infection. So bad has this disease become in some parts of Idaho, that many have abandoned raising pears altogether, while others have discarded all but the most resistant kinds. Still, it is not the writer's belief that pear culture is to be abandoned in Northern Idaho on account of this disease. Many still are able to put good fruit upon the market, notably Bartlet, Sheldon, Seckel and Anjous, while many more pears and varieties could undoubtedly be raised in our country were the orchardists in earnest in combatting this disease. No very thorough experiments have, however, been carried out in our state, that I am aware of.

One of the worst varieties to blight in Idaho is our unsurpassed winter pear, the Winter Nellis. Three of these trees EXISTED near the apple trees last mentioned, but barely so. At the time of the last spraying of the apples, on June 5th, these three trees were about as unpromising specimens as could be seen,—many of the main branches having died from the disease, while the majority of the smaller branches were either dead or more or less affected. A few young fruits had set on unaffected branches on two of the trees.

On this day the writer went after them with the saw and knife, all branches affected being taken off well below the regions of infection. When the pruning was thorough and the material removed, there was little left to the trees but stubs, with a few mutilated branches.

These trees were examined again in October, before any of the leaves had fallen. They all looked WELL, many new branches having been put out, so that they looked quite like merely heavily-pruned trees. NOT A TRACE of the blight was to be seen on the fruit, young branches, shoots or leaves. I do not mean to say that the disease was forever stamped out, for it may come on again next year; but I DO mean to say that these trees were changed by this treatment from unsightly dying things in June into sightly flourishing trees in October. Certainly, in view of what has been said and written for and against pruning for fire blight, I do not consider so limited an experiment conclusive.

L. F. Henderson.