SPRAYING AGAINST INSECT INJURY A PROMINENT FACTOR IN ORCHARD MANAGEMENT.

by

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Plants like animals seem to be more subject to disease and parasitic attack when they appear in large numbers than when found singly, and these attacks seem to increase in proportion to the increase in numbers of the plant grown.

For many hundreds of years they were considered to be inevitable: that they were uncontrollable as far as the hand of man was concerned. But within the last half century, beginning about the time when Paris green was found to successfully combat the Colorado potato beetle (Doryphora decemlineata Say) in America, and a few years later when a mixture of copper sulfate, milk and water was accidentally found in France to prevent downy mildew on the grape, (Peronspora viticola B.& C.), men began to believe that it might be possible, at least in a measure, to control them. Having come to this supposition they at once began experimenting that they might determine with some degree of definiteness to what extent their theory would hold good. As a result of this movement, they not only arrived at the positive conclusion that many of our most injurious insect and plant diseases may be controlled if properly treated, but also many different spraying mixtures were discovered.

These so-called sprays may be divided into two great classes: viz. insecticides and fungicides, the mission of each of which is evident by its name; and, as both if taken together would make most too comprehensive a subject for the space alloted, the substance of this paper will be confined to the former class.

Of the insecticidal sprays we again have two divisions : (1) those which kill by contact and (2) those which kill when taken internally by the insect. The former usually consist of some oily, soapy,or caustic substance and destroy by closing up the abdominal breathing spiracles,thus cutting off the supply of oxygen,or by caustic action on the body tissues; while the latter contain more or less of poisonous substances. Each of these has its own particular class of insects to destroy. The contact sprays are used principally for that class of insects having haustellate or commonly called sucking mouthparts. These obtain their nourishment by means of inserting their beak-like mouthparts in the plant tissues and drawing out their nourishment in the form of sap. We can readily see therefore that regardless of the amount of poison we might have deposited on the surface of the plant,it would do little or no good as far as destroying such insects is concerned. But for the other class—the mandibulate—or those which feed by means of biting or chewing off portions of the plant tissue,the poison sprays are by far the most practical, as they may be applied,and remaining on the leaves or stems may do effective work for a period of several weeks.

Now that we have many remedies which we know to be effective if properly applied,it remains with each individual horticulturist to decide whether he desires to utilize this knowledge. Characteristic of this day and age,the first thing he asks himself is—" Will it pay? Will the increase both in quality and quantity of my fruit as well as the damage I save my trees,justify me in going to the expense of purchasing spraying materials,the machinery for applying the same and the hiring of men to assist in the application?"

Of course there can be no specific rule advanced as to just how much it will cost to spray a tree, or what we may expect such a tree to return us in dollars and cents above the returns taken from a similar but unsprayed tree. Both cost and returns vary with the locality and from one year to the next. However, a couple of illustrations from one year might serve to give one an idea of what may be accomplished along these lines.

In the vicinity of Toledo, Ohio, experiments were conducted last season for the control of the San Jose scale (Aspidiotus perniciosus Comst.). During the month of November, one application of the lime-sulphur-salt wash was made to peach and plum trees very badly incrust-ed with the scale. For several years previous the fruit from these trees had been unsalable on account of the presence of the scale upon it, and the trees themselves had become very much weakened, and in some cases the smaller twigs were beginning to die. The following spring these treated trees bore just as many blossoms and were just as full of foliage as the untreated check trees which had been left for comparative purposes, showing that no injurious effect had been experienced from the application of the wash. Also, examinations at this time showed these trees to be comparatively free from the scale. As the summer advanced the untreated trees began to have a rather sickly appearance, and a large number of the fruits and leaves fell to the ground. (Plate I Fig. 1.) By harvest time hardly any fruits remained on the trees, and the small amount that was still present was so badly damaged by the scale as to make it, as in former years, wholly unmarketable. In comparison with these the treated trees (Plate I Fig. 2.) bore a moderately full crop, which was almost free

from the scale. They also made a fair growth of new wood and the foliage on them was dense and of a dark green, healthy color. The yield of the peaches was in the neighborhood of from one to one and a half bushels per tree, which sold from $1.25 to $1.85 per bushel, thus making the returns from each tree range from $1.25 to $2.75. The yield of the plums was not computed. However by comparing Figures 1 and 2 of Plate 2 for the effect on the foliage, and the upper and lower rows of plums in Figure 1, Plate 3, for the effect on the fruit, one can get some idea of the good accomplished on them. These returns were the result of a very small outlay of capital, as it has been estimated that an application of the lime-sulphur-salt can be made for four cents per tree. Hence for this insignificant amount not only was the owner able to harvest a fair crop of fruit, but also his trees made a good growth of new wood during the season, and hence were much improved; while on the other hand, from his unsprayed check trees he harvested no crop, and besides they were much weakened by the further action of the scale during the season.

The spraying mixture used in this experiment was prepared with a cooking apparatus as shown in Plate 4, Fig. 1. This is a rather unhandy and laborious method and can only be used where a small number of trees are to be treated. Where large orchards are to be sprayed the more practical apparatus is one where live steam is used to boil the liquid. Plate 4, Fig. 2 shows a good example of this type.

Another experiment, also carried on during the past season, was worked out on the State Experiment Station grounds at Wooster, Ohio. This was for the purpose of determining the most effective means of controlling the codling moth (Carpocapsa pomonella Linn.) attacking

the apple. The orchard treated was one of the oldest in the country and usually bears a good crop of fruit,but the past season from some unknown cause,most of the trees were not very full of blossoms,which resulted in a rather light yield. About sixty trees were treated and some left untreated for checks. Two problems were borne in mind; first,a test of various sprays,and second,a comparison of three and five sprayings. The dates of application were:

First———May 19
Second———June 3
Third———June 25
Fourth———July 14
Fifth———Aug.1

Only a small portion of all the trees treated could be closely observed throughout the whole season. The treatment and results from these several trees may be seen in the following table:—

Variety	Spray	Wormy		Not wormy	
		%	Actual count	%	Actual count
Baldwin	Check	64.2	2703	35.8	1504
"	3 Arsenite of Soda with Bord.Mixt.	26.7	1110	73.3	3037
"	" " " " without " "	23	1047	77	3493
Baltimore	Check	46.9	1792	53.1	2023
"	3 Arsenite of Soda with Bord.Mixt.	54.4	884	45.6	740
"	3 Disparene with Bord.Mixt.	29.2	787	70.8	1905
"	5 " " " "	13.6	415	86.4	2646
Wells	Check	56.6	1788	43.4	1372
"	3 Arsenite of Soda with Bord.Mixt.	32	1598	68	3394
"	5 " " " " " "	20.3	500	79.7	1967
"	5 Disparene with Bord.Mixt.	20.9	1046	79.1	3949

But even after determining the exact number of wormy and sound apples taken from each tree,we cannot exactly determine the monetary value of the good accomplished as in the former experiment ,for it has never been determined just how much an apple is damaged by reason of its being wormy. This is one of the problems which is to be worked out in the further investigations against this insect. But for the present we can only roughly estimate the gains by the fact that all sprayed apples,on account of their better appearance,brought ten cents more per bushel when placed on the market than the unsprayed brought.

Of course,success does not always come in our work . We must expect to experience at least a few failures,but the general results during the past half century have been good,and if others have been successful there is no reason why we shall not be. If spraying had been a continuously losing investment,how could it have made the progress it has during the brief period of its existence. If an innovation is not worthy of merit,it is scarcely liable to have for its staunch supporters prominent men all over the United States and Europe.

But in order to obtain uniform results we must be observant and consistent in our work. We must know for what we are spraying ,and after having determined this we must select an insecticide suitable for this particular case. After the insecticide has been selected, unless there is a definite reason for doing otherwise,the ingredients should be mixed strictly in accordance with the formula given.
In so many instances,people ignorant of the working properties of the various components of a spraying mixture,think it makes little difference whether they exactly follow the given directions or not, and the result is that their effort not only ends in failure to do

good,but goes still farther and does positive injury. Again this state of affairs is brought about many times by the same class of persons thinking they can improve on the original formula. For instance,in the case of spraying with Paris green,they reason that if one pound of the poison to one hundred anf fifty gallons of water does good,two,or even three pounds to the same amount of water would do better. As a result the foliage on their trees is burned and the fruit injured.

Another important point which in no wise can be neglected,is the selection of the proper time to spray. This depends largely upon the judgment of the individual grower,for no date can be set which in all instances,regardless of season and locality,will hold good. Where only one spraying is given,the proper time to treat apple trees for the codling moth is just after the petals fall,when the calyx is still open to receive the poison. Here at Manhattan for this season an observer might notice that this happened about May 9",and would say to the horticulturists of the state that this was the proper date on which to spray. As a matter of fact,in the southern part, where the seasons are slightly in advance of those here,by that time the calyx probably would have closed and the poison would do very little good. Or even in this same locality the season might vary for the following year,and May 9" might either be too early or too late to obtain the best results.

But regardless of the precaution taken in selecting the materials and the time for spraying,if the operation of applying is not carefully executed,the results will not be uniform. Some have the idea that the proper way to spray is to take any crude apparatus and squirt the mixture on the trees in a hurried,hit or miss fashion.

This,however,is not the case. The treatment must be done carefully and thoroughly. The apparatus should be so constructed as to enable one to produce a spray of a fog,or mist like consistency,for if it strikes the tree in large drops or streams,it has a tendency to hit and fall off,thus being both ineffective and wasteful. While on the other hand,if the spray is misty it settles in all the crevices and upon all the surfaces,no matter how smooth they may be.

The fineness of the spray produced depends upon two factors;viz. good nozzles and adequate pressure. Nozzles of the Vermorel and Spraymotor types are usually considered the best;and regarding pressure,hand pumps having a large,compressed air chamber,or the regular compressed air sprayers have given the most perfect satisfaction. The larger the volume of compressed air behind the liquid,the more even will be the spray produced and the tendency for the particles of various densities to collect will be proportionately decreased. The latter is a very important item,for it is almost invariably the case that when the mixture in the tank is not kept thoroughly agitated portions of it,being heavier than others,settle to the bottom. This sometimes brings about a very serious state of affairs;for instance,if we were using kerosene emulsion and the oil and water should be allowed to separate,the oil at the last would probably kill the plants and the water which came out before would hardly accomplish the desired results. There is no need of any mechanical mixer when the large compressed air devices are employed,as the intense pressure seems to keep the particles in suspension; but if an ordinary pump is used some kind of a stir is absolutly necessary. Ordinarily,either in the case of compressed air,or the hand pump machines,the spray is forced out through one or more lines of hose,

each terminating in a hollow rod from nine to twelve feet long, the farther end of which bears the nozzles. One man is required to manipulate each rod,and in so doing,it has been found to work to the best advantage if a certain order of procedure is observed. Always spray with the wind,holding the nozzle high in the air and permitting the spray to float through the branches in clouds. It is better to begin at the top of the tree and advance downward,as there seems to be less danger in missing portions. Spraying with the wind may necessitate waiting some days after treating one side of the tree,but when the waste of mixture,the discomfort of having the spray fall back in one's face,and the difficulty in covering the lee side of the tree are all considered,it has been found better to take the chances and wait for conditions.

With an apparatus requiring the services of three men to manipulate it, and consisting of two lines of hose with clusters of three nozzles on each line (Plate 5,Fig.1) one side of from seven to eight hundred trees may be treated in one day,and for general orchard work, where the trees are variable in size,this is the most satisfactory form of appliance. But for the spraying of trees of a uniform size, an apparatus after the style of one invented last season by W.H.Owen of Catawba Island,O.,is far superior. (Plate 5,Fig.2.) This consists of two compressed air tanks containing liquid and air,to one of which is attached a pivoted upright standard bearing twelve nozzles. With such a machine one side of thirtytwo hundred,seven-year-old peach trees can be treated by one man in one day.

When spraying first came in vogue people were timid about eating fruit that had been treated with arsenicals during the growing season, lest enough of the poison would be consumed to do personal injury.

This was well answered by Prof.Riley some years ago in a lecture before the Lowell Institute,Boston,in the following words:—

" If we consider for a moment how minute is the quantity of arsenic that can,under the most favorable circumstances remain in the calyx of an apple we should see at once how absurd this fear is;for, even if the poison that originally killed the worm remained intact, one would have to eat many barrels of apples at a meal to get a sufficient quantity to poison a human being. Moreover,much of the poison is washed off by rain and some of it is thrown off by natural growth of the apple,so that there is,as a rule,nothing left of the poison in the garnered fruit. Add this to the further fact that few people eat apples raw without casting away the calyx and stem ends, the only parts where the poison could,under the most favorable circumstances,remain,and these parts are always cut away in cooking,and we see how utterly groundless this fear is."

After seeing such facts as these presented by Prof.Riley,and also after having passed through a period of several years in which a great deal of sprayed fruit has been consumed and not having heard of a single human death that could be attributed to this cause,people have lost the fear to a great extent,so that now they buy with the quality of the fruit in mind without bothering to inquire what means were used in producing it.

In this age,where competition is sharp,the man who offers for sale the best article of its class,is sure to get the top of the market and eventually drive out of business his competitor with the inferior goods. The old fogy with the worm-eaten apples,gummy peaches and scarred plums has to step down and make room for the wide

awake neighbor who knows how to produce good,sound,clean fruit. The progressive orchardist no longer considers as his enemies the various insect pests which attack his trees,but on the other hand is disposed to think of them as a blessing in disguise,for it is on their account he is enabled to prosper.

Plate 1.

Fig. 1.

Fig. 2.

U. S. Long Distance Telephone.

Ohio Agricultural Experiment Station.

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Plate 2.

Fig. 1.

Fig. 2.

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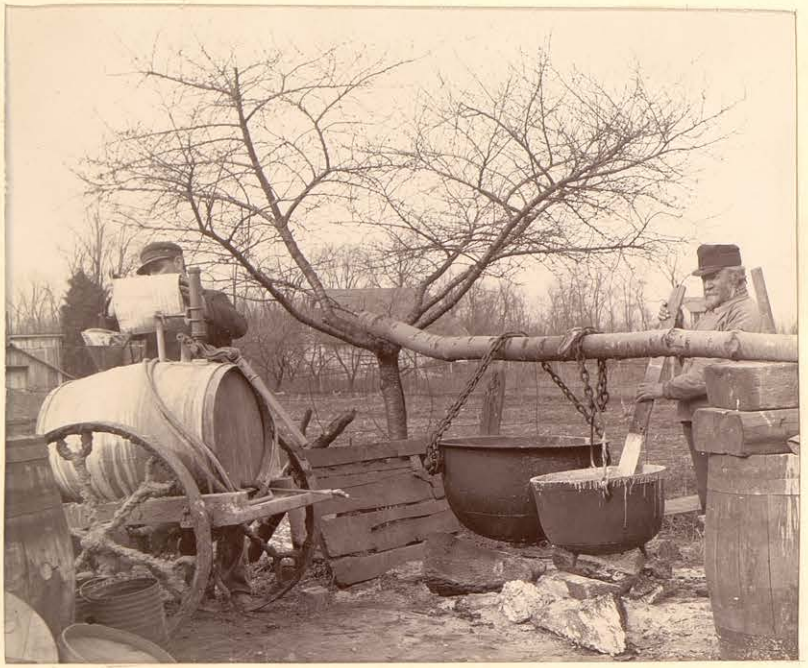

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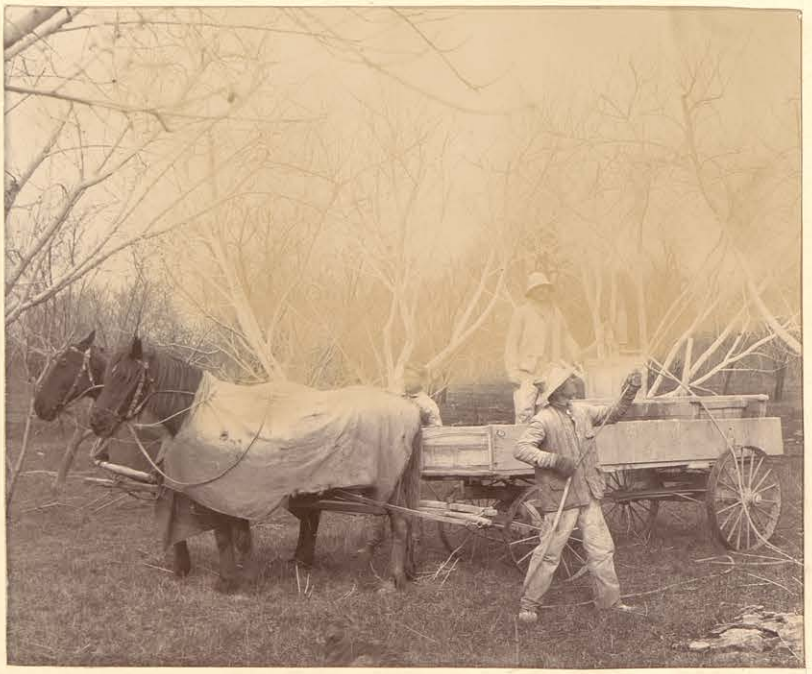

Fig. 1.

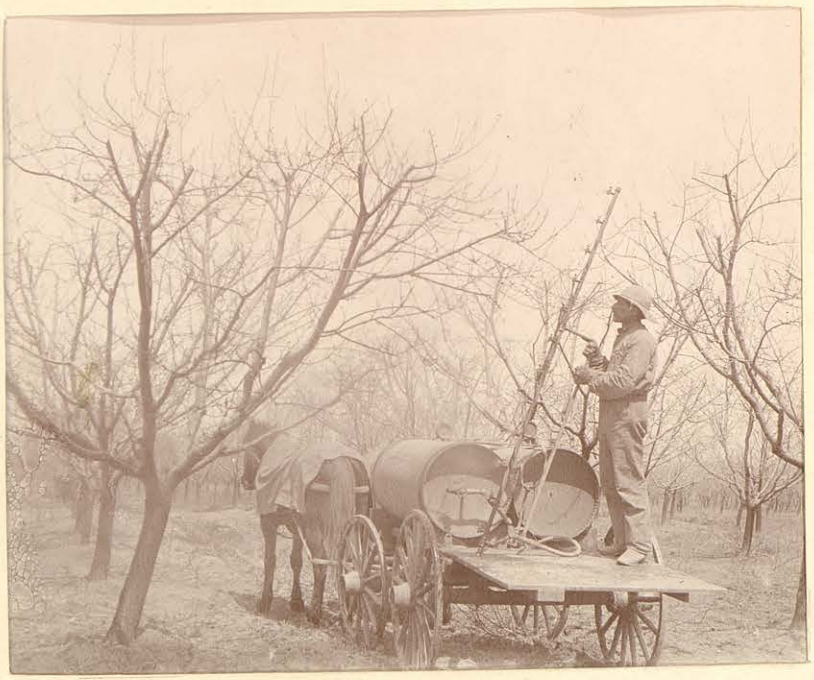

Fig 2