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Insecticides and Spraying.



By J. M. ALDRICH.



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Insecticides and Spraying.

By J. M. ALDRICH.

From the time of its first settlement until a very recent period, the State of Idaho was almost wholly free from those species of noxious insects which are such a source of trouble and loss to fruit-growers and farmers of the eastern states; but it is now evident that this immunity cannot be expected to continue very much longer. Already the Codling Moth has spread through a large part of the apple and pear district, and the dreaded San Jose scale, although as yet more restricted in the area it infects, has obtained a foothold which will make it hard to check. Unless careful and intelligent inspection of all imported apple trees be practiced, the Woolly Aphis, already not unknown within our borders, will probably be another serious pest on our list. Even with these enemies present we may yet congratulate ourselves on our freedom from the Plum Curculio and a host of lesser foes that eastern horticulturists must contend with.

In view of the rapid spread of the Codling Moth and the fearful destruction wrought in some few orchards by the San Jose scale, it is not surprising that fruit-growers are beginning to wonder what the end will be, and whether their business is not threatened with ruin. To such, a word of encouragement should be spoken. The invasion of all these injurious insects would only put us on a level with many other sections of the country, while we may with reason hope that, with proper administration of our inspection laws, many years will yet elapse before any serious damage from some of these species will take place. Moreover, it is an undoubted fact that the last ten years or so have witnessed such a rapid improvement in our knowledge of how to combat insect

pests, that we may now undertake their suppression with a high degree of confidence. The use of the spraying machine has become so general in the older sections, and is attended with such uniform good results, that no hesitation should be felt in making the small preliminary investment requisite to begin operations on this line. The present bulletin is intended to give full instructions in the most approved methods of procedure, not only against insects in general, but especially against the Codling Moth and the San Jose scale. The leading styles of spraying machines are illustrated, their adaptability for various purposes discussed, and the addresses of the nearest local stocks, as well as of the manufacturers, are given.

INSECTICIDES.

This term is applied to all substances that are used to kill insects. There are two general classes, those intended to be eaten by the insects, and those which kill by external contact. When they are applicable the former are as a rule preferable; some insects, however, do not eat the leaves or outer tissues, but suck out the saps somewhat as a mosquito fills itself with blood. For these kinds evidently it will do no good to cover the surface of the plant with poison, hence the second class of insecticides must be used.

PARIS GREEN.

This is a standard remedy, certainly one of the most useful known. It is a fine, heavy, bright green powder. When placed in water, it does not dissolve to any marked extent, but the particles slowly settle to the bottom. Hence in using it frequent agitation of the water is necessary; otherwise the bottom layer becomes too concentrated, and the upper too dilute. As the pump draws from the bottom of the tank, the liquid may be used so strong as to injure the trees, when the average composition of the mixture is very dilute. The better grades of spray pumps usually have some kind of mechanical mixer, either in the form of a paddle connected with the pump-handle or of a device to force back part of the liquid at each stroke into the tank. In any case, it is well while spraying to look into the tank from time to time to see if the contents are well mixed.

In chemical composition, Paris green is called an arsenite of copper,—that is, one of the compounds of arsenic and copper (strictly speaking, it is copper aceto-arsenite, containing also the elements of acetic acid). The poisonous properties are due to the arsenic, which amounts to about 44 per cent by weight of the

compound. Commercial Paris green sometimes contains also a small proportion of a somewhat different compound of arsenic, which is soluble in water. When this soluble arsenic is sprayed upon trees, it penetrates the leaf-tissues and injures them, causing the leaf to curl up and die. This injury is usually not perceptible for several days after application. The pure insoluble Paris green, when applied to trees, is by the evaporation of the water left adhering to the surface of the foliage as a fine powder precisely in the same form as when it was put into the water be begin with. Unless applied in too heavy a coating, this will not injure the leaves. As it is impossible without chemical analysis to tell whether a given sample of Paris green contains soluble arsenic, it is well to add a small quantity of fresh lime, say one fifth to one tenth of the weight of the Paris green, to the mixture before spraying. This lime will take up the arsenic, if any be present, and make it into an insoluble compound.

The proportions of Paris green and water that are at the same time efficient and economical are still the subject of considerable difference of opinion. Some kinds of foliage, notably that of the peach and plum, seem to be be more easily injured than others. There is excellent reason to believe that young leaves, but recently expanded or even not fully expanded, are less liable to injury than older leaves, therefore stronger sprays may be used in May or June than in August. The Washington Board of Horticulture has found that the same variety of trees will stand a stronger spray in the "Palouse Country," than in the moister summer climate of western Washington. The foliage in the former section seems to be tougher and of a darker color. I have myself used a pound of Paris green in 40 gallons of water on the dry plains of South Dakota without injury to trees. As a general rule I should use a pound of the poison to 200 or 250 gallons of water, only deviating from these proportions as experience in any particular case seemed to make it desirable, which would be very seldom. Thoroughness of application is the great thing; with it the mixture need not be very strong.

LONDON PURPLE.

This is a substance similar to Paris green in many respects, but in others very different. It is a light, fine, purple powder, a waste product or bye-product in the manufacture of aniline dyes in England. For years it was thrown away as of no value, but at last its insecticidal properties were discovered and at the

present time it is extensively used. It is imported by Hemingway's London Purple Co. (limited), New York City.

In chemical composition, London purple consists of a compound of arsenic and lime (normal calcium arsenic); in addition to this, however, there is a considerable quantity of the dye remaining, found in an analysis at the Cornell University Experiment Station to be 23 per cent of the whole weight. The arsenic itself forms about 30 per cent of the mixture. Although of less strength as regards arsenic than Paris green is, it is not inferior to the latter in practical work among the insects. It possesses an advantage in being a light powder quite easily mixed with water, and settling to the bottom very slowly. It requires only an occasional stirring when in use.

On account of being soluble in water to a considerable extent, London purple is more apt to injure some kinds of foliage especially that of the peach and plum, than is Paris green. It is therefore more necessary to add a small quantity of fresh lime to the water with this poison than with the latter. A weight of lime equal to that of the purple will do no harm and will probably obviate any trouble. Still it is advisable to use Paris green exclusively on fruit trees, leaving the London purple for gardens and vineyard, and other kinds of trees.

SULPHUR, LIME AND SALT SOLUTION.

This is a widely used remedy for the San Jose Scale. It is strongly recommended in the latest reports of the Boards of Horticulture of Washington and Oregon. We quote from the former page 95, the directions for making it:

“Unslacked lime, 40 pounds.

Sulphur, 20 pounds.

Stock salt, 15 pounds.

Water to make 60 gallons.

“Place ten pounds of lime and twenty pounds of sulphur in a boiler with twenty gallons of water, and boil over a brisk fire for not less than an hour and a half, or until the sulphur is thoroughly dissolved. When this takes place the mixture will be of an amber color. Next place in a cask thirty pounds of unslacked lime, pouring over it enough hot water to thoroughly slack it, and while it is boiling add the fifteen pounds of salt. When this is dissolved add to the lime and sulphur in the boiler and boil for half an hour longer, when the necessary amount of water to make the sixty gallons should be added. This is an excellent winter wash for trees.”

Please note that this is a WINTER wash. If applied when the leaves are out it will kill them completely. It is not perfectly liquid when made, as a portion of the lime and sulphur will remain undissolved; therefore it must be stirred while spraying is in progress. It is desirable to have a nozzle with a rather large aperture, that it may not clog.

A resin wash for the San Jose scale has been tried in California by Mr. D. W. Coquillett, special agent of the Division of Entomology, Washington, D. C. The wash being very successful, and being decidedly simpler to make and use than the lime, sulphur and salt solution, I deem it important to make a somewhat lengthy extract from his report (U. S. Dept. Agr., Div. of Entomology, Bulletin No. 23, pp. 27-28).

"During the past winter I carried on quite a series of experiments with various kinds of washes for the destruction of the San Jose scale (*ASPIDIOTUS PERNICIOSUS* Comstock) on dormant deciduous trees, kindly placed at my disposal by Mr. C. H. Richardson, the inspector of fruit pests for the Pasadena district, Mr. Richardson also aiding me in making many of these experiments. Among all of the washes tried the following gave the best results:

Resin,.....	pounds..	20
Caustic soda (70 per cent)....	"	9
Fish oil.....	pints.....	4½
Water, enough to make.....	gallons..	100

"For making 100 gallons of the above wash a kettle holding 30 gallons will be required. Place all of the ingredients in the kettle and cover with water to a depth of 4 or 5 inches, boil briskly for about 2 hours, or until it will dilute evenly with water, like black coffee, which it closely resembles in color. When this stage is reached the kettle should be filled up with water, adding this very slowly at first; the contents of the kettle can then be emptied into a tank or other vessel, and a sufficient quantity of water added to make 100 gallons. Care should be taken not to chill the wash by adding large quantities of cold water at one time.

"The making of this wash will be greatly accelerated if the resin and caustic soda are first pulverized before being placed in the kettle; if in large pieces, a considerable length of time will be required in which to dissolve them. If a sufficient quantity of water is not used at first the materials when dissolved will form a thick, pasty mass, which breaks open in places to allow the steam to escape, and pieces of the mixture will be thrown out of

the boiler or against its sides or lid by the escaping steam. When this occurs, water should be added until the solution boils in a foamy mass. Whenever there is a tendency to boil over, a small quantity of cold water should be added, but not too much, or the making of the solution will be retarded; after a few trials the operator will learn how much water to add in order to prevent the solution from boiling over and yet keep it in a brisk state of ebullition. If it is not desired to add all of the water at the same time that the solution is made, then enough can be added to equal two fifths of the quantity required; the balance of the water can then be added at any subsequent time without again heating the solution. Thus, if a sufficient quantity of the solution is boiled to make when diluted 100 gallons, this could first be diluted to make only 40 gallons, and the remaining 60 gallons of water added at any time as required. If it is desired to use it in a still more concentrated form than this, it need not be diluted at all after it has been boiled sufficiently, but in this case it will be necessary to heat it again before adding the water.

"On the 11th of February, between the hours of 1:30 and 4:20 p. m. (sun shining, light breeze), I had 60 dormant deciduous fruit trees sprayed with the above solution. These consisted of peach, plum, apple, pear, and quince trees; none of them had started to leaf out except the quince, which had put forth a few leaves at the tips of some of its branches. Each of these trees was infested with the San Jose scale (*ASPIDIOTUS PERNICIOSUS* Comstock) and several of them had been almost killed by the attacks of this pest. April 23 I made a careful examination of these trees and found only a very few living San Jose scales; all of the trees except those which were nearly dead when sprayed were now making a vigorous growth. May 12 I again examined these trees, and found living San Jose scale on only three of them, about half a dozen scales on each. I made another examination on the 11th day of June, and found a few San Jose scales on some of the pears on the above trees. All of the Black scales (*LECANIUM OLEAE* Bernard) which I found on these trees were dead, and their eggs were dry. July 24 I again examined these trees and found three or four living San Jose scales on a few pears and apples on some of the trees, but the fruit was practically clean, whereas on adjoining trees which had not been sprayed nearly all of the pears were very badly infested with these scales."

KEROSENE EMULSION.

This is a mechanical mixture of kerosene and water, so made

by the assistance of soap and heat that the kerosene remains permanently diluted. The formula is as follows:

Kerosene.....	2 gallons.
Water.....	1 gallon.
Hard soap, (cheap).....	$\frac{1}{2}$ pound.

Heat the water and dissolve the soap in it. While the suds is boiling hot remove it from the fire and add to the kerosene. Churn the mixture violently by forcing it through the spraying nozzle, by aid of a force pump, back into the receptacle. This will cause it to break up into minute globules, taking on the appearance of cream. Keep up the agitation for five or ten minutes, or until no free oil rises to the surface on allowing to stand a moment. Before using, dilute with more water so that the kerosene will amount to only about six per cent of the whole volume.

This forms an insecticide that is exceedingly useful for many purposes. For plant lice it is one of the best, and it will also kill all kinds of caterpillars or "worms" that eat foliage. The writer has dipped sheep in it for the scab, with excellent results. It will instantly kill lice on cattle and horses, when rubbed on them with a sponge or cloth.

SPRAYING MACHINERY.

It is practically impossible to make use of the foregoing and other scarcely less useful insecticides, without some kind of spray pump with which to apply them. Consequently we turn now to one of the most important subjects that the fruit growers of Idaho have to deal with. However excellent the instructions which may be sent out by this department, they will be practically valueless unless the recipients have or will procure the means to carry them out. Right here we encounter an obstacle which must be surmounted before much progress can be made. It is that these much-needed machines are all made in far-off places, and no local stocks are as a rule to be found. Consequently the would-be purchaser must send for catalogues, if indeed he knows where to send at all, and then place his order almost at random from the pictures in the price-list. After a delay of from three to six weeks he finally secures the instrument, but of course the time to use it has now passed by for the season. More often, the horticulturist succumbs in advance to the difficulties of great distance, slow freights and high express charges, and does not attempt to order a machine at all.

The only feasible way to remove this state of affairs is to induce reliable men to secure agencies and keep stocks of spraying

machines on hand. There is absolutely no reason in these days why these implements should not be bought and sold on the same basis as other farm machinery, the purchaser merely going to the nearest town, looking over the various kinds kept there, and taking home the one most satisfactory to him. The mere fact that they could be procured when wanted would vastly increase their sale, and the more were sold, the more would their value be appreciated; thus they would rapidly become staple articles of trade.

In the hope of assisting in this consummation we have been endeavoring to secure the establishment of local stocks in Idaho. Through our efforts, spraying machines are now carried on hand at Moscow and Boise City, as will be seen in the list below, which includes all the agents we know of carrying stock in the state.

Fletcher-Steen Co., Boise City, Agts. for Field Force Pump Co.

H. C. McFarland, Moscow, I. W. Numan and P. C. Lewis.

Mitchell, Lewis & Staver Co., Lewiston, Bean Spray Pump Co.

The last named dealers have a large house in Spokane, handling the same machines, which are thus brought quite near to the north part of the state.

The following list includes nearly all the principal manufacturers of spray pumps in the United States:

Nixon Nozzle and Machine Co., Dayton, Ohio.

Field Force Pump Co., Lockport, N. Y.

P. C. Lewis M'fg Co., Catskill, N. Y.

Rumsey & Co., Seneca Falls, N. Y.

The Gould M'fg Co., Seneca Falls, N. Y.

Wm. Stahl, Quincy, Ill.

The Bean Spray Pump Co., San Jose, Cal.

Woodin & Little, 312 Market St., San Francisco, Cal.

TYPES OF SPRAYING MACHINES.

In order to assist those who have had little or no experience with spraying machines, we illustrate the principal styles, with a few observations on the relative advantages of each.

Commencing with the cheapest forms, we have Figs. 1 and 2, representing small, light pumps, designed to work in a pail of water. No. 1 is made by Wm. Thompson & Son, Wilmot, Ohio. We find this pump very satisfactory for the price, which is only \$2.00 express prepaid. No. 2. is made by I. W. Numan Canton, Ohio, and sells for \$2.50. It is really meritorious article for the price and will answer



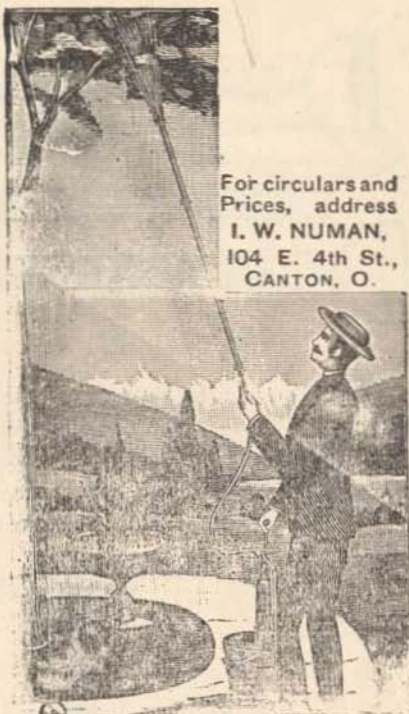
FIG. 1.

very well for those who have only a small amount of spraying to do. It does not use the insecticides so economically as the high-priced pumps with better nozzles, and its use will naturally lead the beginner to see the value of spraying and procure a larger outfit.

The P. C. Lewis M'fg Co's New Wonder Spray Pump, illustrated in figure 3 and 4, is made of brass throughout, is readily separable in all its parts without any tools, and may be changed into a useful veterinary syringe in a moment's time. The price is \$5.50, which includes prepayment of express to any railroad point, —a very important item in this section of the United States.



FIG. 3.



For circulars and
Prices, address
I. W. NUMAN,
104 E. 4th St.,
CANTON, O.

FIG. 2.

The machine has a large cylinder, and a capacity equal to that of some of the more expensive kinds. An air chamber is added at 60 cents additional, and will prove a good investment.

William Stahl has recently added to his line a \$7.50 pump with an eight gallon galvanized iron tank, which appears to be a good thing. It combines capacity with portability in a very acceptable manner.

Passing now to knapsack machines, we illustrate the "Garfield", made by the Field Force Pump Co. Several other makers offer a similar style. This, as the name indicates, is carried on the back, the pump-handle

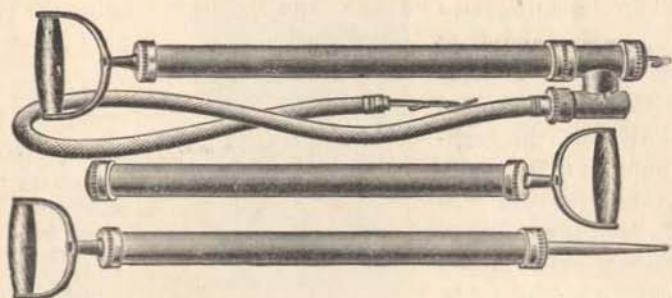


FIG. 4.

coming forward over the shoulder, while the hand on the other side directs the spray. Its value is greatest in gardens and vineyards where it is difficult to get any vehicle through, or in cases where only here and there a little spray is needed. It is rather heavy to carry and the filling is awkward. We do not recom-

mend this style of machine for general purposes. The cost is from \$12 to \$15.

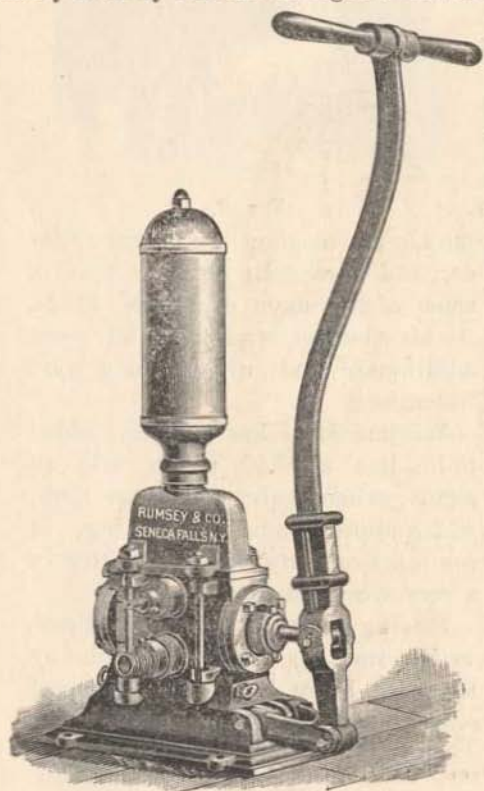


FIG. 8.

Fig. 6 represents the Bean Spray Pumps. This is a strong powerful machine, intended especially to spray orchards. Its principal feature is the very large air chamber, which keeps the pressure even and causes the spray to be kept up for some time after the pump stops. It is a standard western machine, having a large sale on the Pacific slope.

One of the most popular and practical eastern machines is Fig. 7, made by the

Goulds M'fg Co. The Fields Co. and Rumsey & Co. make similar styles. The barrel is not furnished by the makers, but can generally be procured very easily and cheaply. The workmanship of these and other eastern machines is usually of a very high grade. Such a style as Fig. 7 makes in our judgment the best all-round machine out. At the same time it is not very expensive, ranging from \$12 to \$20, according to the size, extras, etc.

For very heavy work, in large orchards, either the large Bean pump or Fig. 8, a style made by Rumsey & Co will be found suitable. The latter will supply four nozzles, and will require several men and a team to use it to advantage.

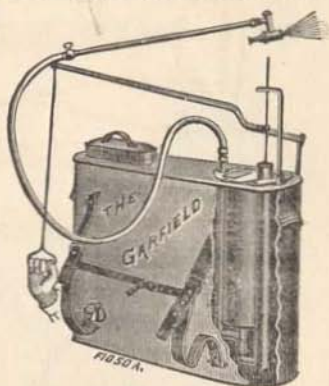


FIG. 5.

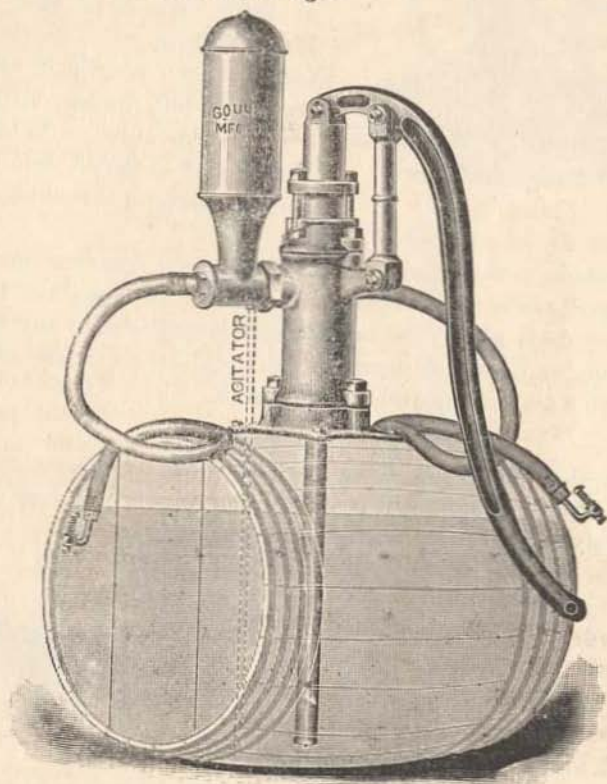


FIG. 7.

Most of the firms that we have mentioned make several styles of pumps. We have selected only one representative machine of each style to illustrate. In addition to the above-mentioned

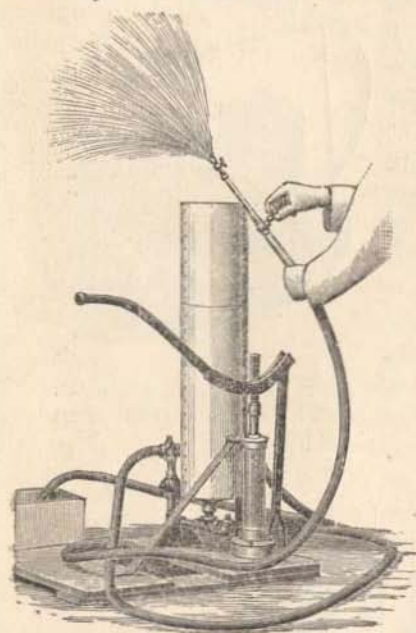


FIG. 6.

models, there are a number of others which we do not figure. Some of these latter are excellent machines for their special purpose. The Progress outfit, made by the Nixon company, is especially worthy of attention. It consists of a 20-gallon tank on iron wheels, fitted out complete with two lines of hose. For spraying in narrow rows where a wagon cannot pass, or for any work where a horse or team cannot be had, it leaves nothing to be desired. One man can handle it easily when full, under ordinary circumstances. When horses and a wagon can be had, however, the best economy is in the use of a barrel as a tank.

For vineyards, potatoes, and other low spraying, several makers offer geared tank machines which automatically produce the spray as they move along; the nozzles may be adjusted in any desired position, and are then firmly held in place, requiring only one man and a team to operate the machine.

SPRAYING NOZZLES.

There are three requisites to successful spraying—insecticide, pump, and nozzle, and the last is by no means least. It does not pay to merely spatter trees with large drops of the poison, when by the use of a good nozzle, the same material can be made to do better work on three times the surface. It is this point that makes the cheapest kinds of pump unsatisfactory when there is much work to do. They do not use the material economically. While every machine has some kind of

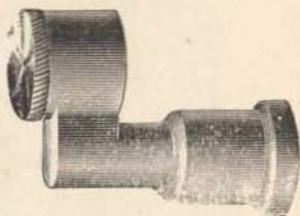


FIG. 9.

nozzle, there is great difference in the styles. As a rule the nozzles of one maker will not fit the couplings on the pumps of any other maker. This is greatly to be regretted, but the manufacturers appear to consider it a desirable thing, and so far have not acceded to a request, made some time ago by a committee of the American Association of Agricultural Colleges and Experiment Stations, to adopt a uniform coupling and thus make all kinds of nozzles interchangeable. Under present circumstances, therefore, it is important before purchasing a machine, to consider the nozzles that may be fitted to it.

Different kinds of work require different kinds of nozzles, or at least the same nozzle differently adjusted to attain the best results.

For spraying low plants, or any

that the nozzle will be within three or four feet of, a very fine mist-like spray should be used; where it is necessary to throw the poison eight or ten feet from the nozzle, however, such a spray will fail to reach its mark, especially against a light wind, as the particles are so small that they quickly lose their velocity. The object should be to use as little material as possible, and yet have every leaf and branch covered with minute

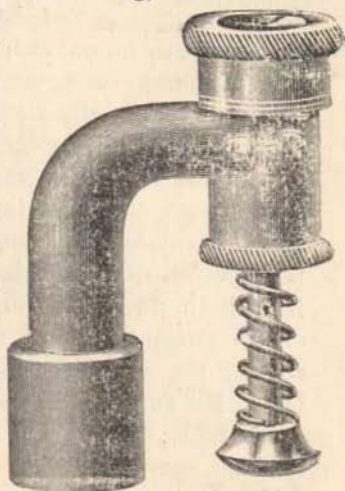


FIG. 10.

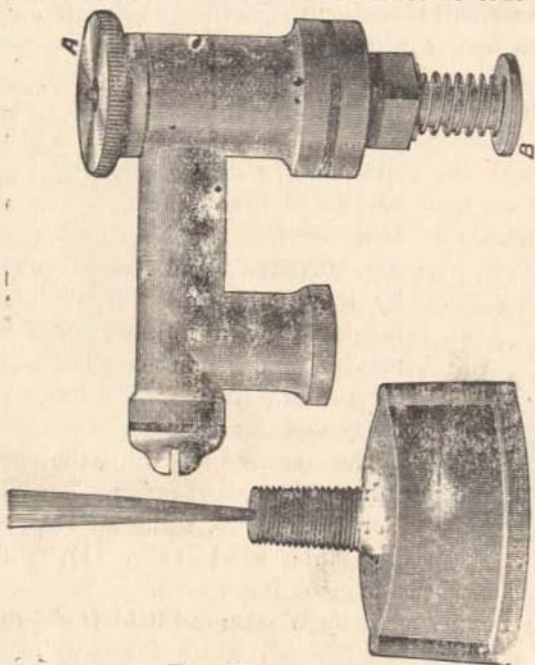


FIG. 11.

particles of the liquid, almost but not quite to the point of dripping. Of course it is impossible to attain this entirely, but it would be perfect spraying.

Probably the best nozzle made for the use of Paris green and London purple is the Nixon, made by the first company on our list, who also make a line of pumps of great excellence. This nozzle we do not illustrate; it consists of a short barrel of brass, across the outer end of which is fastened a wire screen; a small solid stream of liquid dashes through this screen from the inside and comes out the most perfect spray imaginable. The nozzle is made in three sizes, differing in the size of the stream and the coarseness of the screen; the medium and coarse sizes are best. For sulphur, lime and salt it is said these nozzles are not so desirable; the mixture being somewhat thick has a tendency to clog.



FIG. 12.

The Cyclone nozzle is a form shown in Fig. 9., in which the liquid before issuing turns abruptly at right angles with its course and enters a small chamber; the entrance being in an oblique direction produces a whirling motion in the chamber, and the jet issuing from the middle is broken up by this motion, so as to produce a very fine spray. With the addition of a sliding pin which may be pushed in to clear the exit, this form becomes the Vermorel nozzle, Fig. 10. (Figs. 9 and 10 are furnished by the Goulds Co.) This style is furnished by a number of different makers, and is an excellent nozzle for the arsenites, or any other perfectly liquid insecticide. On account of the manner of forming the spray, it has only a short range. The Field Force Pump Co. make an improved separable kind (Fig. 11), which throws a solid stream when the crook is removed.

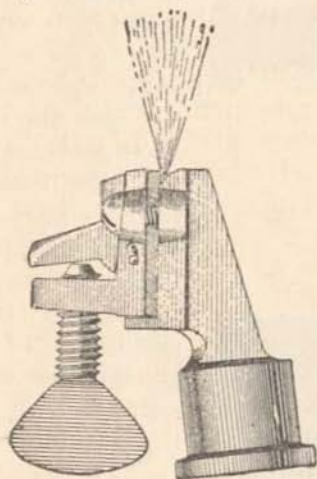


FIG. 13.

The San Jose nozzle, made by Woodin & Little, is shown in Fig. 12. It has a rubber disk through which the spray passes.

This is designed especially for sulphur, lime and salt compound.

Passing to the adjustable nozzles, we illustrate the Duck's-bill Fig. 13, made by the firm just mentioned. It throws a flat stream or spray, the volume of which is regulated by the thumb-screw. The Boss nozzle Fig. 14., made by the Field Co., throws either a round or flat stream; the latter may be adjusted in volume. The figure on the title page represents the graduating spray nozzle of the same company. By rotating one part of the nozzle the stream is made finer or coarser.

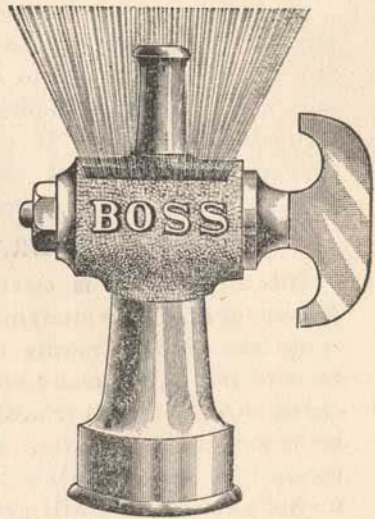


FIG. 14.

Within two or three years, a number of other styles of adjustable nozzles have been placed upon the market. Some of these are undoubtedly meritorious, but our purpose has been to refer to those which have won a recognized place by their permanent success in the field.

EXTENSION RODS.

For high spraying, it is very desirable to raise the nozzle near to the foliage, rather than to use such a coarse spray as would be necessary if it were thrown from near the ground. It is a physical impossibility to throw a fine spray more than a few feet, especially upward. The bamboo extension, with a small pipe inside, is the most practical device for raising the nozzle. It is made by several companies; we illustrate (Fig. 15), the style offered by the Goulds M'fg Co. A six-foot length will generally be found convenient.



FIG. 15.

SPRAYING FOR THE CODLING MOTH.

As soon as the flower-leaves or petals have fallen, spray with one pound Paris-green to 200 gallons of water, taking the precaution to add half a pound or so of well-slaked lime to the mixture. After intervals of

a week or ten days, spray twice more. In case of heavy or continuous rain during the spraying season, an additional spraying will be necessary as soon as the weather clears up.

SPRAYING FOR SAN JOSE SCALE.

At present we must recommend the sulphur, lime and salt mixture, described on a previous page, for winter spraying. If any growers are situated so as to be able to try the resin and soda wash, we should be pleased to correspond with them as to methods and results. It promises very much, but lacks the endorsement of constant use in the field, which the sulphur, lime and salt certainly possesses.

GENERAL REMARKS.

This department is established to aid the farmers and fruit growers of Idaho, by studying the various species of noxious insects, and finding means to prevent their ravages. Some of these insects have already been thoroughly studied in the other states, so that efficient remedies can now be indicated; there will be many cases, however, when long and careful study will be necessary to ascertain all the important facts in the life history of a species. It will greatly assist the work of the department if persons whose crops are troubled by any insect will send us specimens, accompanied by a letter describing the mode of injury, with as full particulars as possible, especially mentioning whether it appears to be wide-spread, whether it has been noticed in previous years, etc. Insects may be sent by mail at one cent an ounce, and should be placed in a TIGHT tin box with a supply of the food-plant. No airholes in the box are necessary.

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