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J. H. Stewart

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WEST VIRGINIA UNIVERSITY
AGRICULTURAL EXPERIMENT STATION,
MORGANTOWN, W. VA.

BULLETIN 78.

JANUARY, 1902.

Treatment for San José Scale.

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BY J. H. STEWART.

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[The Bulletins and Reports of this Station will^t be mailed free to any citizen of West Virginia upon written application. Address, Director of Agricultural Experiment Station, Morgantown, W. Va.]

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TREATMENT FOR SAN JOSÉ SCALE.

BY J. H. STEWART.

A statute of this state, (a copy of which will be found on last pages of this bulletin), commands the Director of the Agricultural Experiment Station and his assistants, to locate the San Jose Scale and other dangerous insects and plant diseases, to prescribe remedies for combating and exterminating the same when such remedies are known, to seek out and devise remedies for the purpose when such remedies are not known, and to enforce the use of recognized remedies or treatments on any and all plants "diseased," within the meaning of this act. A complete report of the work that has been done under the provisions of this act will be published, but in view of the damage that is being done in many sections of the State by the San Jose Scale, and of the fact that this is the best season of the year for combatting the insect, it is considered advisable to publish this brief bulletin at this time.

For a good description of this scale see bulletin No. 70 of this Station, pages 365-367. Suffice it in this connection to say, the breeding season of the insect lasts throughout the warm summer months, being checked only by frost. A female gives birth to a large number of young, each one of which in turn begins reproduction in like numbers within about five weeks from birth. It will thus be seen that it is very prolific and under favorable conditions in any locality the insect multiplies very rapidly.

Observations have shown that the scale thrives not only on orchards and nursery fruit trees, but is also found on hedges,

shade trees, road side shrubs, and forest trees. This makes it impossible to totally destroy the pest, in any section where it has become firmly established, but our aim should be, as nearly as possible, to exterminate it. As surely as we have to continue fighting potato bugs, squash bugs, canker worms, codling moths or any other common garden or fruit pests, just so surely we will have to keep up our fight against the San Jose scale in those sections where it has become firmly established.

MEANS OF COMBATING THE SCALE.

As the scale does not eat the tissues of the plant, arsenical and other poisonous sprays are not effective. Quite a number of contact sprays are however, more or less effective.

The contact insecticides that have been used to advantage in combating the San Jose scale, contain, as a rule, a more or less volatile oil which attacks the body of the insect. But the volatile oils are soon evaporated, thus leaving the tree liable to renewed attacks. It is for this reason that crude petroleum often gives better results than the simpler volatile oils; for in addition to an abundance of volatile oils, such as cymogene, rhigolene, gasoline, naphtha, benzine, kerosene, etc., it also contains varying quantities of heavier oils or greases, such as valeline, paraffin, etc., which being less volatile remain longer on the tree, thus protecting it for a longer period from further attack. But just here we are confronted with another problem, viz: crude petroleum is by no means uniform in composition, and many of them contain so much of the heavier oils and greases that they are likely to injure the trees.

The uncertainties that have attended the use of various crude petroleum have led to a number of "investigations," the majority of which have been characterized by little work, much writing and a profound ignorance of the materials used. For several years this Station has been studying the composition of the various crude petroleum in connection with their effects on the scale and the tree, with the hope of being able to prepare from standard commercial petroleum product artificial mix-

tures which would be more efficient than the natural products; which could be applied with less danger to the tree; which could be varied to meet the great variety of conditions, under which they must be used. and the effect of which under given conditions could be predicted with reasonable certainty. The recently enacted statue, above referred to, may be justly regarded as a recognition of this Station's efforts along these lines.

CONDITIONS FOR TREATMENT.

Several of the treatments named below were* worked out by this Station. Other treatments are being studied. Some of them are very promising indeed, but have not yet been tested under a sufficiently wide range of conditions. And this suggests another point: the conditions determining the effect of the various treatments on the tree. No treatment yet proposed is independent of conditions. at least so far as its effect on the tree is concerned. A spray consisting of a mixture of the simplest of the volatile oils and water may injure a healthy tree if applied in wet weather. A bright, clear, dry day, should if possible always be selected. As such days are rare in the latter part of winter it may be found necessary to spray when the weather is not so favorable.

Different kinds of trees vary widely in their power to withstand the various remedies proposed for this pest. Apple and pear trees can usually resist the most, plum and peach trees the least. In treating peach trees the most favorable conditions should always prevail

SPECIFIC TREATMENTS.

The following treatments of San Jose Scale are commended:

1. KEROSENE AND WATER. Pure kerosene oil, if properly applied may be used on apple trees in the winter without great danger to the trees. A spray composed of 40 per cent. kerosene and 60 per cent. water is practically as destructive to the insects as the pure kerosene, and may be used on apple and pear trees in winter without danger. This mixture is applied

with any good mechanical mixture pump. Lower percentages of kerosene are not recommended, for destroying adult scale insects in winter.

2. KEROSENE WITH VASELINE. Kerosene containing 5 per cent. to 10 per cent. of vaseline destroys the scale very effectually, and may be used on apple trees in winter. This mixture however, is somewhat injurious to peach trees.

3. KEROSENE WITH VASELINE AND PARAFFIN. Crude vaseline and paraffin will dissolve readily in kerosene, and the spray may then be applied with a force pump. Five pounds of the mixture of crude vaseline and paraffin dissolved in 100 pounds of kerosene form a good spray for apple and pear trees in winter, but this is likely to injure peach trees.

4. CRUDE OILS. Crude oils as found in the Allegheny oil regions of West Virginia, and adjoining States, known as Pennsylvania oils, are quite variable, and it is necessary to examine them pretty carefully before using on the trees. Crude oil (petroleum) of 43 degrees Beaume or over, is safe for use on apple, pear, and plum trees in winter, but is likely to be injurious to peach trees if used full strength. If the test be as high as 45 degrees, or 46 degrees, a mixture of 25 per cent. of this oil with 75 per cent. of water may be applied with safety to peach trees by means of a kerowater pump.

5. WHALE OIL SOAP is very destructive to the mature scale insects when used at the rate of two pounds of soap to a gallon of water. This may be applied to any infested trees in winter with an ordinary spray outfit. For winter use on tender trees, as the peach, two pounds of soap to three gallons of water is advised. For use on trees when in full leaf a strength of one pound of soap to five gallons of water can be safely used and is sufficient to kill only the young insects which are most abundant in summer. Whale oil soap is not so convenient as the crude oils, and is more expensive for orchard spraying. It is however, very advisable to use it when only a few trees are infested, and a kerowater pump is not in the neighborhood.

Bulletin No. 70, pages 369 to 372 gives a detailed account of the preparation and application of whale oil soap.

6. KEROSENE EMULSION, though an old-fashioned remedy, is effectual in destroying the young insects and may be applied by spraying even when the trees are in full leaf. It may be made by using soft soap two quarts, or hard soap one-half pound, boiling water one gallon, kerosene two gallons. Churn or pump the ingredients thoroughly together for fifteen minutes. Dilute this ten times before using.

FUMIGATION.

Fumigation with hydrocyanic acid gas is not to be recommended for general use by individual orchardists. The fumes are very dangerous, one of the most deadly poisonous materials known, to human life, and no risk should be taken by parties unfamiliar with the best methods of handling it.

The operations are very expensive except when carried on very extensively with one equipment of gas tight tents. Combating the scale by this method is not practical for large trees. The chief objections to its use are: (1) *The great danger.* (2) Too great expense for individual orchardists. (3) Suited only to trees of limited size, about ten feet or less in height.

DESTROYING TREES.

Destroying trees by the owner is to be recommended in certain extreme cases. It not infrequently happens that trees used for resetting a few spots in an orchard are found during the first season to be very badly infested with the pest. Such was more often the case before the passage of the State laws requiring nursery inspection in this and adjoining States. Orchardists have, under such circumstances, found it best to grub up the few infested trees and burn them immediately, thus avoiding the possible spread of the scale to other trees.

The vitality of a badly infected tree is far below normal, so if it could be immediately and forever freed from the scale it would require quite a while in which to regain normal vigor and productiveness. In the case of a badly infected young

tree, it will usually pay to cut it down, burn it up and replant. Older trees in like condition may present a problem in connection with which it will be well to observe that *a badly infected tree is already worse than dead*. This in brief is the spirit of the new law, which devotes itself first to the protection of the healthy tree. The owner of an infected tree is unfortunate. In view of the damage his trees may communicate to healthy trees, he is commanded to destroy the pest even though it may necessitate destroying his trees. In view of the fact, however, that there are remedies capable of destroying the scale, the law very wisely provides that the owner of infected trees may try to save them by prompt and dilligent application of recognized remedies. It will be just as well for owners of infected orchards and nurseries, to keep very clearly in mind the object of this law. As a matter of fact, it is the owner of infected plants who is responsible under heavy penalties for the eradication of such infectious diseases and pests on his premises. In complying with this statute the Director of the Station and his assistants will be glad to aid such owners in saving as much as possible of their infected stock, and they may be relied upon to make good use of that provision of the statute which requires them to seek out and devise new remedies for combating these pests.

PREVENTIVE MEASURES.

In the sections of the State where the pest is known to exist all orchardists will find it to their interest to spray their trees as a prevention from the attacks of the scale.

Crude oil in the percentages indicated will be very valuable for this purpose as the heavier (greasier) constituents of the oils remain upon the trees for many months and will kill the young insects which may be carried, by any means, to those portions of the tree covered by the oil. It is for this reason the use of kerosene in which crude vasaline and paraffin have been dissolved is recommended. (See paragraph numbered 3, page 218.)

WHEN TO SPRAY.

The season best suited for the application of each of the

Figure 1.—Spraying before the buds swell in early spring; using 40 per cent. crude oil and 60 per cent. water on Pear trees with a kerowater pump.

sprays described is mentioned in each case. In general it may be said that the only time to use any of the kerosene or crude petroleum sprays, without injury to the trees, is when the trees are dormant—during the winter when the leaves are off and the fruit buds and leaf buds are well protected by their natural coats. As it is very desirable that the liquid remain upon the trees until the breeding season begins, it is best to make the application in the latter part of the dormant season, but before the buds begin to swell or loosen their coats; say the latter part of February or early March, the exact date depending upon the advancement of the season.

HOW TO SPRAY.

There is always some difficulty in applying sprays during cold weather. With numb fingers, and cold spray material clogging the nozzle from time to time the operator is apt to become depressed and quit the work or hasten over an orchard too rapidly. The work must be done thoroughly and every part of a tree completely covered by the liquid. Do not leave a tree until this is accomplished; neither should the spray be continued upon a tree after it is entirely covered. Very often the violation of this injunction is the cause of injury to orchards. Any spray added after a tree is covered is surely a waste of material and time.

APPARATUS.

A force pump with a capacity sufficient to give twenty-five to thirty pounds pressure will do for spraying a few small trees as peach and plum and young apple and pear trees; but for large trees and for large orchards of small trees it is necessary to be able to develop a pressure of about 100 pounds.

Most force pumps for spraying are run by hand. One man can run a pump giving 100 to 150 pounds pressure. Another man can drive the team, and a third will handle the spray rod if only one be connected with the pump. A number of mechanical and horse power pumps are now upon the market. These are best suited to regions very extensively planted to fruit. Pumps run by gasoline engines are suited only for

throwing material which is not combustible. They are not considered safe for spraying when kerosene and crude oils are used. See figure 2.

Fig. 2.—Mounted gasoline engine and outfit for use in large orchards, spraying noncombustible materials.

A form of horse-power pump is made which attaches to a gearing on the hub of the wagon wheels. The force of the horses drawing the wagon also runs the pump when the wagon is moving. This plan is objectionable for spraying under some circumstances, especially where large trees are to be covered because the operator is often unable to completely cover a tree while the wagon is in motion.

A good bamboo rod is needed. See figure No. 3.

Fig. 3.—Bamboo spray rod with valve at left.

This should be provided with a shut-off valve at the lower end and a good nozzle at the other. These should be connected by a brass rod extending through the bamboo. A good garden hose of suitable length is used to connect the valve of the rod with the pump.

The Vermorel nozzle (shown in the accompanying cut) or some modified form of it will produce a fine mist, which is very desirable. A cyclone nozzle also produces a mist. If the spray rod will reach the tops of the trees a nozzle producing a mist is the best. But in very large apple trees it is sometimes necessary to use a nozzle which will allow the liquid to be thrown some distance beyond the end of the spray rod. An example of such a nozzle is the "Seneca." The McGowan nozzle, may be called

Fig. 4.—Double Vermorel nozzle ready to connect on spray rod.

Fig. 5.—Seneca nozzle.

a general purpose nozzle, as it can throw a rather fine spray some distance, thus reaching the tops of large trees. It will, if desired, produce a mist near the end of the spray rod, adapting it to spraying small trees.

MECHANICAL MIXTURE PUMPS.

The force pumps above referred to are not suited for those sprays composed of a mechanical mixture of kerosene and water, or crude oil and water. For either of these the pumps sold under the name of kerowater or mechanical mixture pumps are required. Such a pump is figured on page No. 370 of Bulletin No. 70, and fig. 6, next page, 224.

The pumps of this type have the lever arm supplied with two valve plungers. One valve draws water from the tank or barrel, and the other draws oil from a small metal cylinder within the tank. A movable pin and scale on the lever are provided, so the operator is able to change the percentage of oil at will.

Fig. 6.—Kerowater pump in barrel. Used for spraying a mixture of oil and water.

FIRMS SUPPLYING SPRAY OUTFITS.

Orchardists who contemplate the purchase of apparatus for spraying should obtain catalogues and prices from the following firms and of any others of which they may learn the addresses.

The Goulds Manufacturing Co., Seneca Falls, N. Y.

Bean-Chamberlin Mfg., Co., Hudson, Mich.

Thos. Pepper, Highstown, N. J.

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

W. & B. Douglas, Middleton, Conn.

The Deming Co., Salem, O.

Leggett & Bros., 301 Pearl St., New York City.

Ripley Hardware Co., Grafton, Ill.

John J. McGowan, Ithaca, N. Y.

Wm. Stahl, Quincy, Ill.

F. E. Myers & Bro., Ashland, Ohio.

Barnes Mfg. Co., Mansfield, Ohio.

HOW TO GET CRUDE OILS.

Crude oils may be obtained in West Virginia, Ohio, Pennsylvania and New York, from any oil well or pipe line company

that can be prevailed upon to sell it.

As already stated great care must be exercised in getting the oils which give a high Beaume test.

The following firms have supplied oils for spraying at various times in the past:

W. P. Cutler, 758 Brouse Building, Philadelphia, Pa

Atlantic Refining Co., Pittsburg, Pa.

Cooper Bros., Winchester, Va.

TESTING CRUDE OILS.

Parties desiring to have the gravity of oils tested should send a sample of it by express (prepaid) to the Experiment Station; The sample may be placed in a quart bottle or jug and carefully labelled with a tag or other label, giving the brand of oil, where obtained, and address of the sender. Upon receipt of the sample, the Station will make the test and report the result to the sender very promptly, free of charge. As the crude oils with light Beaume test are very destructive to vegetation it is very necessary that a sample of the oil should be tested carefully before being applied to trees.

CONTINUATION OF EXPERIMENTS.

The conflicting results from the use of different remedies show conclusively that the fighting of scale is still in an experimental stage. At present this station is conducting experiments to determine the best and most practical means to be used for each kind of fruit tree, which will be continued within the limits of the facilities and funds afforded.

A copy of the new State law entitled "An act to prevent the introduction and spread of the San Jose scale, etc.," is herewith published. It is so brief and pointed and so clear in its language that no explanation of it is necessary.

An annual report of work done under this act will be issued at a later date.

THE LAW.

An act to prevent the introduction and spread of the San Jose scale and other dangerous insects and dangerously contagious diseases affecting trees, shrubs, vines, plants and fruits.

Be it enacted by the Legislature of West Virginia.

1. That the Director of the West Virginia Agricultural Experiment Station, immediately on the taking effect of this Act, shall appoint a competent person or persons who shall, under the direction of the said Director, perform the duties hereinafter provided.

2. It shall be the duty of the Director, either in person or through his assistants, to seek out and devise means of suppressing and eradicating throughout the State the San Jose scale and other dangerous insects, and tree, shrub, vine or plant diseases. Black knot and peach yellows are hereby declared to be dangerous within the meaning of this Act and trees, shrubs, vines or plants affected with either of these diseases, shall be subject to its provisions. The mention of San Jose scale, peach yellows and black knot in this section shall not be held to exclude other insects or diseases which may be found to be dangerous, from the provisions of this Act.

Said Director in person, or through his assistants, shall examine once in each year, not later than August 15th, all nurseries in the State of West Virginia as to whether they are infested with San Jose scale or other dangerous insects, or infected with dangerously contagious tree, vine, shrub or plant disease; and if upon inspection, such nurseries appear to be free from such insects or diseases, the Director shall upon receipt of \$10 give each owner of such nursery or nurseries, a certificate to the facts, provided that it shall require but one day or part of one day to make such inspection, and for each additional day or fraction thereof, required to complete the inspection, \$5.00 shall be charged therefor, and collected before the certificate is granted. In addition to the above fee, nurserymen must fur-

nish transportation to and from railway station, and facilities for reaching their growing stock, to such person or assistants selected by the Director to make said inspection. This certificate shall be void after August fifteenth of the year following. A duplicate of each certificate together with a statement of amount received therefor, shall be filed by said person or assistants with said Director within ten days of its issue, and neglect to file such duplicate of certificate and statement shall be treated as a misdemeanor. If any dangerously injurious insects or infectious diseases are found on the premises of any nursery, or nursery stock, the Director may order and enforce such treatment of said nursery stock as he may deem sufficient, in addition to a thorough inspection, before granting a certificate, and the same per diem shall be charged for overseeing treatment as for nursery inspection. Whenever a nurseryman or any other person shall ship or deliver within this State, except for scientific purposes, trees, shrubs, plants or other nursery stock, he shall place upon car load, box, bale or package a copy of a certificate, the original of which is signed by a State or Government inspector, stating that such stock has been inspected and has been found apparently free from dangerous insects and dangerously contagious tree, shrub, vine and plant diseases. The illegal use of said certificate by changing, defacing or placing it on uninspected stock, or using the same after date of expiration or revocation, shall render the owner or shipper liable to the penalty prescribed for violation of this Act.

No person growing for sale any trees, shrubs, vines or plants shall deliver the same without applying to the Director for the certificate provided for in this Act.

3. It shall further be the duty of said Director, through his assistants, to cause the examination of all orchards, gardens, and other premises, either public or private, which they shall have reason to suppose to be infested or infected with any dangerous injurious insects or infectious diseases liable to spread or to be conveyed to other premises, and for this purpose said Director and his assistants are authorized, during reasonable

business hours, to enter into or upon any farm, orchard, nursery, garden, storehouse or other building, or place used for growing, storing, packing or sale of nursery and other horticultural products. If said Director or his assistants shall find on inspection as aforesaid that any nursery, orchard, garden, or other property or place is infested or infected with such dangerously injurious insects or infectious diseases, liable to spread or to be conveyed to other premises, to the serious injury of the property thereon, the same shall be declared a public nuisance, and he shall notify, in writing, the owner or persons in charge of such infested or infected property, and shall direct him, within a time and in a manner prescribed in such notice to use such measures as shall prevent the conveyance or spread of such insects or diseases to the property of others and such infested or infected property must not be removed from the premises after the owner or persons in charge of the same shall have been notified as aforesaid, without the written permission of the said Director or his assistants. If the person so notified shall refuse or neglect to treat and disinfect such premises or property in the manner and within the time prescribed, it shall be the duty of the Director to cause such premises or property to be so treated, and they shall certify to the owner or person in charge of such premises one-half of the cost of the treatment. If said sum is not paid to them within sixty days thereafter, the same may be recovered, together with the costs of action, before any court in the State having competent jurisdiction. Any tree, plant, shrub, etc., which may, in the judgment of the Director or his assistant, be so badly infested or infected, as to render expense of treatment unjustifiable, shall be declared a public nuisance and may be destroyed by them or their assistants without liability for compensation to the owner thereof.

Right of appeal from the decision or requirements of the assistants may be made to the said Director within three days after notice of the decision or requirements has been served, and the decision of the Director shall be final.

4. Every package of trees, shrubs, vines or plants shipped into this State from any other State, territory, country or

province shall be plainly labelled on the outside with the names of the consignee, and a certificate showing that the contents have been inspected by a State or Government officer, and that the trees, shrub, vines or plants therein contained appear to be free from all danger of insects and dangerously infectious diseases. If any trees, shrubs, vines or plants are shipped into this State without such certificate plainly fixed on the outside of the package, box or car containing the same, the consignee thereof shall not receive, use or distribute the same until the consignor shall have affixed thereto the certificate of inspection required by this Act.

When nursery stock is shipped into this State accompanied by a certificate as herein provided, it shall be held *prima facie* evidence of the facts therein stated. But the Director or his assistant, when they have reason to believe that any such stock is infested or infected as heretofore described, shall be authorized to inspect the same. In case such stock is found to be infested or infected by any of the aforesaid insects or plant diseases such stock shall be held subject to order of shipper not to exceed ten days before being declared a public nuisance and destroyed. All the expenses incurred by the Director or his assistants, in carrying out the provisions of this Act shall be paid out of the funds appropriated by this Act.

5. Any person violating or neglecting to carry out the provisions of this Act, or offering any hindrance to the carrying out of this Act, shall be adjudged guilty of a misdemeanor, and upon conviction before any Justice of the Peace shall be fined not less than ten dollars and not more than one hundred dollars for each and every offense, together with all the costs of the prosecution, and shall stand committed until the same is paid. It shall be the duty of the Prosecuting Attorney to prosecute all violations of this Act and all amounts so recovered shall be paid over into the State Treasury.

6. The Director shall make an annual report to the Governor of the State, a copy of which shall be sent to the West Virginia Horticultural Society at its annual meetings, showing the number of nurseries inspected, the number of certificates issued, the number of trees treated or disinfected by them or

their assistants, the kinds and amount of property destroyed by them in pursuance of this Act, and such other facts concerning the operation of their office under this Act, as the said Director may deem necessary.

7. The provisions of this Act shall not apply to florists' green-house plants, bulbs, flowers and cuttings commonly known as green-house stock.

8. The said assistants shall pay over to said Director all funds coming into their hands under the provisions of section 2 of this Act with an itemized statement of the sources whence received, which moneys shall be used by said Director to aid in carrying into effect the provisions of this Act, and the amounts so received shall be stated in the annual report of the said Director. The said assistants shall also make to said Director an itemized statement of their expenses and the amounts paid for assistants employed in prosecuting the work under this Act, which, when certified by the said Director, shall be paid out of the State Treasury upon the warrant of the Auditor of the State.

9. There is hereby appropriated to the said Director for the purpose of carrying out the provisions of this Act the sum of one thousand five hundred dollars for the year nineteen hundred and one, and one thousand five hundred dollar for the year nineteen hundred and two, or so much thereof as may be necessary. The Auditor of the State is hereby authorized to draw his warrants upon the State Treasurer against the sums herein appropriated upon the presentation of proper vouchers and the State Treasurer shall pay the same out of any funds in the public treasury.

10. The Act heretofore passed at the present session of the Legislature is hereby repealed.

I, Harry Shaw, Clerk of the House of Delegates of West Virginia, hereby certify that the foregoing is a true copy of an Act passed by the Legislature of West Virginia on the 16th day of February, nineteen hundred and one; and that the same takes effect ninety days from its passage.

Given under my hand this sixteenth day of March, nineteen hundred and one.

HARRY SHAW,
Clerk of the House of Delegates.