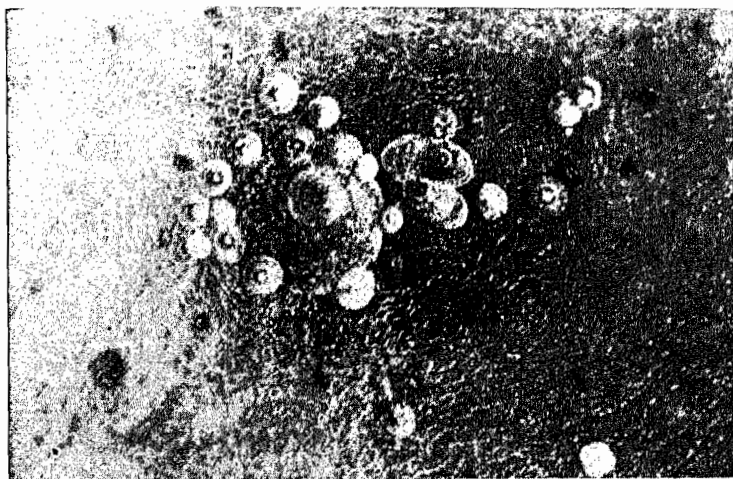


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THE SAN JOSE SCALE IN TENNESSEE
WITH METHODS FOR ITS CONTROL

BY

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KNOXVILLE, TENNESSEE

The Agricultural Experiment Station

OF THE UNIVERSITY OF TENNESSEE

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The Experiment Station building, containing the offices and laboratories, and the plant house and part of the Horticultural Department, are located on the University campus, 15 minutes walk from the Custom House in Knoxville. The experiment farm, the barns, stables, dairy building, etc., are located one mile west of the University on the Kingston Pike. The fruit farm is adjacent to the Industrial School and is easily reached by the Lonsdale car line. Farmers are cordially invited to visit the buildings and experimental grounds.

Bulletins of this station will be sent, upon application, free of charge, to any farmer in the State.

THE SAN JOSÉ SCALE IN TENNESSEE WITH METHODS FOR ITS CONTROL

THE SAN JOSÉ SCALE

Aspidiotus perniciosus, Comst.

Introduction

Paramount of all the insects causing loss to the horticulturists and nurserymen is a small scale insect no larger, when mature, than the head of a common pin. This insect is the San José scale (pronounced San Ho-zay), *Aspidiotus perniciosus*. No insect pest has received more attention and has had more written concerning it. Nearly every experiment station in the land has published one or more bulletins as to its life history and ravages, and remedies for its control.

Newspapers, journals and magazines have issued volumes calling the attention of fruit growers to the effects of this scale pest and encouraging legislation for its control. Those who have heeded this admonition of the entomologists and followed their recommendations have satisfied themselves that in spite of the enormous damage done by this scale, there are methods which, if properly pursued, will reduce injury to the minimum. The careless, unheeding grower who has scale-infested stock and has done nothing by way of controlling the pest suffers heavy losses and eventually is compelled to go out of business (be he horticulturist or nurseryman) or is advised to start anew.

The orchard and nursery interests in Tennessee are developing with rapid strides, and the heavy daily correspondence pertaining to San José scale and its remedies emphatically indicates a need for suggestions and information applicable to Tennessee conditions.

History of occurrence of San Jose' scale

Through investigations of Prof. C. L. Marlatt during 1901-02, acting for the U. S. Department of Agriculture, the native home of the San José scale was definitely located in Northern China, not far from Pekin. From existing conditions the indications are that San José scale has been present in China for a number of years. San José was first noticed in this country in 1870, in the San José Valley in California. In the town of San José, in 1873, it had increased sufficiently to be serious. Not until 1893 was the scale discovered east of the Rocky Mountains, when it was noticed at Charlottesville, Va. It is supposed to have reached Virginia from New Jersey, where it had been scattered by means of nursery stock shipped from the San José Valley in 1886 or 1887. The infested nurseries in New Jersey continued to ship nursery stock to all parts of the United States until investigations were made in

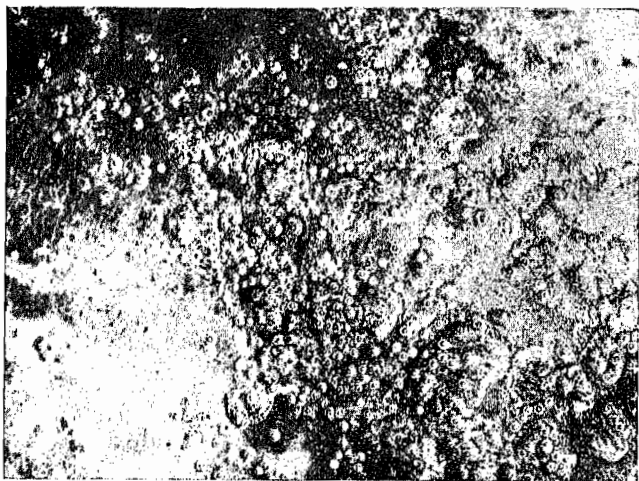


FIG. 1. A GROUP OF SAN JOSÉ SCALE OF DIFFERENT AGES
SLIGHTLY MAGNIFIED

After Lowe and Parrott, N. Y. Agr. Exp. Sta., Bul. 193

1893 and 1894. Thus many sections throughout the United States became infested, especially in nursery and orchard districts.

The occurrence in Tennessee

In Tennessee San José scale first made its appearance in the eastern part of the State, in Roane County, at Harriman, where it was brought in on nursery trees during 1891 or 1892, yet it was not discovered until 1896.* At this time many trees were found in a highly infested condition. Scale was found next in Claiborne County, near Cedar Fork, in 1897. The following year specimens were received by the Experiment Station from another section of the same county, at Tazewell. In less than a month afterward scale was found in Washington County, at Austin Springs. These scale insects were on trees that had been purchased four years previous from a New Jersey nursery.

Habits and life history

Perhaps the worst feature of an attack of San José scale is the difficulty of recognizing the insect, due to its size and color; it is about 1-16 of an inch in diameter when mature, and in color it resembles the bark of tree or plant infested. If there is a very bad infestation an ashy-gray appearance is noticeable; again one may determine the presence of scale by crushing many of them, when an oily appearance is noticed.

If a female scale be carefully turned over with a knife or a pin, there will be found underneath a flat, yellowish insect, looking very much like a small piece of rich butter. It has no legs, no wings, no eyes, no

*Univ. of Tenn. Agr. Exp. Sta. Bulletin, Vol. 10, No. 4.

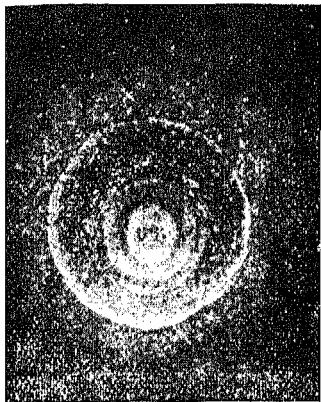


FIG. 2. ADULT FEMALE SAN JOSÉ SCALE—HIGHLY MAGNIFIED

After Lowe and Parrott, N. Y. Agr. Exp. Sta., Bul. 193

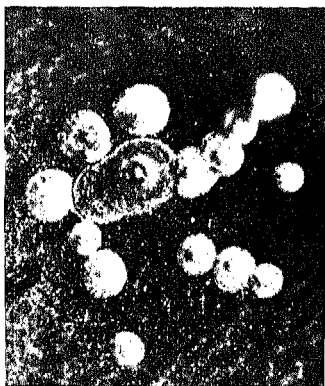


FIG. 3. MALE SAN JOSÉ SCALE AND SEVERAL YOUNG FEMALE SCALES

antennæ (feelers), nor a distinct head, but it does have a long, thread-like sucking proboscis, with which it bores through the bark of trees into the young, growing wood and draws out the sap.

In April (earlier in advanced seasons) the adult female begins to give birth to living young, continuing to do so for about six weeks, after which she dies. The young scale has legs, antennæ and eyes; it moves about over the twigs for some hours, then settles down and begins to push its mouth parts slowly into the bark to the sap beneath. A scale-like covering now begins to be formed, coming from all parts of the body and looking at first like waxy filaments or threads, which later fuse together, making, with the cast skins, an entire covering over the insect. All young San José scale look alike in size, color and shape until the first molt, about twelve days after birth, but from then on there is a very great difference. The male scale, which is smaller, is now elongate, while the female scale is circular, or nearly so, both sexes losing legs and antennæ, and the female her eyes. In from 24 to 26 days from birth the male comes from under the scale in the form of a minute and extremely delicate two-winged, fly-like insect.

It takes the female about thirty days to develop fully. From thirty-three to forty days from

birth she gives birth to a new generation.



FIG. 4. ADULT FEMALE SAN JOSÉ SCALE AND SEVERAL YOUNG SCALES

After Lowe and Parrott,
N. Y. Agr. Exp. Sta.,
Bul. 193

Each female is supposed to produce 200 male and 200 female young; this being so, and counting four generations in a season, there will be produced, according to Dr. L. O. Howard, 3,216,080,400 male and female scales from one progenitor in a year.*

In Tennessee, where there are at least five generations or broods each year, the above number is greatly increased. Thus it is easy to understand why a slight infestation, if untreated, soon becomes bad. If the scale are

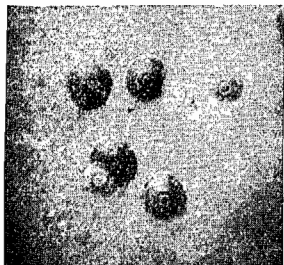


FIG. 5. YOUNG SAN JOSÉ SCALE—HIGHLY MAGNIFIED. ACTUAL SIZE, THESE LOOK LIKE BLACK SPECKS

allowed to increase unmolested they will kill a young bearing peach tree in about three years, and an apple tree in about four or five years. Consequently, when San José scale are first discovered in an orchard immediate preparations should be made for applying a remedy, the most satisfactory of which is the *Boiled Lime-Sulphur Solution*, if the tree is dormant.

How it spreads

Chiefly by means of infested nursery stock is San José scale introduced into isolated and uninfested districts. When

once introduced it is only a short time before multitudes occur. When the scale are young and active they crawl upon the feet and legs of birds and insects and are thus transferred from tree to tree. Men and teams at work in an infested orchard or nursery may also convey the pest. Strong wind and a beating rain frequently cause the young scale to be carried some distance. It is very common to find that in an orchard slightly infested the scaly trees are in line with the prevailing winds.

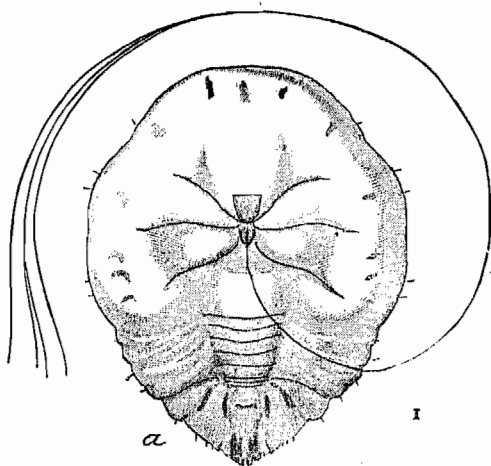


FIG. 6. ADULT FEMALE SAN JOSÉ SCALE, BEFORE DEVELOPMENT OF EGGS; VENTRAL VIEW, SHOWING BRISTLE-LIKE SUCKING MOUTH PARTS

After Howard and Marlatt, Bul. 3, N. S., Bureau of Ent., U. S. Dept. of Agr.

*Bureau of Ent., U. S. Dept. of Agr., Bul. 12.

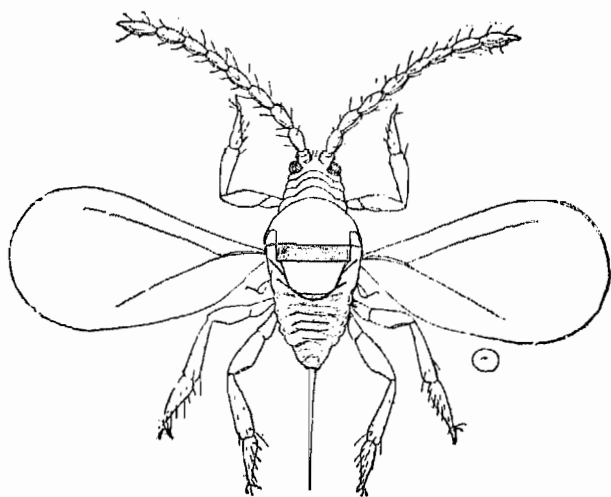


FIG. 7. ADULT MALE SAN JOSÉ SCALE—HIGHLY MAGNIFIED

After Howard and Marlatt, Bul. 3, N. S., Bureau of Ent., U. S.
Dept. of Agr.

Through the channels of trade they are frequently carried long distances, as from continent to continent, upon infested nursery stock, cuttings, fruit, etc. A very common source of San José scale in the nursery is from grafting wood and bud sticks which have been cut from old infested orchards. Propagation wood should not be obtained from this source; if there is doubt as to scale being present fumigation should be performed. The ability of the scale to live upon many kinds of fruit and forest trees makes it possible for it to become scattered rapidly over a wide range of country.

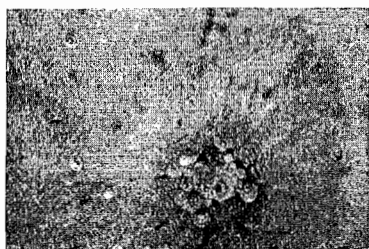


FIG. 8. YOUNG SAN JOSÉ SCALE
GROUPED NEAR THE FEMALE
SCALE

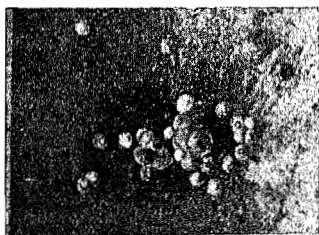


FIG. 9. MALE AND FEMALE WITH
GROUP OF YOUNG SAN JOSÉ
SCALE

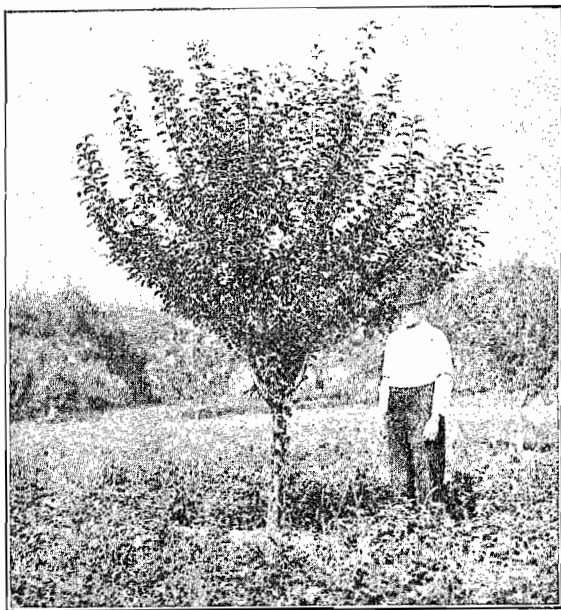


FIG. 10. SPRAY BEFORE THE TREE IS INJURED BY SAN JOSÉ SCALE

Food plants

In brief, it might be said that practically all deciduous fruit trees and also shade and ornamental trees and shrubs are attacked by San José scale. The following list of food plants is taken from Bulletins No. 12 and 62, U. S. Department of Agriculture, Bureau of Entomology:

ORCHARD FRUITS.—Pear, peach, apple, crab apple, plum, cherry (sweet), Rocky Mt. dwarf cherry, persimmon, quince, flowering quince, apricot.

SMALL FRUIT.—Strawberry.

BUSH FRUITS.—Raspberry, gooseberry, grape, currant, flowering currant, black currant.

NUT PLANTS.—Almond, chestnut, pecan, black walnut, English walnut, Japan walnut.

MISCELLANEOUS ORNAMENTAL PLANTS, FOREST AND SHADE TREES.—Rose, hawthorn, spirea, cotoneaster, euonymus, English huckleberry, linden (basswood), acacia, elm (American and English), osage orange, alder, sumac, weeping willow, English willow, laurel-leaved willow, golden willow, milkweed, *Catalpa speciosa*, Lombardy poplar, Carolina poplar, silver maple, cut-leaved birch, mountain ash, Japanese quince, actinidia, *Citrus trifoliata*, red dogwood, snowball, juneberry, loquat, laurel, akebia, *Cornus alba*, *Cornus baileyi*, *Cornus sanguinea*, European purple-leaved

beech, common privet, flowering almond, choke cherry, hop tree, snowberry, common lilac, Persian lilac.

OCCASIONALLY OR RARELY INFESTED.—Maple, silver maple, Weir's cut-leaved maple, Norway maple, horse-chestnut, alder, Virginia creeper, birch, cut-leaved white birch, box, chestnut, catalpa, persimmon, silver thorn, eucalyptus, fig, ash, white ash, honey locust, shrubby althea, pecan nut, black walnut, English walnut, mountain laurel, globe flower, California privet, honeysuckle, mulberry, white spruce, sour cherry, Photinia villosa, sumac, smoke bush, locust, red raspberry, common blackberry, dewberry, elder, sassafras, sorbaria, spirea, arborvitae, viburnum, grapes.

Nature of the injury

The scale, being a sucking insect, draws its food from the sap of the young, growing parts of twigs, branches, stems and leaves, or just beneath the skin of the fruit. Usually the scale has the effect of reddening the young bark or skin of fruit; the cambium layer (or the young, growing layer) is frequently highly colored red after scales have been present for a short while. In time the young, growing stems become pitted and very irregular, especially in the peach and Japanese plum. An apple tree commonly can withstand the attack of San José scale for four or five years; a peach tree from two to three years; while a pear tree shows great injury at once.

The tips of the branches of the infested tree show injury first. The twigs seem to dry up as a result of the waste of sap by the insects.

Parasites and natural enemies

Notwithstanding the fact that nearly a dozen parasites have been bred from San José scale, yet these either do not multiply sufficiently to afford an effective means of control or they do not prey alone upon the San José, but upon all scale insects.

Among the predaceous insects of this scale are several representatives of the ladybird family (*Coccinellidae*). The most important in some sections of the country is the twice-stabbed ladybird, but this insect does not multiply rapidly and is not very effective. In spite of the popular accounts given in magazines regarding the great use of parasites and predaceous insects in controlling San José scale, there yet remains much to be done before any satisfactory results can be forthcoming. At present we should plan to spray annually in the same manner as for most insects. Spray for San José scale as you would for "potato bugs," that is, at least once a season.

What is being done in Tennessee to control the San Jose' scale

An annual inspection of all the nurseries of the State is made. When scale is found in a nursery the infested tree is pulled or cut close to the ground and burned. Should scale be found in an adjoining or neighboring orchard these trees are cut, if infested badly; otherwise they are recommended to be sprayed. Often the nursery is moved. A further precaution is that all trees, buds, grafts, cions, or cuttings of apple, apricot, cherry, peach, pear, plum and quince which shall be sold in the State of Tennessee shall be

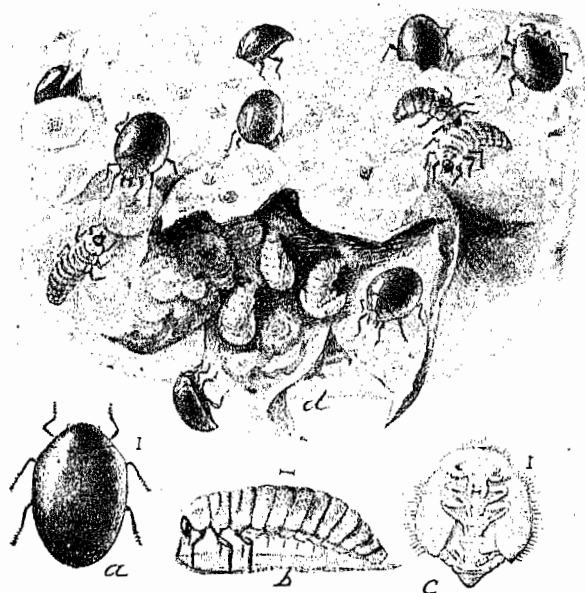


FIG. 11. MICROWEISEA MISELLA, SCALE-FEEDING COCCINELLID
a, beetle; b, larva; c, pupa; showing San Jose scale with larvae feeding
upon them—all greatly enlarged

From Howard and Marlatt, Bureau of Ent., U. S. Dept. of Agr.

fumigated, immediately before shipment or delivery, with hydrocyanic acid gas. At the time of the nursery inspection the fumigating house or box of the nurseryman shall also be inspected, and must be found in a satisfactory condition; otherwise no certificate can be granted.

Many of the orchards of the State are inspected. Such an inspection is most essential for effective results in controlling the situation. Steps have been taken by way of locating the commercial and small orchards with the hope of soon being able to inspect them all and advise a remedy where scale is present. Tennessee is a large fruit-growing State. This industry is of comparatively recent origin, and is rapidly increasing. Early apples and the peach are both well adapted to Tennessee soil and climate; in the production of the former Tennessee bids fair to become one of the leading States in the Union.

Through the work of the farmers' institutes, the State Experiment Station and the State Board of Entomology, the people of the State are being made familiar with the habits and life histories of the San José scale and other injurious insect and fungous pests, and how best to combat them. Daily, twigs are sent into the office of the Entomologist for determination of scale. Generally over the State the fruit growers and nurserymen are very desirous of knowing if they have scale, and, if so, how best to treat for it.

Throughout the greater part of the eastern and western parts of the State the scale is found, but much of the central part of the State—the part representing the great nursery interests—is apparently free from infestation. Every nurseryman shipping into Tennessee has to file in the office of the State Entomologist an inspection certificate, and an agreement to fumigate thoroughly with hydrocyanic acid gas, all stock shipped into the State and to attach a fumigation tag to each and every shipment subject to San José scale infestation.

GENERAL SUGGESTIONS FOR SPRAYING

Before spraying it is best to prune trees intelligently, to economize in the surface to be covered by the spray, also to rid the tree of perhaps its worst affected limbs. *Burn parts removed.* Prune out the dead wood, the undesirable water sprouts and suckers. Keep the trees from becoming bushy. Do not spray right after a rain while the limbs are still wet—try not to spray just preceding a rain. The spray should thoroughly dry on the limbs, thus giving it the best chance to adhere. An ideal spray day is a quiet, bright one, when the air is dry and cool. Study the formulas of sprays and the different makes of pumps and nozzles and use only the best fitted for your conditions, realizing that there is a proper time to spray and the best results are obtained only at such time. *Spray thoroughly.* I doubt if one-tenth of the people who spray do so correctly. Above all else, spray carefully, doing *thorough work* by covering not only one side but all sides of the twigs, not only the growing tips but also the branches and trunks of the trees. I was greatly surprised last winter to find one of our leading orchardists, a man who has sprayed for years, spraying carefully the branches and twigs of his peach trees, leaving the trunks unsprayed. He thought there was no scale upon the trunks of the trees, and only was he convinced to the contrary when multitudes of scale were shown him there.

To spray a tree properly it is best to begin at the topmost branch and spray down, doing one side of the tree at a time. Should a breeze be blowing, take advantage of the same and spray but one side of the tree, going up one row and down another; when the breeze changes or becomes quiet complete the spraying of the trees. Spraying should be discontinued when a strong wind is blowing; likewise in cold, freezing weather the wash should not be applied.

If you spray for several days with the lime-sulphur solution, smear vaseline upon the face and hands. Use a pair of oil or tar-soaked cotton gloves; the wash is caustic and coming in contact with the hands and face soon makes the flesh tender. Care should be taken to have no leaks in the hose or nozzle. Use an extension rod, equipped with an angle nozzle.

Spray when the trees are dormant; it does not matter of what age the trees are, boiled lime-sulphur solution does no injury if applied when the trees are dormant. If but one spraying can be given, I would advise early spring as the most effective time.

REMEDIES

Lime-sulphur solution

The lime-sulphur solution from the standpoint of cheapness, accessibility and efficiency is the best spray now known for the San José scale. Numerous patent remedies for the scale are upon the market.

There is a place for a few of these which have given good results, for they are convenient, and when there are only a few trees to spray it does not always pay to take time to make the lime-sulphur wash. Many of these proprietary remedies, however, are ineffective when used according to the directions given on the packages. If their strength is increased sufficiently to make an effective spray the cost is increased to from two to six times what the lime-sulphur solution costs. We have tested some fifty of these patent remedies at varying strengths.

The time for applying the lime-sulphur solution is, as stated above, while the trees are dormant, as in the late fall, winter or early spring. Prune the trees before spraying and do *thorough spraying*. If all parts of the trees cannot be covered at the first spraying, repeat the process soon.

Boiled lime-sulphur solution	Quicklime (burnt or stone lime)	21 pounds
	Sulphur (flowers or flour)	18 pounds
	Water	50 gallons

Slake lime in about 5 gallons of hot water; add the sulphur that has passed through a flour sieve: boil, stirring frequently, for forty minutes to one hour; dilute all to make 50 gallons. While boiling add water from time to time to keep the solution thin enough to boil readily.

The above solution may be boiled by fire or steam, according to the amount to be made. An average orchardist will find that very satisfactory boiling may be done by using iron kettles, holding from 20 to 50 gallons. There should be two of these, one for boiling the solution, the other for heating water to be used for adding to the solution as it boils. The kettles may be set in a brick or stone base, with space sufficient beneath for placing wood or coal (see accompanying figure). The large orchardist will find it economical to practice the boiling of the wash on a larger scale, using steam and boiling from two to six barrels at a time. Fig. 15 shows the arrangement of boiler and barrels and pipes conducting the steam.

I know of one orchardist who boils his lime-sulphur wash in a barrel by means of heated irons. This process works successfully. When this method is used the spray must be carefully strained before it is put into the spray pump to rid the wash of the ashes added by the heated irons.

The *Boiled Lime-Sulphur Solution* as yet has no equal for its cheapness and efficiency in killing the San José scale.

The salt which was formerly added to lime-sulphur solution has no appreciable useful effect—with it the spray adheres no longer and kills scale no better. The addition of salt increases the cost of the wash and, furthermore, the cool solution does not pass through the nozzle so readily when salt is added.

Bluestone—copper sulphate—added to the lime-sulphur solution has no beneficial effect as an adherent.

To make the lime-sulphur solution one should have suitable equipment. It is best to be so located that plenty of water may be handy. After one has once made the spray the second attempt will be with less effort. One soon learns the little steps in the process of making by which the work is made lighter and more convenient.

It is not uncommon for orchardists to lose their hired men because they ask them to help spray with the lime-sulphur solution. Due to the smell and the caustic properties of the wash, many are actually afraid of

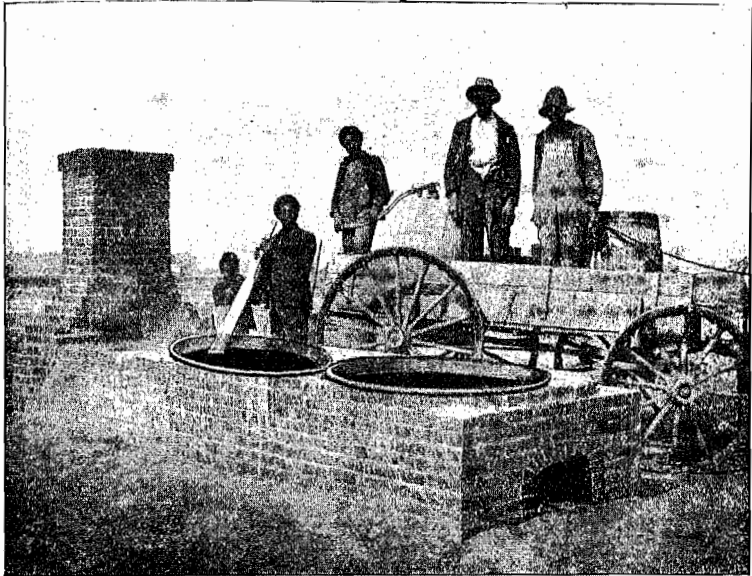


FIG. 12. A CONVENIENT AND ECONOMICAL MANNER OF CONSTRUCTING A LIME-SULPHUR BOILING PLANT

After Smith, Ga. State Bd. of Ent., Bul. 21

it. With proper apparatus, clothing, and a little experience, however the operator will meet with little discomfort.

The amount of the solution for a tree will depend on the kind and size of the tree and how closely it has been pruned. An amount for an average-sized bearing tree is from one quart to two gallons.

THE LIME-SULPHUR SOLUTIONS

The sprays made from lime and sulphur may be divided into three heads, viz., the *home-boiled*, *factory-boiled* and *self-boiled*. The first two act both as fungicides and insecticides, the last only as a fungicide. The lime-sulphur solutions have efficiency and cheapness which commend them highly.

**Home-boiled
lime-sulphur
solution**

Home-boiled lime-sulphur may be made after many different formulas. The one which we have used with best success is made from,

21 lbs. stone lime (burnt).

18 lbs. flour of sulphur.

50 gallons of water.

Into the boiler, a kettle or tray, (a barrel, or tank if steam is to be used) place five or six gallons of water; into this add the sulphur which has been passed through a flour sieve; then the lime, small quantity at a time. Fire should now be started under the boiler. After all the lime has been added and the slacking has finished, add water to keep to a good boiling consistency and boil vigorously for 40 to 60 minutes. The solution is now ready to be thinned and strained carefully into the spray tank or barrel; sufficient water being added to make 50 gallons of spray.

This spray solution is for winter, late fall or early spring use. Never apply while leaves or flowers are present. Never put this solution into a copper tank or spray, for its action upon copper is rapid and will soon ruin a receptacle of this metal.

This winter spray is to control San José scale, and leaf-curl. The above is known as home-boiled solution.

This formula with its excess of lime leaves the trees white, which has advantages in showing any part of tree not sprayed, also in retarding the opening of the bud.

**Factory-boiled
lime-sulphur
solution**

A very similar solution can be obtained in concentrate form from factories, and is then known as the factory-boiled, or commercial lime-sulphur solution.

This should be diluted with 8 to 10 parts of water to make the winter spray. In barrel lots this sells for \$6.00 to \$7.00 per barrel, making the cost about the same as that made at home. There are many grades, the best of which are about as efficient as the home-boiled solution. If good lime cannot be obtained and the proper care given to making and straining the solution, preference should be given to factory-boiled preparation.

**The Self-boiled
lime-sulphur
solution**

The experiments with the self-boiled lime-sulphur solution for the past three years in different states have given results which highly commend this spray for the troubles which have heretofore been met with difficulty. All credit is due Mr. W. M. Scott, for his

preliminary experiments in 1907 and 1908.

PREPARATION OF THE SELF-BOILED LIME-SULPHUR SOLUTION.

The formula giving the best results is:—

8 lbs. flour of sulphur

8 lbs. burnt lime

50 gals. water

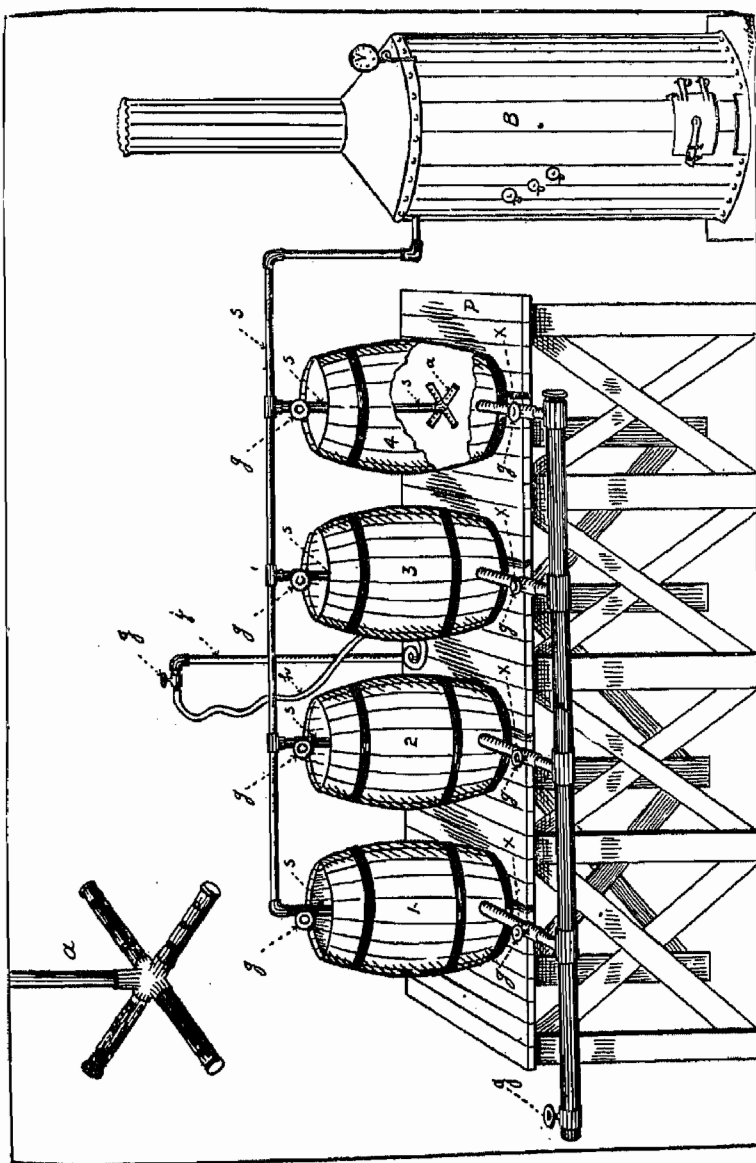


FIG. 13. A SIMPLE STEAM BOILING OUTFIT FOR PREPARING LIME-SULPHUR WASHES

B, boiler; ss, steam pipes; gg, globe valves; 1, 2, 3 and 4, 50 gal. barrels; x, pipes for drawing off mixture after boiling; f, large pipe, carrying liquid from pipes x to wagon tank or spray barrels; a, lower end of steam pipe, with cross arms; P, platform 6 feet above ground; h, pipe supply; h, water hose for carrying clear water to 1, 2 and 4.

After Newell and Smith, Ga. State Bd. of Ent., Bul. 14.

In making this mixture best results can be obtained by making a larger quantity—say four times this amount, as follows:—To 8 or 10 gallons of water in a barrel add 32 pounds of fresh burnt lime (the quicker acting lime the better); when the slacking begins add 32 pounds of fine sulphur which has been run through a sieve to break up all lumps. As the lime continues to slack, water may be added to keep it from drying.



FIG. 14. UNSPRAYED AND SPRAYED APPLES, RESULTS EFFECTED BY USING SELF-BOILED LIME-SULPHUR SOLUTION

The mixture should be constantly stirred until the slacking is over, when more water is added to stop the cooking. Strain and dilute to make 200 gallons of spray. Only a small amount of soluble sulphur should be present; the desired solution is a mechanical mixture of lime and sulphur. In straining the spray the coarse parts of the lime are to be taken out, but the sulphur worked through the sieve.

HOW AND WHEN TO USE THIS SPRAY.

The self-boiled lime-sulphur solution should be applied in the form of a fine mist by a pump equipped with a good agitator. The time for applying will be governed by the disease to be treated. The number of applications may be two, three or four times, according to conditions and objects sought. The first spraying with self-boiled lime-sulphur may be just after the bloom has fallen. Lead arsenate, at the rate of 3 lbs. to 50 gals. of water, may be added to this first spraying to kill the codling moth and curculio. The following spraying with self-boiled lime-sulphur should be without the lead arsenate.

Results comparable to the use of the self-boiled lime-sulphur solution may be obtained by reducing the commercial concentrated lime sulphur solutions, as follows:

Hydrometer readings in the concentrated	Baume degrees of lime-sulphur	No. of Gals. of water to 1 Gal. of concentrated lime-sulphur
34		41½
33		40
32		37¾
31		36¾
30		34¾
29		32¾

Precautions

Never put the lime-sulphur wash into a copper sprayer. The action of the chemical is very rapid upon the copper and will shortly destroy a copper sprayer. For spraying this solution use a galvanized iron or wooden receptacle.

In spraying, great pains should be taken to cover all parts of the tree, shrub or plant. If a heavy rain immediately follows your application of the spray the process should be repeated. Do not spray when the trees are wet.

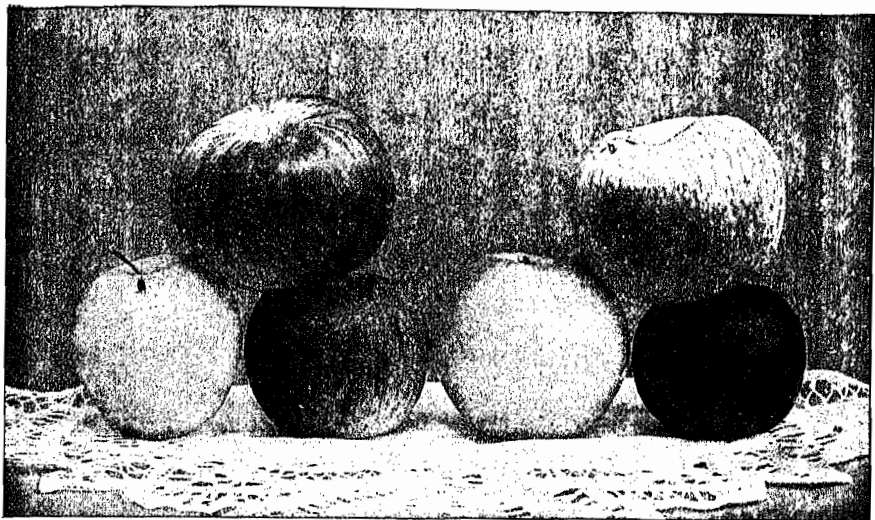


FIG. 15. PERFECT FRUIT A RESULT OF TIMELY AND THOROUGH SPRAYING

In all the formulas which require the quicklime, the best stone lime freshly burned should be used. *Air-slaked lime will not answer* in making lime-sulphur solutions.

SUMMER TREATMENT OF SAN JOSE SCALE

No encouragement can be given for summer treatment, due to varying results. A spray strong enough to kill scale will also seriously injure the foliage of the trees. It would be far better in most cases to postpone spraying until the trees are dormant, then apply the strong lime-sulphur solution, which will give effective results; furthermore the work comes at a season of the year when labor can be easily obtained.

THE SPRAY PUMP AND NOZZLE

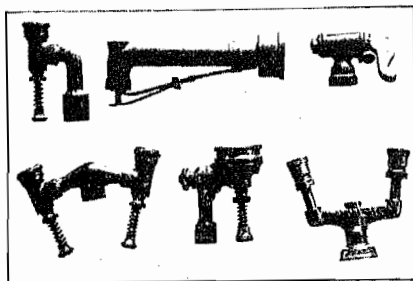


FIG 16. COMMON TYPES OF SPRAY NOZZLES

It is very essential that a good spray pump be secured, together with a suitable nozzle. The lime-sulphur should be applied in a fine mist which comes to the tree with a good force. A nozzle that gives a conical-shaped spray is to be preferred to one that produces a flat or fan-shaped spray. Thus the Vermorel, Mistry, Demorel, Angle Friend, etc., are types of nozzles to be selected.

There are many good types of barrel sprayers; a few suggestions, however, may not be amiss for those anticipating buying. For a very few trees a good bucket sprayer, such as the "Success," with from ten to fifteen feet of hose and an extension rod, does very creditable work. For a small orchard a barrel sprayer should be purchased. It is best to have this fitted with two leads of hose. It is important to get from



FIG 17. BARREL SPRAYER IN WAGON

fifteen to twenty feet of hose on each of these. The heavy parts of the sprayer should be located well toward the bottom of the barrel if the pump is mounted in the end of the barrel, or at the lower side if the pump is placed in the side of the barrel. The weight being low prevents the sprayer from being top-heavy when empty. It is also important to have a good, easy and thorough-working agitator. A simple pump with valves and working parts that can readily be taken apart and cleaned is

very essential. In buying a barrel sprayer, an expense (about \$2.00) can be saved by getting the pump detached from the barrel and placing it in a kerosene or other good barrel at home. If the orchard has several hundred trees a larger type of sprayer, a power sprayer may be used with economy.

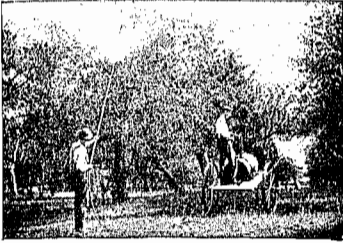


FIG 18. BARREL SPRAYER MOUNTED ON TWO-WHEELED TRUCK



FIG. 19. DOUBLE ACTING SPRAYER MOUNTED ON SLED

FUMIGATION

In treating nursery stock to kill San José scale all trees upon which scale can be found should be destroyed (burned) if the trees are to be sold. The remaining stock should be carefully subjected to hydrocyanic acid gas and allowed to fumigate as follows:



FIG. 20. COMPRESSED AIR SPRAYER; EFFICIENCY WITH LITTLE WEIGHT

FORMULAS.

For one or two-year-old apple, pear, plum, and peach use the following charge for every 100 cubic feet:

Potassium cyanide (98 per cent)	1 ounce
Sulphuric acid	2 ounces
Water	4 ounces

Allow fumigation to continue from 30 to 40 minutes.

For June buds, roses, and budding and grafting wood use the following charge for every 100 cubic feet:

Potassium cyanide (98 per cent)	$\frac{3}{4}$ ounce
Sulphuric acid	$1\frac{1}{2}$ ounce
Water	3 ounces

Allow fumigation to continue 30 minutes.

APPARATUS REQUIRED.

A graduate marked for ounces.

Accurate scales.

A glazed porcelain dish.

How to fumigate nursery stock Before the trees are packed into fumigator, pains should be taken to see that they are dry and stripped of all their leaves and that all surplus dirt is shaken from the roots. It is well not to puddle the roots before fumigating. Fumigate the trees the last thing before they are sold. All nursery stock sold or bought with the purpose of re-selling should be carefully fumigated. Any cuttings or buds secured for use in propagation should likewise be subjected to the gas.

After the trees have been properly packed in the fumigator, a porcelain or glass dish should be placed beneath the false floor, or at a safe distance from the trees. The required amount of water is added. The acid is now added to the water. The cyanide, which should have been carefully weighed and placed in a paper bag, is next added to the dish containing the water and acid. The door and ventilator are at once closed and securely fastened. Fumigation should continue for 30 to 40 minutes. At the end of this time the ventilator and door are opened and the room is allowed to ventilate for at least 15 minutes.

Chemicals In buying chemicals great care should be taken, since the desired results can be obtained only when everything is of proper strength and correctly used. The potassium cyanide should be the best, fused, 98 per cent pure. This should be white and very hard, in lumps of varying sizes. There are many grades of potassium cyanide. From experience it is found that the most reliable results are gotten from the use of cyanide put out by

Merck & Co., St. Louis or New York, or the Baker & Adamson Chemical Co., Easton Pa., and The Roessler & Hasslacher Chemical Co., 100 William St., New York. If you get chemicals of these firms and properly use them your fumigation will be most effective. The sulphuric acid should be a good commercial grade, with a specific gravity of 1.83. Rain or well water may be used. Arrangements have been made with leading firms in each of the following cities to handle these recommended chemicals for fumigating purposes, and it is strongly advised that each person in Tennessee wishing to fumigate shall get his chemicals from one of these firms and insist that they are chemicals of Merck & Co., or the Baker & Adamson Co., or Roessler & Hasslacher.

Chattanooga

Fritts & Wiehl

Strong Bros.

Clarksville

Owen & Moore Drug Co.

Knoxville

Chapman Drug Co.

Sanford, Chamberlain & Albers Co.

Memphis

Hessig-Ellis Drug Co.

Lillybeck Drug Co.

Memphis Drug Co.

Van Vleet-Mansfield Drug Co.

Wiikerson Sons

Nashville

Berry, Demoville & Co.

Spurlock-Neal Co.

We urge that in the purchase of potassium cyanide you demand from your druggist unbroken packages and a guarantee of 98 per cent pure potassium cyanide.

Precautions Potassium cyanide is one of the most deadly poisons. Therefore great care should be taken in its use. The gas formed when the cyanide is added to the acid and water is also poisonous. This gas must not be breathed by the operator. When starting the fumigation close the door quickly after adding the cyanide to the dish, and allow the room or box to ventilate thoroughly before removing the trees. Buy cyanide fresh each year. Keep cyanide in an air-tight tin or glass vessel, properly labeled.

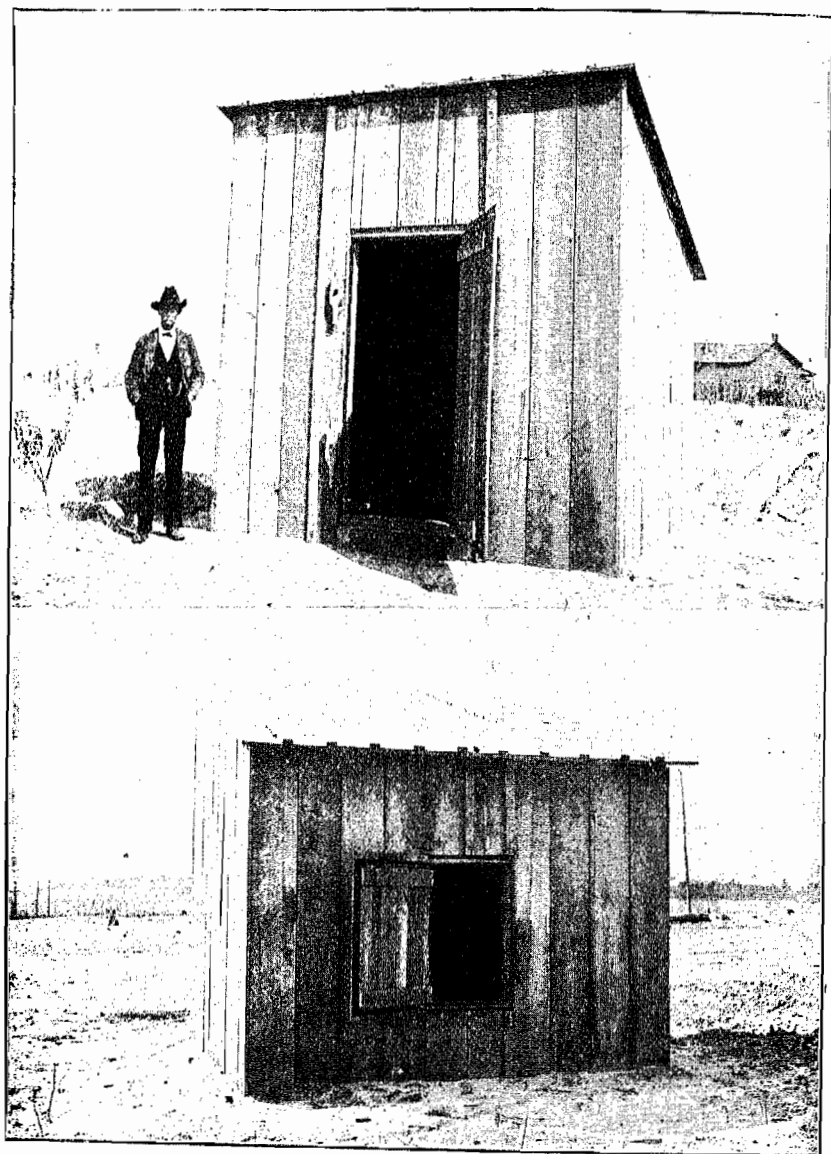


FIG. 21. AN INEXPENSIVE FUMIGATOR, FRONT AND REAR VIEWS

SUMMARY

1. A scale of Asiatic origin, known as the San José scale, is one of the worst enemies of the fruit grower. To combat this sucking insect satisfactorily it is necessary to know its life history and habits. From April till December the San José scale gives birth to living young here in Tennessee at periods of from 33 to 40 days. There are at least five broods; hence the necessity of controlling this insect, which is capable of the greatest destruction.

2. The San José scale, being a sucking insect, must be dealt with by means of a remedy that kills by contact.

3. Thoroughness in spraying is one of the most important elements of success, yet one most frequently unheeded.

4. A majority of the recently introduced insecticides and fungicides are not as good as the more simple and older remedies. They are made to sell and are given deceptive names.

5. Results of spraying in the spring instead of the fall or winter show that the scale is more susceptible to the action of insecticides in the spring than in the fall or winter. Unfortunately, it is not safe to postpone all spraying till spring. The peach is especially liable to set bloom before the work is finished if much spraying is to be done.