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The Purple Scale and its Control

By

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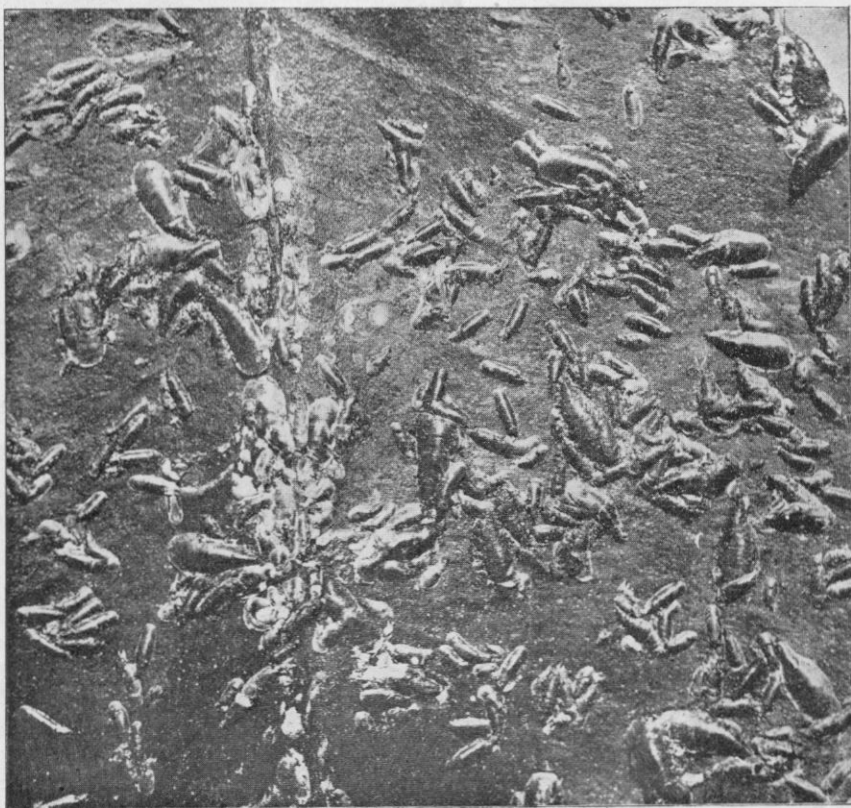


Fig. 1.—Purple scale as it appears under a hand-lens, enlarged about nine times, showing the large, somewhat oyster shell-shaped female and the much smaller and more straight male scale coverings. (Original photo by Author.)

COOPERATIVE EXTENSION WORK IN AGRICULTURE AND HOME ECONOMICS, THE ALABAMA POLYTECHNIC INSTITUTE AND THE UNITED STATES DEPARTMENT OF AGRICULTURE COOPERATING—ACTS OF MAY EIGHTH AND JUNE THIRTIETH, NINETEEN HUNDRED FOURTEEN.

THE PURPLE SCALE AND ITS CONTROL

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Early History and Distribution

The purple scale (*Lepidosaphes beckii*) was first described by the English entomologist, Newman, in 1869. Glover, in the U. S. Department of Agriculture Yearbook for 1876, states that it was found on imported lemons in Jacksonville, Fla., in 1857. The original home of this scale is unknown but it now occurs practically all over the world where citrus is grown. It was probably introduced into the United States at a very early date but when and where has never been determined. For many years it was confined, in the United States, to Florida and the Gulf region, but it seems to have been introduced into California

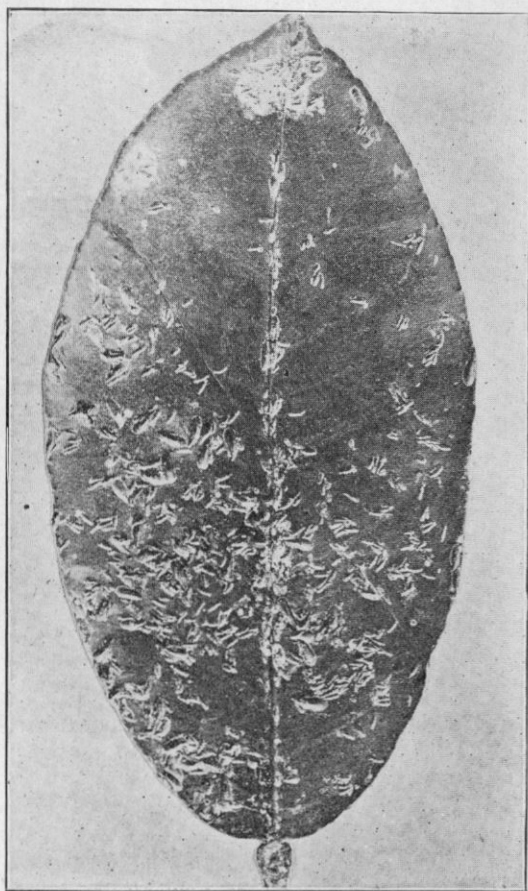


Fig. 2.—Satsuma leaf heavily infested with purple scale. Natural size. (Original photo by Author.)

in 1888 or 1889 on a shipment of two carloads of orange trees from Florida that were set out in Los Angeles and San Diego Counties without disinfestation. This scale is now well established over a large part of California and is one of the most serious citrus pests of that State.

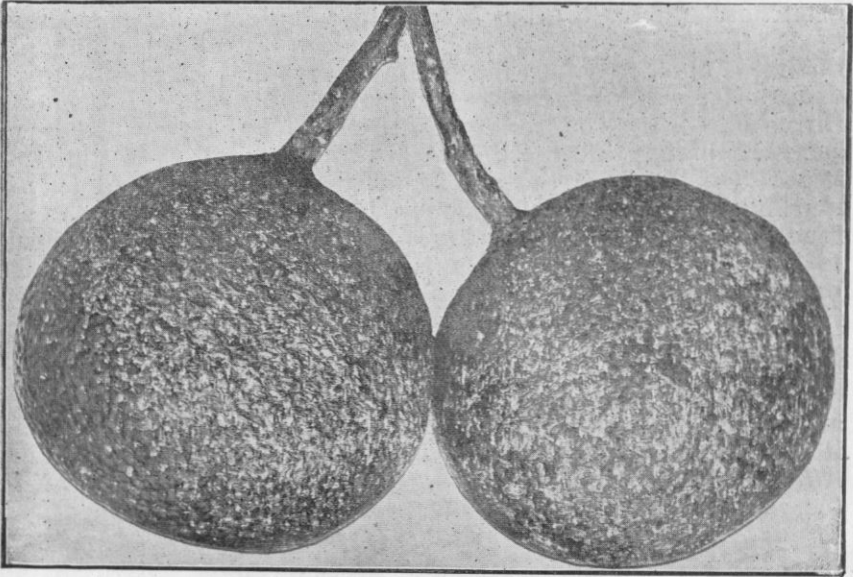


Fig. 3.—A cluster of Satsuma oranges entirely incrustated with purple scale; such fruit is unmarketable. (Original photo by Author.)

At the time of the big freeze in 1895 there was a rather flourishing native orange industry all along the Mississippi Sound and Mobile Bay. It seems that at that time the purple scale occurred on these native oranges and may have been introduced from Florida or Cuba by means of boat traffic. In all probability this scale was exterminated with the killing of the native trees in this freeze and was re-introduced later by means of nursery stock from other states. Mr. H. P. Loding, a reliable entomologist, of Mobile, Ala., states that he observed this scale abundant on native orange trees in 1914 at Coden and on Mon Louis and Dauphin Islands. It was first noticed in Baldwin County, Ala., in 1915 on only a few trees. In April, 1916, Dr. R. Van Iderstine reports that he found trees dying from its attack at Fairhope, Ala. At that time it was well distributed along the Eastern Shore district. Purple scale is known to have occurred in Mobile County in 1917 but the infestation in that county probably dates back to about the same time as that in Baldwin. During recent years this pest has spread very rapidly

all along the entire Gulf Coast and the growers, not knowing about it, have for the most part paid no attention to it. ,

Economic Importance and Manner of Injury

The purple scale is without any doubt the most serious pest that the grower of citrus fruits along the Gulf Coast has to contend with. It is the hardest to control. It infests the leaves, branches, and fruit, often becoming completely incrustated upon these. Injury is done by sucking juices out of the plant, producing a marked yellowing of the leaves and causing many to drop. It frequently causes complete defoliation. It seems to thrive best in the interior of the tree. If left unsprayed it will soon completely incrust the large branches and even the trunk itself. On the fruit the scales delay the coloring and leave a marked green spot about them while the remainder of the surface is the natural yellowish-orange color. They adhere firmly to the fruit and render it unsightly and unmarketable. The ordinary brushing or washing of the packing house is not sufficient to clean them off.

Food Plants

Fortunately for the growers of the Gulf Coast this scale is almost entirely a pest of the different varieties of citrus although it has been recorded as occurring occasionally on the fig, olive, *Allamanda* sp., bergamot, *Cal. privet*, *Murraya* sp., palm, mistletoe, magnolia, Spanish bayonet, croton, oak, *Banksia integrifolia*, *Taxus cuspidata*, *Cercidiphyllum japonicum*, *Pomaderris*, *apetala*, Chinese holly, mango, orange jessamine, *Elaeagnus* and pecan. The shrub, *Elaeagnus longipes*, has been observed by the

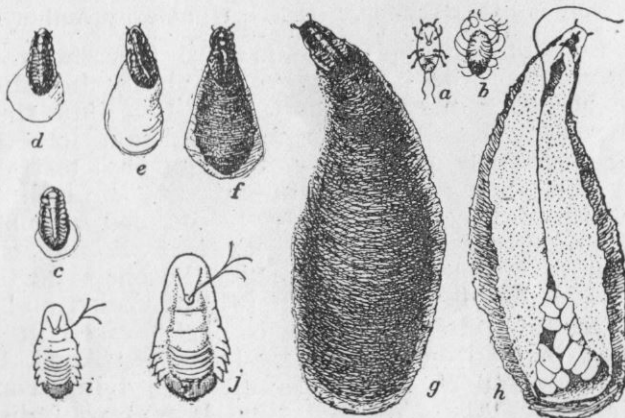


Fig. 4.—Purple scale, showing different stages of female: (a) newly hatched larva or crawler; (b) different stages of growth; (g) mature scale; (h) same inverted, showing eggs; (i) and (j) half-grown and full-grown female insects removed from scale covering. All enlarged. (U. S. D. A.)

writer at New Orleans, La., and Gulfport, Miss., heavily infested with purple scale. A number of vines of the maypop or passion flower, a heretofore unrecorded host plant, were found entwined around Satsuma trees in a grove at Dawes, Ala., August 20, 1923. These were infested with purple scale in all stages but the infestation was probably an accidental one as the Satsuma trees themselves were heavily infested.

Description and Life History

The general brownish-purple-color of the scale covering gives this insect its common name, the purple scale. The scale covering of the female is from one-tenth to one-seventh of an inch long. In shape it exactly duplicates an oyster shell, being somewhat curved or horn-shaped. The covering of the male scale (see Fig. 1) is much smaller in size, is almost straight and more narrow than that of the female. Beneath the scale covering is found a soft-bodied, elongated insect itself, yellowish in color. This is the mother insect which is provided with a long slender beak for sucking out plant juices.

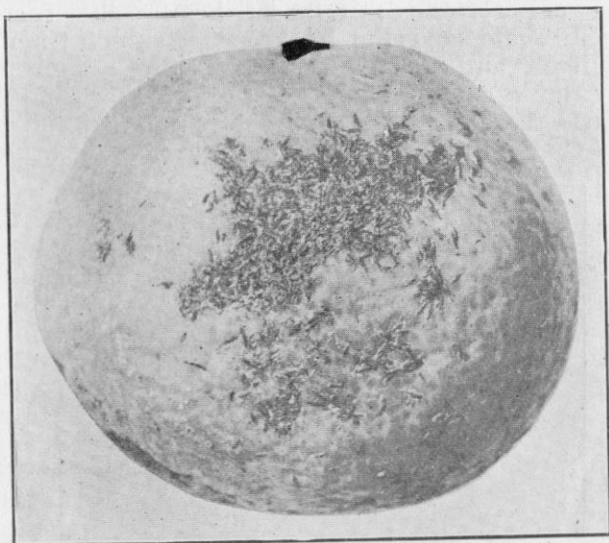


Fig. 5.—Satsuma orange infested with the long scale which is often confused with the purple scale. (Original photo by Author.)

The oval-shaped pearly-white eggs are deposited beneath the mother scale covering in more or less definite rows, standing partly on end. They are extremely well protected, not only by the upper side of the scale covering, but on the under side by a lighter and more cottony secretion, leaving them practically enclosed on all sides except the hind end where the under

covering is not complete and the eggs may be seen. These eggs are deposited over a period of three or four weeks, the number varying from forty to eighty or more. Those eggs nearest the hind end are the oldest and, therefore, the first to hatch.

The period of hatching depends on the season and weather conditions, the eggs hatching in summer in as short as fifteen days and taking much longer during the cold winter months. They hatch out into very small "crawlers" that are very flat, oval-shaped, about one-thirtieth of an inch in length, and whitish in color, greatly resembling small mites. After wandering about over the plant for a short time the crawler selects a suitable spot to insert its beak and then settles. This so-called "settling period" will vary from a few hours after hatching to several days. During cool weather the crawlers often remain beneath the mother scale covering for some time before issuing. After settling and starting the formation of its covering the female purple scale never moves or changes its position. Very soon after settling the young crawler secretes a couple of rather coarse cottony threads from the front end of its body. These entangling threads extend entirely over and around the body. After these are formed the insect begins the secretion of its permanent scale covering by secreting much finer threads that cover itself and these melt down into a more compact covering. After a certain period of growth this small creature molts or casts its skin which becomes a part of the top scale covering. After another period of growth a second molt takes

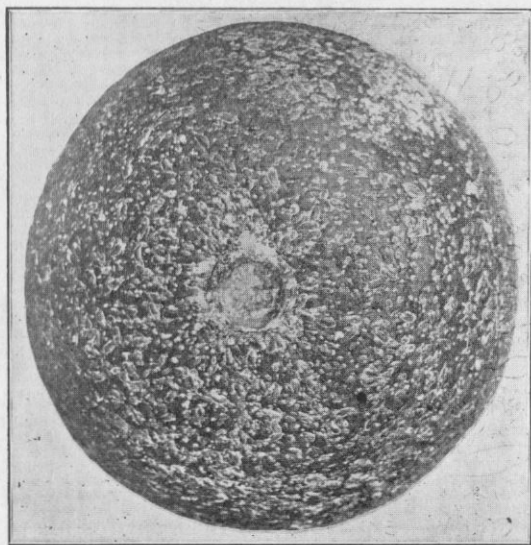


Fig. 6.—A Satsuma orange showing adults and newly settled purple scale, August 21, 1923. Original photo by Author.)

place and the second cast skin becomes a part of the scale covering, and together these two cast skins form the so-called nipple of the scale covering. Then after a short period of development the adult female is ready to be fertilized.

The narrow, elongated covering of the male insect is formed entirely during this second stage of development. The male insect goes through a development somewhat similar to that of the female, but, when mature, it issues from beneath its scale covering as a very small, yellowish, two-winged fly or gnat that flies away to seek its mate. Its life is of only a few days duration while its mate lives for months.

Seasonal History

Practically nothing is known of the exact life history of the purple scale in the Gulf Coast region. Observations show that about three months are required from young to young during the summer and that there are at least three more or less definite generations or broods a year with probably a partial fourth. There is, however, a continual over-lapping of broods and this makes it very difficult to determine the periods of maximum abundance or issuing of crawlers. Breeding continues throughout most of the year. So far as the writer has been able to observe there are three periods in Southern Alabama, Mississippi, and Louisiana when the young crawlers are especially abundant, marking in a rough way the appearance of the main broods, namely, in March, June, and about the 1st of September.

Natural Control

There are a number of natural factors which aid in the control of this pest but none of these can be relied upon for adequate control.

Black fungus (*Myriangium durieui*) is the most abundant and effective fungus disease attacking this insect. Heretofore it has always been considered strictly beneficial, but recent observations in Southern Alabama show that in certain cases this fungus does harm. Sometimes it becomes so abundant and incrusts the branches so completely that the tree cannot function properly; and, in combination with the devitalized condition produced by the purple scale, it results in the death of the tree. The writer observed 30 trees in a grove of 2000 trees in Baldwin County that were so badly affected that many of them died completely. It is equally certain, however, that this fungus does not occur on citrus trees unless some of its scale hosts are present upon which it can feed. It is and must be considered a friend and very beneficial until it reaches the stage where it completely encrusts the branches of the tree, and then it must be knocked off by one or two strong applications of Bordeaux Mixture.

Red-headed scale-fungus (*Sphaerostilbe coccophila*) is also very abundant throughout the Gulf Coast region where it at-

tacks certain scale insects. It is often very effective in its work against the purple scale. The reddish heads or fruiting bodies of this fungus, although usually smaller than a pin head in size, may be easily seen growing out of dead scales.

Another fungus that occurs abundantly in Florida and Louisiana, but which seems to be scarce along the rest of the Gulf Coast, is the so-called gray-or white-headed fungus (*Podonectria coccicola*.) This preys upon purple and long scales.

The internal insect parasite of the purple scale, *Aspidiotiphagus citrinus*, a very minute wasp-like, lemon-colored fly, is present in the Gulf Coast region and does a great deal of good in aiding with the control of this pest. The most efficient insect predator on this species is the twice-stabbed lady-beetle, *Chilocorus bivulnerus*, which is widely distributed and abundant in this territory.

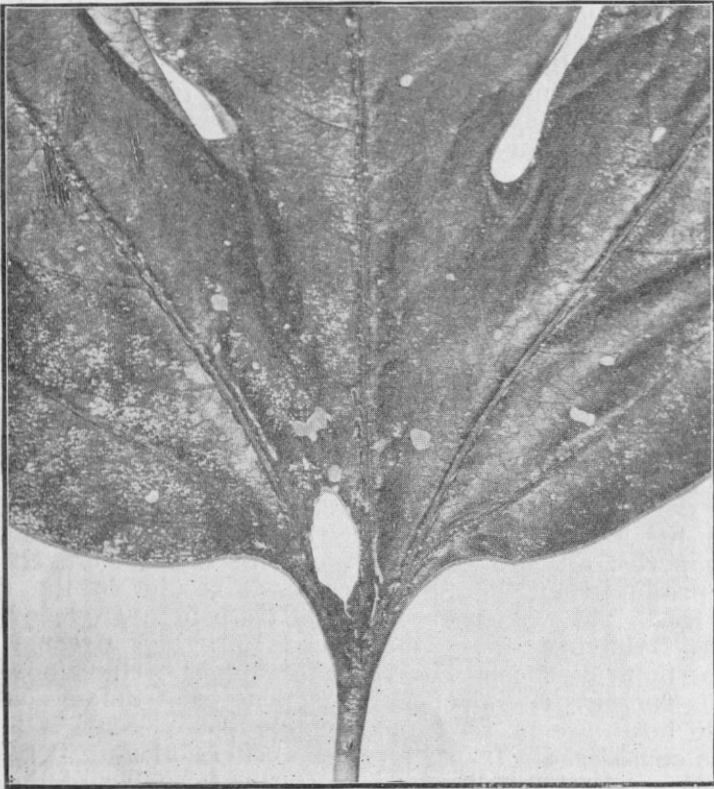


Fig. 7.—The Passion Flower or maypop vine infested with purple scale. (Original photo by Author.)

Artificial Control

The first step for the grower to take is to acquaint himself thoroughly with this insect in all of its stages and to get used to using a good strong hand-lens or magnifying glass, so as to determine when the crawlers have issued in maximum abundance; then make a thorough spraying with a standard oil-emulsion made according to one of the following formulas.

There are two ways in which a miscible oil-emulsion can be made: (1) The boiled emulsion, made according to the Government formula, and (2) the so-called cold-stirred emulsion, made without heat. Both are efficient and reliable but the writer recommends that either of the following cold-stirred emulsion formulas be used as they are just as efficient as the boiled formula, are cheaper, more easily made up, and stand much longer without breaking down or deterioration.

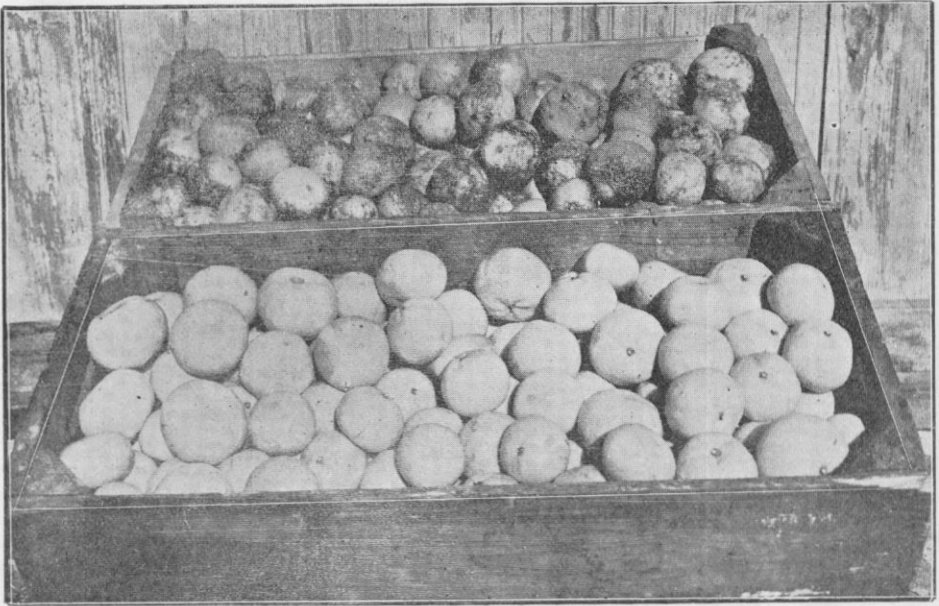


Fig. 8.—Does it pay to spray? Field boxes showing the difference between bright sprayed fruit and culled fruit rendered unsightly and worthless by the purple scale. (Original photo by Author.)

Cold-stirred Emulsions

Formula I (Missouri formula)

Diamond paraffin oil	2 gals.
Water	1 gal.
Calcium caseinate (Kayso or Spray Spread)	4 ozs.

This emulsion can be made easily by means of either a bucket pump or a power sprayer. Make the desired amount of Calcium caseinate into a paste by slowly adding water and stirring until the full amount of

water is added; then add this to the oil and pump. If a power sprayer is used, put the suction hose and a hose from the return line into a barrel and pump the mixture back and forth several times, using a coarse spray for a minute and then reducing the opening of the spray nozzle to make a fine spray. While one pumping generally produces a good mixture it is best to pump it back again.

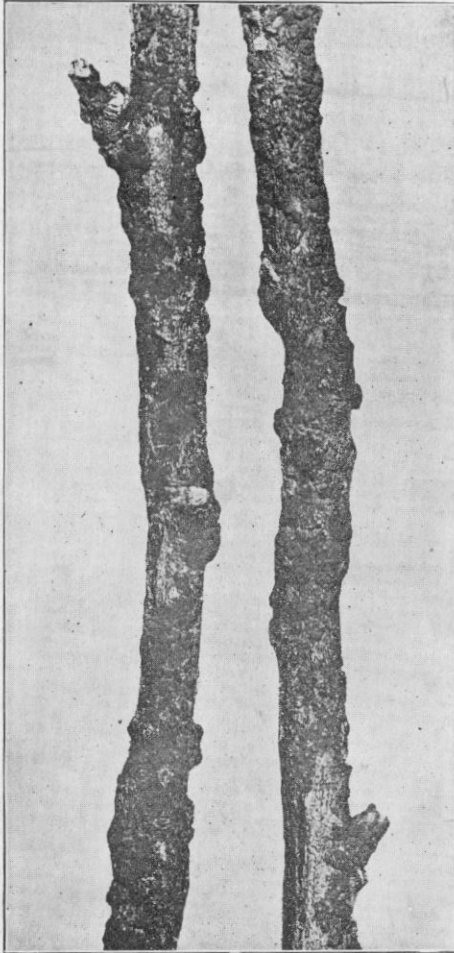


Fig. 9.—Twigs heavily incrustated with the black fungus (*Myriangium duriei*). Original photo by Author.)

This formula has been used successfully against the San Jose scale on apple trees in Missouri and on peach trees in Georgia. It is by far the most promising formula known to the writer. It has the following points in its favor over other formulas:

- (1) A cold-stirred emulsion easily mixed at home;
- (2) Better spreading qualities;
- (3) Mixes with Lime-sulphur readily, and with no injury following;
- (4) Cheaper than other formulas;
- (5) No clogging of machinery;
- (6) Has a decidedly more agreeable odor than the fish-oil emulsion;
- (7) Mixes with hard water;
- (8) Holds up well without breaking down for long periods.



Fig. 10.—Satsuma tree killed from the combined effects of a heavy incrustation of the black fungus and the devitalized condition produced by the purple scale. (Original photo by Author.)

The killing efficiency of this formula is borne out by statements and tests made by the Missouri Station where excellent results were obtained by using a 2 percent solution. There is

no reason to believe that it could be less efficient than the old Government formula boiled emulsion which is in use so much at present. It contains the same amount of oil which does the killing. The calcium caseinate increases the spreading and adhesive qualities of the mixture.

Formula II (Improved Government formula)

Diamond Paraffin oil	2 gals.
Water	1 gal.
Potash fish-oil soap	2 lbs.

It has been found that the amount of fish-oil soap can be reduced from 8 pounds as recommended in the old Government formula to 2 pounds by pumping it through a spray machine twice under a pressure of 200 pounds. This makes an excellent emulsion that will stand up indefinitely. It has passed through a temperature as low as 14 degrees F. without breaking down. This emulsion, however, will not mix with a lime-sulphur solution without curdling and consequent danger. It has the disagreeable fish-oil odor, and, is, therefore, less desirable than Formula I where the calcium caseinate is available.

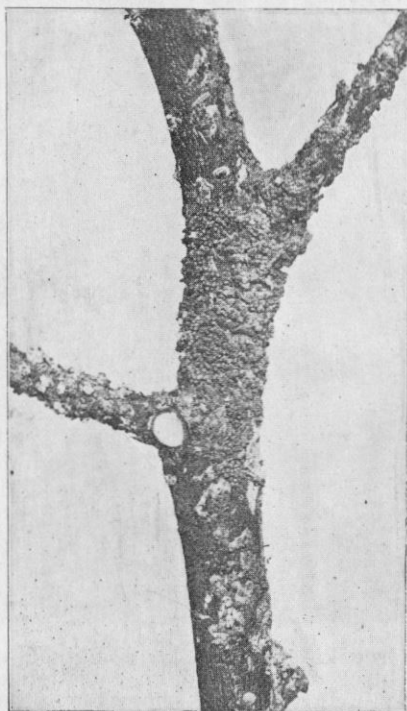


Fig. 11.—Gray-or White-headed fungus (*Podonectria coccicola*), attacking purple scale. (Original photo by Author.)

Oils of all kinds have been tried in making these emulsions and those most promising and generally used now are: Diamond-Paraffin, Jr. Red Engine, Nabob, Atlantic, and the Gulf "A" (Alcopol). The writer prefers and recommends the use of Diamond-Paraffin for use in citrus work.

These stock emulsions contain 66 2-3 percent of oil. To make a 2 percent emulsion for use in a 200 gallon spray tank it is necessary to use 6 gallons of the stock emulsion, at the rate of 1 gallon of emulsion to 33 gallons of water. A 1 percent oil solution is in general use in spraying to control this and other scale pests on orange trees in Florida and along the Gulf Coast. This is at the rate of 1 gallon of the mixture to 66 gallons of water.

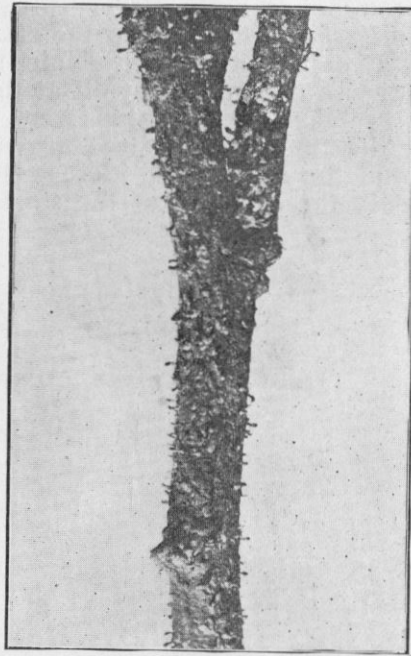


Fig. 12.—The Red-headed fungus (*Sphaerostilbe coccophila*), attacking the purple scale. Original photo by Author.)

From field observations and experiments of the writer it is quite evident that the 1 percent oil emulsion (1 to 66) is too weak to give satisfactory control. Undoubtedly a stronger strength is necessary but the vital point yet to be established by further experimentation is just how much oil a citrus tree, especially the Satsuma, can stand during a season and how often these sprayings can be made without injury. Citrus trees in

foliage stand a 1 percent oil solution without injury under nearly all conditions of weather, if the solution is thoroughly emulsified and there is no free oil in evidence. The presence of the latter is always an indication that: (1) The mixture is not properly emulsified, (2) the mixture has reverted or "gone bad," or else (3) the water used is too hard.

During the dormant period there is no danger of burning and dropping of fruit and the trees withstand a much stronger spray than during the summer. It is a well known fact that an application of oil emulsion when closely followed by a very cold snap often produces defoliation and care must be taken in choosing the best time and weather conditions to make the application. It is preferable to apply the first of these dormant sprays in the fall immediately after the fruit is picked.

The writer recommends as a winter spray for citrus that light oil (Diamond Paraffin) be used at the rate of one to forty or the heavier oil (Atlantic or Jr. Red Engine) at one to fifty. As a summer spray use only the light oil at the rate of one to fifty. Care must be taken not to injure very young fruit and tender foliage at the time of the June growth. During that period it is best that the dilution be increased to one to sixty-six or approximately three quarts of the stock emulsion to 50 gallons of water.