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## Proceedings of the Twenty-seventh Annual Meeting of the American Association of Economic Entomologists

(Continued)

*Afternoon session, Tuesday, December 29, 1914, 2.00 p. m.*

PRESIDENT H. T. FERNALD: We will now listen to a paper by W. W. Yothers.

### SPRAYING SCHEME FOR THE CONTROL OF INSECT PESTS ON CITRUS TREES IN FLORIDA

By W. W. YOTHERS, *Bureau of Entomology, Orlando, Florida*

Of the total damage caused by insects to citrus in Florida more than 95 per cent may be attributed to six species. The most destructive is the citrus white fly (*Aleyrodes citri* R. & H.) which now infests nearly all the groves in the state. The second most destructive pest is the purple scale (*Lepidosaphes beckii* Newm.) which is found in greater or less numbers on every citrus tree in the state. According to my observations the rust mite (*Eriophyes oleivorus* Ashm.) ranks third. The Florida red scale (*Chrysomphalus aonidum* L.), the cloudy-winged white fly (*Aleyrodes nubifera* Berger) and the red spider (*Tetranychus sexmaculatus* Riley) are also of primary importance. It has been the object for several years to perfect a spraying scheme which would largely eliminate the damage caused by these pests. There are also several pests of secondary importance such as the woolly white fly (*Aleyrodes howardi* Q.) and the purple mite (*Tetranychus mytilaspidis* Riley), which this spraying scheme will also partially or completely control.

As a general proposition the time to spray for the control of all pests on citrus trees is when they are present in such numbers that,

if left to reproduce without artificial hindrance they would soon become injurious. In other words, the pests should be killed before they do much damage to either the tree or fruit. The pests should always be kept in such a state of subjection as to do little or no damage. In case the various pests to citrus trees are permitted to become so abundant as to cause damage, the profits which might be derived from artificial treatment, such as spraying with an insecticide, are, to a certain extent, lost. The life history and habits of nearly all pests on citrus trees are, fortunately, such that good and satisfactory results can be obtained any time the spray is applied. While such is the case there are times when it is opportune to spray. These periods come when the largest percentage of the insects is in the youngest stage, which is the one most easily killed.

The following spraying scheme has been used quite extensively for three summers and has generally given satisfactory results. It must be admitted, however, that no hard and fast scheme can be given, and the number of sprayings depends to a large extent on the thoroughness of the work.

I. PARAFFIN-OIL EMULSIONS; Government formula 1-50 or 1 per cent of oil—May. The main object of spraying at this time is to kill the white fly, scale insects, and to a large extent rust mites, although this treatment must not be relied upon to control the last. This spraying should be given after the adults of the first brood of white flies have disappeared and before the appearance of those of the second brood. The fruit should be an inch or more in diameter when the spraying is done. This treatment should be given before the beginning of the rainy season, so that the beneficial fungi will take care of those insects which are not killed by the spray.

II. LIME-SULPHUR SOLUTION, 32° Baumé, 1-50 to 1-75—June to July. The main object of this treatment is to kill rust mites and the opportune time for its application varies with the appearance of the maximum number of the rust mites. It should be applied before the mites get very abundant and before any russetting appears. It will also kill some scales and white flies, but is of little value for that purpose.

III. PARAFFIN-OIL EMULSIONS; Government formula 1-50 or 1 per cent of oil—August 25 to October 31. This is the second spraying for the white fly and scale insects. The object of spraying at this time is to kill all the white fly larvæ which are the progeny of the third and last brood. It is this brood which causes nearly all the damage from the white flies, and the earlier they are killed the better it is for the tree. This spraying also comes after all the beneficial fungi have done their work. This will also remove the sooty mold from the trees and

sufficiently from the fruit to permit the sun to color it up. Soda-sulphur 1-50 may be added to this spraying and this will increase its effectiveness in killing rust mites.

IV. LIME-SULPHUR SOLUTION, 32° Baumé, 1-50 to 1-75—November or December. The object of this spraying is to kill rust mites and it may or may not be necessary, depending on the abundance of the mites.

It may be necessary to spray for rust mites before No. 1 is given. In case the red spider becomes abundant enough to be injurious, a spraying with lime-sulphur solution should be given. It may also be necessary to spray three times with the oil sprays, in which case this treatment can be given in midsummer or in winter. If the red scale is very abundant, two sprayings with the oil emulsions should be given at intervals of about a month.

The paraffin-oil emulsion may be made according to directions given in Circular No. 168, Bureau of Entomology. In addition to the above there are two miscible oils on the market in Florida which are highly satisfactory. The soda-sulphur solution is made according to the standard formula, 30 pounds sulphur, 20 pounds caustic soda, 20 gallons of water. This tests about 16° Baumé and may be used 1-40 instead of lime-sulphur solution but it is not so effective in controlling rust mites. It has the advantage of the lime-sulphur solution in that it will mix with the oil emulsions. To follow the above scheme it will cost from 20 cents to 35 cents a year per tree. It costs one grower 20 cents for trees of about five-box capacity or 4 cents per box. Another did the work for 32 cents for eight-box trees or 4 cents per box. It cost several other growers 3, 3, 6, 7, and 8 cents per box respectively. A maximum figure would be 8 cents per box.

Even though this scheme is not strictly adhered to it will result in raising the grade of the fruit. The second grade will become first, the third will be largely eliminated, and the culls will almost disappear. The increase of production due to the increase in size of the fruit resulting from the elimination of the rust mite will be from  $12\frac{1}{2}$  to 25 per cent, amounting approximately to two million boxes. The devitalizing of the trees by the insects would be eliminated and the trees would then expend their vitality to produce fruit instead of nourishing insects. This would also increase the quantity and quality of the fruit and make a crop more certain from year to year, which would be crop insurance. It is a conservative estimate that the total benefits which would be derived, if this scheme was followed throughout the state, would be not far from an increase of production of a minimum of 25 per cent over that which is the result at the present time with a total de-

pendence on the beneficial parasitic fungi. The appearance of the fruit on the market would be vastly improved. The total dependence of the Florida citrus grower on natural enemies for the control of the pests on citrus trees is a delusion.

February 2, 1915.

PRESIDENT H. T. FERNALD: The next paper on the program will be read by P. J. Parrott.

## AN ANALYSIS OF SPRAYING METHODS AGAINST THE CODLING MOTH

By P. J. PARROTT]

One who has at heart the permanent prosperity, extension and normal development of fruit-growing in New York can hardly fail to be impressed with two facts: (1) The increased planting of apple trees, so that the care of orchards frequently over-shadows all other farm operations, resulting in an unbalanced state of farming; and (2) the growing necessity of more frequent and thorough applications of spraying mixtures. In addition to scab, scale and codling moth, it is now the lot of many orchardists to have to contend against fruit-puncturing capsids and leaf and fruit-infesting aphides; and spraying for these has become a regular part of the routine prescribed by the latest and most approved spraying schedule. The cost for spray materials is also increasing. Formerly lime-sulphur and arsenate of lead sufficed for the principal ills that the apple is heir to, but now the grower must needs use lime-sulphur and lead, plus other substances; and according to present usage nicotine is the most popular third constituent in the combination of spraying materials.

Individually and collectively the growers of New York are confronted with what may prove to be a great economic problem. In addition to the necessity of maintaining a high state of culture at increasing expense, they are apparently facing a period of diminishing returns. As a result more serious thought than ever before is being given to a study of methods of producing maximum yields of high-grade fruit at minimum cost. A partial solution of the dilemma is to improve spraying practices, at least as to the character, if not number, of the treatments. In spite of present methods, injurious insects are responsible for great reductions in financial returns. Moreover, in addition to direct losses, failure to maintain a high level of spraying practices may have the effect of neutralizing, if not actually destroying any benefit by other standard operations, as pruning, thinning, cultivation, etc., so essential today for the upkeep and