dusting or spraying by first chopping the cover crop. This resulted in much better control than where cover crops were standing at the time of application.

SUMMARY

An account of the 1947 grasshopper problem on Florida citrus is presented. There were 2 generations which did damage particularly in June and early July and again in September and October. Experiments concerning the use of benzene hexachloride, chlordane, thiophos 3422 and chlorinated camphene for grasshopper control are described. The effects of cultural practices and the possibilities of control by judicious cultivation and cover crop management is discussed. Recommendations for control are outlined.

LITERATURE CITED

HENMAN, E. J., AND F. T. COWAN. New Insecticides in Grasshopper Control. *USDA Bur. of Ent. and Pl. Quar.*, E-722, May 1947.

LIST, G. M., AND J. L. HOERNER. Dust and Sprays for Grasshopper Control. *J. Econ. Ent.* 40:148. 1947.

WEINMAN, CARL J., G. C. DECKER, AND J. H. BIGGER. Insecticidal Sprays and Dusts for the Control of Grasshoppers. *J. Econ. Ent.*, 40 91-97. 1947.

NEW INSECTICIDES AND THEIR APPLICATION ON CITRUS

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During the past four years a number of organic compounds have been developed for use as insecticides. Some of these are already in use and others are still in the experimental stage. When a new insecticide is to be tested, there are a number of factors to be considered and two or three years of experimental work is frequently required before the material can be recommended for general use. Some of the important questions to be answered are:

1. Toxicity of material to various species of insects and mites?
2. Toxicity, if any, to the tree?
3. Minimum concentration which will give results?
4. Compatability with other materials in combination sprays?
5. Effect on beneficial insect population?

Until the research workers have had time to obtain at least preliminary answers to the above questions, it is not advisable to treat large acreages with any new insecticides.

Some of the new insecticides may have a limited but definite use in combating insects infesting citrus groves. Until recently there was no insecticidal spray or dust that could be used economically for the control of grasshoppers, plant bugs, ants and shothole borers. Now there are several materials which may be used effectively for the control of those insects. Fortunately, the above mentioned insects are not of major importance over a wide area, but any one of the above named group can be of major importance in one or more groves during certain years, and it is at least gratifying to know that there are materials which can be recommended for their control. One or two of the newer compounds may eventually replace some of the insecticides now in use, but only extensive experimental work plus commercial trials can determine their real value.

At the present time the Citrus Experiment Station is working with a number of the newer insecticides but it will take time

before proper recommendations can be made for each of them. In this paper the materials and the results obtained with them are discussed very briefly because a full discussion of any one of them would require the full period.

O,O-diethyl - O-p-nitrophenyl thiophosphate commonly called Thiophos 3422 or Parathion is one of the newer materials that show promise for the control of a wide range of insects infesting citrus trees. This material should not be used generally until it has been tested thoroughly since, according to the manufacturer, 3422 is quite poisonous in the concentrated form and it remains to be seen how toxic it is to human beings in the dilute form. However, there are a number of insecticides now in general use which are poisonous in the concentrated form but not particularly harmful in dilute sprays or dusts and it is hoped that the same will be true of this material.

According to the manufacturer 3422 can not be used satisfactorily in strongly alkaline solutions which limits its use in some combination sprays and much remains to be done in determining the materials it is compatible with and the dilutions needed to kill the various insects to which it is most toxic. Results obtained to date indicate that the toxicity of 3422 to insects is immediate and that it does not seem to have much residual effect.

Preliminary experiments with 3422 indicate that it is effective in killing scale insects. Where one-half pound of the active ingredient per 100 gallons of water was used, purple scale populations were reduced on an average of 81 percent as compared to an increase of 15 percent in untreated plots. Florida red scales were reduced to an average of 70 percent as compared with an increase of 9 percent in the check. Citrus mealybugs, on oranges, were reduced 65 percent while they increased 27 percent in the check. Rust mite populations were reduced to a very low level, no mites being observed 20 days after an application of 3422 in two different groves while checks showed a 30 percent infestation. A citrus aphid infestation was reduced 99 percent with only a few living aphids being observed in tightly curled leaves.

Since 3422 kills scales and mites it becomes a potentially important insecticide to citrus growers. Extensive testing will be carried out during the next year to determine the advantages and disadvantages of this material.

Di (4-chlorophenoxy) methane, known as K-1875 is one of the newer organic compounds which looks very promising for the control of purple mites. In 1946 Jeppson (3), in California, reported that concentrations of one pound per 100 gallons of spray or 4 percent or more of the active ingredient in dusts gave satisfactory control in preliminary field tests. Results of preliminary field experiments at the Citrus Station indicate that 0.8 to 1.0 pound of the active ingredient per 100 gallons of spray was as effective as DN Dry Mix (40 percent dinitro-o-cyclohexyl phenol) at 2/3 pound per 100 gallons. Where thorough coverage was obtained no living purple mites were observed for at least 12 weeks after single application of K-1875 at either 0.8 or 1.00 pound per 100 gallons. This material is one of the few newer organic compounds which is effective in alkaline solutions, consequently it was combined experimentally with a number of the combination sprays commonly used on citrus. It was found to be effective combined with the following: (1) Lime-sulfur; (2) lime-sulfur and wettable sulfur; (3) lime-sulfur, zinc sulfate and wettable sulfur; (4) zinc sulfate, hydrated lime and wettable sulfur; (5) zinc sulfate, borax, hydrated lime and wettable sulfur; and (6) zinc sulfate, neutral copper, hydrated lime and wettable sulfur.

Young citrus foliage appeared to be more tolerant to K-1875 than to DN but more tests will be necessary before definite conclusions can be drawn. Experimental work is being continued with this material in both sprays and dusts.

Diphenyl trichlorethane or DDT. The

use of DDT on citrus in Florida will probably be limited because of the toxic effect on beneficial insects. Griffiths and Thompson (3), 1947, reported increases of Florida red scales following 1 to 2 applications of DDT combined with either sulphur or an oil emulsion. It was concluded that the increase of red scales was a result of practically eliminating the Florida red scale parasite: (*Psudohomalapoda prima* (Gir) and *Prospaltella aurantii* How.) and the twice stabbed ladybeetle. Where DDT had been applied combined with an oil emulsion for two consecutive years there was an average of 200 red scales per leaf as compared to 1 scale per leaf where the DDT had been omitted in the oil spray. No parasites were observed in scales where the DDT had been used while there were 35 parasitized scales to every 100 living scales where oil alone was used. Citrus mealybugs and purple mites also increased following DDT sprays.

Osburn (4), 1945, reported satisfacory control of the little fire ant (*Wasmannia auropunctata* (Roger) when he sprayed the trunks and main limbs with a DDT-fuel oil emulsion.

The use of DDT for the control of shothole borers in citrus was reported by Thompson (5), 1945. The entrance of the beetle into the trunks of the trees was checked by spraying the trunks with DDT at the concentration of one ounce of DDT in 1 gallon of water. Dead beetles were found at the base of treated trees when the last inspection was made two weeks after treatment.

Benzene hexachloride or BHC has been found to be effective in controlling grasshoppers, plantbugs, citrus aphids and to some extent ants, but it was not effective where applied for the control of purple mites.

BHC should not be used in sprays or dusts containing hydrated lime but it can be combined with pyrophyllite, clays, talcs and sulfur. BHC has a heavy musty odor which may be detected in the grove several days after an application. At present it is not recommended that BHC be sprayed or dusted on trees from the time the fruit has set until September 1 since in some instances where trees were dusted or sprayed during the summer an "off-taste" was detected in some of the oranges when they ripened. The taste was more pronounced when oil had been combined with BHC in the spray. No bad flavor has been detected when BHC was applied as a dust or spray after September 1st. It should never be combined with an oil emulsion if the spray is to be applied on citrus trees carrying fruit. The taste of BHC was very noticeable in oranges six months after an application of BHC-oil emulsion spray.

BHC contains several isomers but the gamma isomer has been found to be the most potent as an insecticide. Growers should become familiar with the term gamma isomer because the insecticidal potency of BHC is reported as the percentage of the gamma isomer in the material. For instance, a 50 percent wettable BHC material containing 10 percent gamma isomer is more potent than a 50 percent wettable material containing 6 percent of the gamma isomer.

The most extensive use of BHC in citrus groves has been for the control of grasshoppers. Griffiths et al. (1947) found that BHC dust containing 1 percent of the gamma isomer and applied at the rate of 45 pounds per acre was effective for grasshopper control. The dust should be applied uniformly on the cover crop and portions of the trees that are infested. Fifty percent BHC wettable material containing 6 percent gamma isomer was effective when used at 1.5 pounds per 100 gallons and applied at the rate of 500 gallons per acre.

Satisfactory control of the citron plant bug infesting oranges was obtained with a spray containing two pounds of a 6 percent gamma isomer wettable BHC per 100 gallons of water. It is possible that a more dilute spray may be effective but until more tests are made, it is recommended that the above dilution be used. A dust containing

1 percent of the gamma isomer was also effective.

Citrus aphids were controlled with a spray containing 2 pounds of a 6 percent gamma isomer in 100 gallons of water. Equal results were obtained when BHC was combined in a spray with a neutral copper and wettable sulfur. Although no tests for residue were made, aphids did not reinfest the portion of the grove where BHC was applied as soon as they did where a rather volatile material was used. A very thorough coverage of infested leaves is necessary for aphid control when BHC is used. In one grove where some of the leaves had been curled by the aphids before the spray was applied, there was a very low percentage of the aphids killed in curled leaves which emphasizes the need for thorough coverage.

Purple mites were resistant to the toxic effect of BHC. Within a few days after the spray, mites were as numerous in the BHC treated plots as in the untreated ones.

Certain species of ants found in groves were killed by BHC dust but where ant hills were treated with 1 percent BHC dust, some ants were killed but in some cases the whole colony was not killed and it became active again.

Chlordane is a chlorinated hydrocarbon which will probably be used for the control of several species of insects. It is formulated in stable emulsions, wettable powders and in dusts. Alkaline materials should not be used as carriers for chlordane because they will reduce its toxicity.

Chlordane has been tested most extensively in Florida for the control of grasshoppers. Griffiths et al. (2), 1947, reported satisfactory control with a 5 percent dust applied at the rate of 30-40 pounds per acre in groves and 20 to 30 pounds in open fields or 1 to 2 year old groves. Control was also obtained with a 50 percent wettable material used at a concentration of .6 pound per 100 gallons of water and applied at the rate of 500 gallons per acre in the grove. In open fields or in young groves it is recommended that the dilution be increased to 1.6 pounds per 100 gallons and applied at the rate of 125 gallons per acre.

The citron plant bug, *Leptoglossus gonagra,* which sometimes attacks citrus was controlled with the same dosage of chlordane as was used for grasshopper control.

Until recently it has been difficult to control ants which nest at the base of a tree. A 2 1/2 percent chlordane dust has resulted in 90 to 95 percent control of the common species of ants found in groves in the central part of the state; however, when a 5 percent dust was used, all treated colonies were killed out or at least there was no evidence that the colonies became active again. A dust containing 2 1/2 percent chlordane and 10 percent DDT has also resulted in a 100 percent control of ant colonies. The best method of killing out a colony of ants around the base of a tree is to mix a small amount of chlordane dust with the top inch of soil where the ants are working and then sprinkle an additional amount over the top of the soil and around the base of the tree. Where the ant hills are out in the open, a small amount of dust sprinkled in the crater shaped entrance of the hill is sufficient. Injury by ants to young trees was reduced during the winter by sprinkling some chlordane - DDT dust around the base of the tree at the time the tree was banked. In some cases the ants made a nest near the top of the bank and in such cases the dust was placed around the trunks of the tree about one inch below the top of the bank. The leaf eating or agricultural ants can be controlled by sprinkling the chlordane dust over the whole surface around the entrance of the nest.

Chlorinated camphene is another of the new chlorinated hydrocarbons. It is being sold as a dust, a wettable powder and as an emulsified material. Tests for its usefulness on citrus have been limited to the control of grasshoppers and leaf footed plant bugs. Griffiths et al. (1947) reported

that it gave satisfactory control of the bird grasshopper at 35 to 45 pounds of a 10 percent dust per acre, or when used as a spray at 3.5 to 4.5 pounds of the active ingredient per acre. Only preliminary work has been performed on the leaf footed plant bug but a 20 percent dust at 25 pounds per acre showed favorable results.

Hexaethyl tetraphosphate or HETP has been tested for the control of citrus aphids and purple mites. HETP is very volatile and should be used as soon as it is mixed as a dilute spray. It has no residual effect as a spray and should never be combined in sprays containing lime. Precautions should be taken to prevent the concentrated material from coming in contact with the skin.

In experimental tests HETP (100% active ingredient) used at 1-1600, reduced citrus aphids populations 93 to 96 percent where the leaves were not curled. Where it was used in a commercial grove, a medium infestation of citrus aphids was reduced to a very low level.

Where HETP was applied at a concentration of 1-1600 for the control of purple mites, a high percentage of the active mites were killed but, within a week after the application, 9 percent of the leaves were infested with young mites as compared to no mites where a more effective material was used. A month following the application there was no difference in the populations in the treated and untreated plots.

LITERATURE CITED

1. GRIFFITHS, JR., J. T., AND W. L. THOMPSON. The use of DDT on citrus trees in Florida. *Jour. Econ. Ent.* 40:386. 1947.
2. GRIFFITHS, JR., J. T., J. R. KING AND W. L. THOMPSON. Grasshopper control in citrus groves in Florida. *Proc. Fla. State Hort. Soc.* 1947. (in press).
3. JEPPSON, LEE R. Di (4,chlorophenoxy) Methane for control of citrus red mite. *Jour. Econ. Ent.* 39:814. 1946.
4. OSBURN, M. R. DDT to control the little fire ant. *Jour. Econ. Ent.* 38:167-168. 1945.
5. THOMPSON, W. L. Control of the shothole borers in citrus trees. *The Citrus Industry* 26 (12). 1945.

COUNT ODETTE PHILLIPPI, – A CORRECTION TO FLORIDA'S CITRUS HISTORY

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All the accounts of the introduction of grapefruit into Florida with which the writer is familiar recount that the man primarily responsible was "Don Phillippi, a Spanish Nobleman." No account of his antecedents or how he came to choose the region of Safety Harbor on old Tampa Bay have appeared in any of the accounts that have come to the writer's attention. It came therefore as a surprise, and a distinct shock, to read an authoritative account of this man's career in a newspaper article and to learn that he was no Spaniard but a Frenchman and one of a famous family with an important place in French history.

Col. D. B. McKay has been running a series of most interesting articles in the Sunday edition of the Tampa Tribune, articles dealing with the early history of Tampa and the surrounding territory. A newspaper man of long experience, several times Mayor of Tampa, and a student of history, his articles are on a plane far above the common run of reminiscent anecdotes. In the issue of Dec. 29, 1946, he gives a detailed account of this famous Frenchman to whom Florida is so much indebted. His career is so eventful, and truly romantic as to furnish the theme for a historical novel