Glover's scale, and citrus snow scale. Emergents from these hosts have been sufficiently variable to warrant separate treatment even though, as stated by Compere (1955), the parasite has not lost its specific distinctness. See Table 1 for characters.

Adult females are yellow with narrowly dusky thoracic sterna, Figure 5. Males are common and have a distinct stippling on the venter of the abdomen. Pupae are pale yellow with a duskiness on the margins of the thorax and at the tips of the wing pads. The venter of the thorax, between the legs, is dark and the venter of the abdomen is marked with a dark longitudinal bar that is wide and distinct on the anterior sternites and narrow but usually distinct on the posterior sternites.

DISCUSSION: This species was first recognized from citrus snow scale in Florida, Muma *et al.* (1961). At the same time, 4♂s and 1♀ were reared from Florida red scale but were not recognized as conspecific with the specimens from citrus snow scale. In the summer of 1963, specimens reared from Glover's scale were immediately identified as this species, and reexamination of the Florida red scale rearings resulted in their assignment here. Recently, 2 typically marked pupae have been taken from chaff scale.

Incidence in all hosts is presently too low and sporadic to evaluate. This is the only species of *Aphytis* on Florida citrus that does not readily and effectively attack 1 of the 9 species of armored scale insects known to infest citrus in the state. It is possible that a preferred or primary host of the species is not present on citrus or, as indicated by DeBach and Sisojević (1960), temperatures in Florida may not be favorable for the development of large populations.

DISTRIBUTION: There are many slides of this parasite in our collections. It has been recorded during all seasons but only in the northern and central districts.

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USING CONCENTRATED SPRAYS ON FLORIDA CITRUS

DON S. BRYAN[1]

Concentrated sprays are a medium whereby citrus production costs may be held or reduced. They can be used effectively and with relative ease using the knowledge, materials, and machinery now at hand.

Most citrus producers have used concentrated

[1]Grove Production Manager, Lake Garfield Nurseries Co., Bartow.

sprays. Consider one of the routine practices followed in citrus spray operations. Recommendations call for 25 pounds of wettable sulfur per 500 gallon tank and a sprayer speed of 1½ mph. There is another way of doing the job, and in most cases equally as well, at quite a reduction in cost. This is by using 50 pounds of wettable sulfur per tank and traveling at a speed of 3 mph. This is a form of concentrate spraying. Almost every grower has sprayed in this manner.

Today, concentrate spraying has advanced somewhat beyond this stage. Growers using concentrated sprays are indebted to the research men of the Florida Citrus Experiment Station at Lake Alfred for the original good work done on concentrated sprays for Florida citrus in the late 1940's and through the years since then. The report at the conclusion of these experiments was that there was no significant difference in control of certain citrus pests caused by the use of concentrated sprays as compared to dilute sprays. There was no difference in grade or external quality of the fruit attributable to concentrated sprays, (1, 2, 3). These concentrate sprays were applied at one eighth the gallonage and six times the normal concentration of materials.

Why use concentrated sprays on Florida citrus? They are used to give as good or better pest control at a reduced cost. The author has been using concentrated sprays fourteen years and has not used dilute sprays since 1952, except as a check. This is done regularly.

Much progress has been made in the use of concentrated sprays, mainly due to these several things: (1) The need for the grower to minimize costs; (2) The development of new and better spray materials; (3) Research on the use of materials and the machines (including nozzles) with which concentrated sprays might be applied.

There are several types of equipment now being used to apply concentrated sprays to Florida citrus. These are (1) fixed wing aircraft, (2) helicopters, (3) especially built air-blast type concentrate spray machines, and (4) the standard air-blast type spray machines modified for concentrate spraying.

The author's experience has been with the standard air-blast type machines equipped with volutes and modified to use concentrated sprays. In order to simplify the use of one concentration during one spray period, and then shifting to another during another spray period, the author has preferred to reduce the amount of material in the tank by 25 percent rather than extend the range of the spray machine 25 percent as is done by the Citrus Experiment Station. For instance, when using 6X concentrate, six times as many rows or trees are sprayed with a 500 gallon tank of spray mix as formerly sprayed with dilute (1X). This might be called Volume Concentration.

Most growers wanting to try concentrate spraying with the standard air-blast type spray machine, will want to concentrate on the volume basis, reducing the amount or percent of material in the tank according to the concentrate used and the acreage covered. Thus, direct comparisons may be easily made between dilute (1X) and any of the various concentrations in a grower's own grove under his particular conditions. This comparison is most important. It is best not to wonder a month, six months or a year after spraying whether the spraying operation has been carried out in the best or most economical way, because it is easy to make direct comparisons using volume concentration. Education is a matter of experience, and experiences and conditions vary from place to place and time to time. The author has been convinced of the usefulness of concentrated sprays and feels that you will be if you are not now using them.

In years past when using dilute (1X) sprays the grower's thinking regarding rate of application has been in terms of gallons per tree needed for good visual coverage. When using more concentrated sprays it has been found that, with the exception of visual observation of the spray pattern as the spray is emitted from the spray machine, it is rather difficult to observe the deposit or coverage of certain spray materials on the tree. For this reason and due to the fact that the concentrated sprays are more efficient due to lack of run-off and other factors not yet fully determined it has been found that growers using concentrated sprays are now thinking in terms of (1) rows per tank, (2) acres per tank, and (3) spray material per acre.

Good records are important in any grove spraying operation and the use of concentrate sprays does not lessen the need for good records. As a grower proves for himself the usefulness of various concentrate sprays as compared with dilute in his spray operation, good records become increasingly important to prevent false conclusions. It is good to know what has been done, when and where, under what conditions, and why.

Some of the record forms which the author uses as aids to concentrate spraying are shown in Table I.

Factors Affecting The Successful Application Of Concentrate Sprays Using The Standard Air-Blast Type Spray Machine

GENERAL

1. The spray materials used are both liquids and wettable powders. Obviously the liquids are preferred but very little difficulty has been experinced using wettable powders when proper mixing procedures are followed.

2. When mixing, it has been found that a good mix is obtained if the spray material is passed through a strainer into the supply tank. Continuous agitation should be maintained during the mixing and transfer and while in the spray machine.

3. Proper clean-up of equipment is important. Rusty or dirty tanks should be thoroughly cleaned.

4. The cooperation of the supply truck driver and the spray machine operator is important, both in dilute and concentrate spraying. In addition to mixing and hauling spray material the supply truck driver can be of help to the spray machine operator by (1) watching for proper air control in reaching the top of the trees, (2) watching to see that there are no stopped nozzles, and (3) helping to check the speed and output of the machine.

5. Spray machine speeds—Experiment Station recommendations of 1 to 1½ mph for concentrations of 1X to 10X, 1 mph on scalicides and 1½ mph on the post bloom spray are satisfactory. From concentrations of 10X upward however, the author has had to deviate from the present recommendations; and on rust mite and miticide applications usually travel 3 mph. On certain occasions a speed as high as 6 mph has shown satisfactory control and reduced costs.

The Spray Machine

1. Two minor modifications to the standard air-blast type spray machine have been found helpful in concentrate spraying. These are (1) two auxiliary strainers added to the lower end of the spray manifolds—one on each side of the spray machine (strainers should not be too fine but finer than smallest nozzle used) and (2) an auxiliary bypass line from the top of each spray head manifold back to the tank. (⅜″ copper tubing and a shut-off valve for each by-pass line is satisfactory). These modifications help prevent sedimentation in the pipe when using high concentrations of spray materials other than liquids.
2. Concentrate nozzles with swirl plates should be used in the machine. Nozzles should be set up to give the heaviest concentration of spray material in the thickest part of the tree . . . for older trees ⅓ of the nozzles low and ⅔ high.
3. Resistor type spark plugs on sprayer power plants have been found best for continuous operation on gasoline.
4. Molybdenum or Lithium base grease gives long life to the pump bearings and packing.
5. For the tank lining, fiberglassing or epoxy painting of old tanks after sand blasting has been satisfactory. Stainless steel or perhaps whole fiberglass tanks would prove superior.

Factors Affecting The Rate Of Spray Application

Some of the factors affecting the rate of spray application are:

1. The number and size of the nozzles and swirl plates—these components wear and should be replaced as needed.
2. The pressure of the pump should be constant —slipping belts and improper impeller clearance can cause variation from calculated output. Some adjustment of out-put is possible by opening or closing the main by-pass valve.
3. The rpm of the sprayer engine should be checked periodically. (Machine should be operated at full governed R.P.M.)
4. Strainers should be cleaned and checked at least once daily.
5. Spray leaks in the system affect the rate of application and do not put the material on the tree where it is wanted.

TABLE I - GROVE SPRAY RECORDS

GROVE INSPECTION SHEET

Grove	Variety	Rust Mite	Red or Tex.C.Mite	6 Spotted Mite	Snow Scale	Purple or Red Scale	Black or Yellow Scale	White Fly	Mealy Bug	Melanose - Scab	Greasy Spot	Comments	Sprouts	Pruning	Date

SPRAY LIST

Grove	Variety	Conc.	Formula	Estimated Tanks	Tanks Used	Rows per Tank	S or D Head & Mach.No.	MPH	Date Applied

SPRAY CARD

_________________ COMPANY

DAILY SPRAYING RECORD

MACHINE NO. _________________ OPERATOR _________________

GROVE _________________ DATE _________________

VARIETY	FORMULA	ROWS PER TANK	TANKS USED
		TOTAL TANKS	

TABLE II

FACTS AND FIGURES NEEDED FOR CONCENTRATE SPRAYING

1 mph	=	15 min/40A
$1\frac{1}{2}$ mph	=	10 min/40A
2 mph	=	7.5 min/40A
3 mph	=	5 min/40A
6 mph	=	2.5 min/40A

6. The ground speed of the machine should be a pre-determined constant speed. Speed is easy to check by using a pocket or wrist watch with a second hand.

TABLE III

SPRAY DISC OUT-PUT

Nozzle Disc No.	Orifice Size (inches)	Capacity in Gallons per Minute at pressures of 40*	60*	80*	100*
2	.041	.16	.19	.22	.25
3	.047	.19	.23	.26	.29
4	.063	.29	.35	.40	.45
5	.078	.35	.42	.48	.54
6	.094	.44	.54	.62	.70
7	.109	.52	.63	.73	.81
8	.125	.61	.75	.89	.97
10	.156	.76	.96	1.07	1.21

*pounds per square inch

Using Standard Air-Blast Type Spray Machine

The author feels that the minimum gallonage and nozzles for good coverage using a double head standard air-blast type spray machine is 6.66 gallons per minute or about 24 nozzles, 12 on each side of the machine. This will give a spraying time per tank of approximately 75 minutes.

Simple Sprayer Calibration Procedures

To calibrate the spray machine to find out if its output per minute is above or below the standard output table at a given pressure:

A. Start by determining (1) the number of rows wanted to spray per 500 gallon tank of spray material. Assume spraying 3 rows across 40 acres, (3/40), (2) determine the minutes required to spray this number of rows at the speed desired. In this case assume setting up for a scale spray and traveling 1 mph; then 15 minutes x 3 rows = 45 minutes per tank. (3) Divide the total minutes into 500 gallons. This will give the gallons per minute output—11.11 gallons per minute. (4) Put the proper number of nozzles and size discs (as determined from Table III) into the spray machine. At 80 pounds pressure this would be 6 No. 4 nozzles and 18 No. 5 nozzles, the calculated output for these 24 nozzles being 11.04 gallons per minute which is about as close as one can get to the desired gallonage output of 11.11 gallons per minute.

B. (1) Fill the tank with 500 gallons of water; (2) crack the main by-pass valve; (3) rev the engine up to full governed rpm; (4) open the spray valves and check for leaks—in pipes, around nozzles and strainers. When all leaks are stopped: (5) fill the tank with water again; (6) determine the spraying time necessary to empty the tank. If the spraying time is 45 minutes the machine is properly calibrated. If the spraying time is 47 minutes the machine output is approximately 4% under the proper output and this should be taken into consideration when calculating nozzle needs for various setups in the future.

In spraying operations for the past several years the author has used several different spray concentrations. Some concentrations are preferred at one time of year and under certain conditions while others are preferred at other times. Some materials are more dependable or desirable at one concentration than another. No attempt will be made here to show all the materials used nor all the materials that may be concentrated.

Table IV shows several commonly used spray materials with the Experiment Station recommendations for their use when spraying dilute 1X or 6X if the material is reduced for 6X by 25%. The other concentrations have been worked out through the years. The amount of material per tank and per acre used in the higher concentrations was determined by consulting with those who have had experience with aerial applications on citrus and other crops, mathematical calculations and field trials. In light of the findings at the Citrus Experiment Station that with 6X concentrate 25 to 50% more spray material was deposited per tree, the further reduction of materials at 10X, 20X and 40X is realistic.

TABLE IV

CONCENTRATING MATERIALS PER 500 GAL. TANK

(Dilute)	1X	2X	4X	6X	10X	20X	40X
Wettable Sulfur (Pounds)	25 50	50 100	81.25 162.5	112.5 225.	141 282	282 562	563 ---
Chlorobenzilate (4E) (Pints) (Rust mite)	1.25	2.5	4.06	5.625	7.5	15	30
Ethion (4) Summer (Pints)	3.75	7.5	12.25	17.0	21.25	42.5	85
Oil 85% (1.3%) Application (Gallons)	7.8	15.6	31.2	46.8	---	---	---
Oil 99% (1.3%) Application (Gallons)	6.6	13.2	26.4	39.6	---	---	---

6X Calculated by multiplying 1X material by 6 and reducing 25%.
40X Calculated by multiplying 6X material by 5, (usually not practical because of speed).

20X Calculated by taking one half of 40X material.
10X Calculated by taking one half of 20X material.
4X Calculated by taking one half the difference between 2X and 6X materials.
Oil Calculations are straight line calculations with no reductions for concentrate. Reductions have been made with success.

TABLE V

COST OF MATERIAL TO SPRAY 20 ACRES (MATURE HEDGED GROVE)
(Calculations Based on 2 Tanks per Acre Dilute (1X) Application Rate)

	1X	2X	4X	6X	10X	20X	40X
Wettable Sulfur (3.5¢#)(Dollars)	35.00 70.00	35.00 70.00	28.42 56.81	26.22 52.44	19.74 39.48	19.74 39.48	19.74 -----
Chlorobenzilate (4E) (Dollars) (Rust mite) $1.80 pt.	90.00	90.00	73.00	67.43	54.00	54.00	54.00
Ethion (4) Summer $1.26 pt. (Dollars)	189.00	189.00	154.35	142.66	107.10	107.10	107.10
Oil 85% (1.3%) Application .32¢ gal. (Dollars)	98.64	98.64	98.64	98.64	----	----	----
Oil 99% (1.3%) Application .58¢ gal. (Dollars)	153.12	153.12	153.12	153.12	----	----	----
Approximate % Savings in material	0	0	19%	25%	40%	40%	40%

Table V shows several spray material costs and savings possible on a 20 acre grove when using various concentrations from 1X to 40X. Note that savings can run as high as 40% in some instances.

Table VI indicates the comparative labor and machine costs of spraying a 20 acre grove at 1X to 40X concentrations. Note the last line of the table. If Table V (Cost of Material to Spray 20 Acres) and Table VI (Labor and Machine Costs 20 Acres) are combined it is possible to determine the total cost of spraying this 20 acre grove at various concentrations.

As an example—to spray this grove dilute 1X (as per standard recommendations) with Ethion would require $189.00 worth of material, plus labor and machine costs of $280.00 for a total cost of about $469.00
6X cost would be $142.66 for material, plus $133.20 labor and machine costs for a total of $275.86
20X cost would be $107.10 for material and $40.00 for labor and machine costs, for a total of $147.10

The author would not imply that he believes that the preceding tables and comments are absolute or final. For instance, it has been rather difficult to determine the actual cost of spraying a tank of dilute spray. In talking with growers, caretakers and Extension personnel about this cost the figures quoted were from $5.00 to $9.00 a tank. For use in Table VI a moderate figure of $7.00 a tank was chosen. The cost per tank figures for 2X through 40X are the author's figures derived from careful cost calculations. For commercial use some additional charges will be in order.

Table VII indicates the spray machine time involved in spraying a 20 acre grove at concentrations of 1X to 40X. This table has been prepared mainly for stimulative thinking. As growers investigate why their spraying costs vary at different concentrations and speeds and under various conditions it is hoped that they will continue to look for other ways to do a good job and minimize costs. The purpose for which the table has been prepared has been accomplished to some degree through the observation that one of the big cost factors when using the lower concentrated sprays is that of sprayer fill-up time. The author has enlisted the aid of agricultural engineers at the University of Florida and the Citrus Experiment Station to help with this problem by asking them to provide the citrus grower with a good in-transit spray machine loading system.

Conclusion: Concentrated sprays have been used on citrus groves under the author's care for fourteen years. They have been used to give as good or better pest control at a reduced cost. It is the author's belief that through the judicious use of concentrate sprays most growers will be able to hold or more likely, reduce the cost of production to some degree while continuing to improve the external quality of their fruit.

TABLE VI

LABOR AND MACHINE COSTS 20 ACRES (MATURE HEDGED GROVE)
Double Head

	1X	2X	4X	6X	10X	20X	40X
Speed (MPH)	1½	1½	1½	1½	1½	3	6
Acres Per Tank	0.5	1	2	3	5	10	20
Tanks Per Acre	2	1	0.5	0.33	0.2	0.1	0.05
Gallons Per Acre	1000	500	250	166.66	100	50	25
Tanks Per 20 Acres	40	20	10	6.66	4	2	1
Cost Per Tank (Dollars)	7.00	10.00	17.00	20.00	25.00	20.00	30.00
Cost Per Acre (Dollars)	14.00	10.00	8.50	6.66	5.00	2.00	1.50
Cost Per 20 Acres (Dollars)	280.00	200.00	170.00	133.20	100.00	40.00	30.00

TABLE VII

SPRAY MACHINE TIME INVOLVED IN SPRAYING AT VARIOUS CONCENTRATIONS

(Based on a Mature Hedged 20 Acre Grove)

	1X	2X	4X	6X	10X	20X	40X
Choice of Speeds Miles Per Hour	1½ 1	1½ 1	1½ 1	1½ 1	1½	3	6
Rows Across 20 Acres to a Tank	3/4	1.5	3	4.5	7.5	15	30
Acres Sprayed Per Tank	0.5	1	2	3	5	10	20
Tanks Required to Spray 20 Acres	40	20	10	6.66	4	2	1
DOUBLE HEAD							
Spraying Time per Tank Double Head (in minutes) *	7.5 11.25	15 22.5	30 45	45 67.5	75	75	75
Gallons per minute Out-Put *	66.66 44.44	33.33 22.22	16.66 11.11	11.1 7.41	6.6	6.6	6.6
Total Spraying Time 20 Acres in Minutes *	300 450	300 450	300 450	300 450	300	150	75
Spraying Time Plus 6 min. Per Tank Fill up Time *	540 690	420 570	360 510	340 490	324	162	81
SINGLE HEAD							
Spraying Time per Tank Single Head (in minutes) *	15 22.5	30 45	60 90	90 135	150	150	150
Gallons Per Minute Out-Put *	33.33 22.22	16.66 11.11	8.33 5.55	5.55 3.7	3.33	3.33	3.33
Total Spraying Time 20 Acres - in minutes *	600 900	600 900	600 900	600 900	600	300	150
Spraying Time Plus 6 min. Per Tank Fill-up Time *	840 1140	720 1020	660 960	640 940	624	312	156

* Lower figure represents lower speeds required for scalicides.
Upper figure represents faster speeds for other sprays.

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EFFECT OF CLIMATE OF FLORIDA AND ARIZONA ON GRAPEFRUIT FRUIT ENLARGEMENT AND QUALITY; APPARENT TRANSPIRATION AND INTERNAL WATER STRESS[1]

R. H. HILGEMAN[2]

ABSTRACT

Fruit enlargement rates, changes in physical characteristics and water relationships were followed between July and November in Florida in 1964 and in Arizona in 1965.

In Florida, due to summer rains and clouds, relatively uniform fruit enlargement rates were maintained. With soil water below 10 cbs. tension, heavy rains increased enlargement rates and intensified internal pressures on the peel. In Arizona, blossoming was 45 days later, fruit was only ⅓ as large as Florida fruit on July 1 but grew more rapidly. Fruit enlargement rates varied widely between irrigations. Internal pressure on the peel was low.

In Florida, continuously high soil water and low internal water deficits in July, August and September apparently induced high juice content and thin peel. The high juice content resulted in lower solids and acid percentages than found in Arizona.

On sunny Florida days, apparent transpiration was similar to Arizona, although atmospheric vapor pressure deficits were about 3 times higher in Arizona; internal water deficits were markedly higher in Arizona.

[1]University of Arizona Agricultural Experiment Station Journal Series paper No. 1173.

[2]Horticulturist, University of Arizona Citrus Experiment Station, Tempe, Arizona. The author was employed as collaborator by the USDA, ARS Crops Research Division at Orlando, Florida, during 1964, while on Sabbatical leave.

INTRODUCTION

'Valencia' oranges grown in Florida have a thinner peel and more juice but lower percentages of acid and total soluble solids than Arizona fruit (3). Similar differences in grapefruit are indicated by maturity studies (6) (8). These differences have been associated with the widely different climatic conditions (3). However, detailed comparisons of the responses of trees to each environment have not been made, except with trunk growth of 'Valencia' oranges (4). This investigation was designed to evaluate responses associated with typical commercial trees, grown with normal culture practices in each area. It is recognized that differences in soils, stocks and cultural practices, particularly use of arsenical sprays, influence tree responses and fruit characteristics, as well as climate.

This report compares the effects of climatic conditions in the 2 areas on (A) fruit enlargement rates and physical and chemical characteristics; (B) apparent transpiration from leaves and internal water deficits.

MATERIALS AND METHODS

Five large, vigorous 'Redblush' grapefruit trees on rough lemon stock, about 18 years old, were selected in a commercial grove growing on fine sand soil, about 11 miles south of Winter Garden, Florida. Trees received adequate fertilization and insect control and were sprayed with arsenical materials. Irrigation was with