control of this weed pest. The plant, like most members of the milkweed family, is apparently unpalatable to most animals and insects. A mildew-like disease, orange colored aphids and pod beetles have been observed on the vines at times. However, none of these appear to be of commercial importance. Cooperating agricultural agencies in areas of South America from which the vine originates have been requested to report any natural enemy which may be keeping it under control effectively.

The milkweed vine is a most dangerous weed and continues to pose a very serious threat to the citrus industry. All growers are, therefore, encouraged to embark on a long-term program of control, be it mechanical, chemical, or a combination of both. The expense of treating large areas in mature groves with herbicides and the prospect of re-infestation from adjoining groves may be discouraging, however, both expense and effort is entirely justified when the consequences are considered. For those growers not presently plagued by this pest, its inclusion in the grove inspection check list is sound advice. Removal of the entire plant is essential, using hand labor if necessary, as individual vines appear. Satisfactory results from a weed control program are always more assured if the vines are treated at an early stage of development. It is not expected that this vine will be eradicated in the near future but a concerted effort by *all* growers at its control and curtailment of its spread will go a long way towards this end.

The authors are devoting a considerable amount of time to the control of this weed and solicit the cooperation of growers in developing an overall program of control.

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FIELD TESTING AIRBLAST SPRAYERS FOR FLORIDA CITRUS

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Abstract

An experiment conducted in a 35-acre 'Pineapple' orange grove compared 6 low volume sprayers with a standard dilute sprayer in the application of a citrus spray program. The overall superiority of the dilute sprayer was demonstrated in this experiment. The dilute sprayer and the S.S. 607 Hi-con provided significantly longer citrus rust mite control than the RSM, S.S. 757 at 6X, 1/8th gal and 3X, 1/4th gal at 2 mph. A significantly higher percentage of fruit were damaged by scale insects from plots sprayed by the Myers 2A42 and the S.S. 607 Hi-con. Melanose control was poor in plots sprayed with the RSM and Myers 2A42 sprayers.

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Introduction

Methods of pesticide application are often overshadowed by reports on the effectiveness of the pesticides themselves. The thoroughness of application of citrus pesticides is equally as important as the selection of the pesticide. In the case of citrus snow scale control, thorough coverage of all the woody portions of the tree is more important than the choice of a pesticide.

Workers at the A.R.E.C. (Citrus Experiment Station at Lake Alfred) have conducted research on a continuing basis to evaluate the effectiveness of spray equipment offered to the Florida citrus grower. Thompson (3) and King et al. (2) suggested improvements in existing equipment. Brooks (1) reviewed the contributions of various Florida workers in improving application equipment.

In recent years, Florida citrus growers have expressed considerable interest in low volume applications to supplement or replace dilute applications. Whitney (4) suggested reducing gallons per acre as a possible way to reduce application costs. The experiment reported here compared

various types of low volume applications with a standard dilute sprayer in the application of a citrus spray program.

Materials and Methods

The experiment was conducted in a 35-acre block of 'Pineapple' orange trees 16′ to 18′ high planted 20′ x 25′ with average foliage density located near Auburndale, Florida. The experiment was arranged in a randomized block design with the types of applications serving as treatments. Each treatment was replicated 5 times with individual plots 6 rows wide and at least 10 trees long. Sample trees were selected from the center 2 rows with at least a 2 tree buffer at each end of the plot. Data were subjected to an analysis of variance and Duncan's multiple range test at the 5% level.

Pest populations were measured periodically from both top and skirt portion of the sample trees. Citrus rust mite infestations were measured by determining the percentage infested in samples of 25 leaves and 25 fruit randomly selected from around each of 4 sample trees in each plot. Populations of scale insect and whitefly larvae were determined by counting the number of mature female scales and whitefly larvae on 50 leaves picked at random from around the skirt and top of the 4 sample trees.

The sprayers and a description of their types of application are listed in Table 1. Each low volume sprayer applied the same amount of pesticide per acre but in varying amounts of water. However, the dilute sprayer applied 25% more material because of spray run off (1). All applications were made in winds less than 8 mph. The rates of materials and dates of application are shown in Table 2. The nutritional mix listed on this table was custom made to the grove owner's specifications.

Commercial fruit harvesters inadvertently partially picked the grove at the end of the first year and prevented the collection of fruit samples. However, fruit samples were picked at the end of the second year on January 11-12, 1971. Twenty-five fruit were picked at random from around the top and skirt of each of the 4 sample trees per plot. The fruit was examined for citrus rust mite, scale insect, melanose, and injury from wind scarring.

Results and Discussion

Citrus rust mite control was satisfactory with each type of sprayer from the postbloom spray of 1969 to the summer spray of 1970. However, serious citrus rust mite infestations developed after the 1970 summer spray following treatment by some of the sprayers.

The data presented in Table 3 indicate that the dilute sprayer (Treatment 1) and the S.S. 607 Hi-con (Treatment 7) provide significantly longer citrus rust mite control on the fruit in the tree tops and skirts than the RSM (Treatment 2), S.S. 757 at 6X, 1/8th gal (Treatment 3) and 3X, 1/4th gal (Treatment 5). The Myers 2A42 (Treatment 4) was superior to the RSM and S.S. 757 at 6X, 1/8th gal in the tree tops but only better than RSM on the tree skirts.

Table 1. Characteristics of airblast sprayers used in the application of a citrus pest control program, 1969-70.

Make and model	Concentrations used	Number and type of fans	Air volume and velocity	Pump type	Tank type and capacity	Tank agitation
John Bean Speed Sprayer 757 with aux engine	1X, dil 3X, 1/4 dil gal 6X, 1/4 dil gal	One axial	100,000 cfm 90 mph	Centri-fugal	Steel metalized 500 gal	Mechanical paddle
RSM Super 500 with aux engine	15X, 1/20 dil gal	One axial	33,000 cfm 160 mph	Piston	Stainless steel, 500 gal	Mechanical paddle
Myers 2A42 with aux engine	6X, 1/8 dil gal	Two axials	95,000 cfm 80 mph	Centri-fugal	Epoxy coated 500 gal	Mechanical paddle
Kinkelder Royal pto driven	15X, 1/20 dil gal	One centri-fugal	10,000 cfm 180 mph	Centri-fugal	Dipped galvanized, 250 gal	Hydraulic
John Bean Speed Sprayer 607 Hi-con with aux engine	15X, 1/20 dil gal	Two axials	30,000 cfm 130 mph	Piston	Fiber glass 250 gal	Mechanical paddle

Table 2. Application dates, materials, and rates used in testing airblast sprayers in a citrus grove near Auburndale, Florida.

Application date	Materials in amounts per 500 gal dilute spray	Amounts used per acre per application with: Low volume	Dilute
	Parathion 4E, 2.5 pints	5.9 pints	7.9 pints
	Acarol 2E, 2.5 pints*	5.9 pints	7.9 pints
May 5-13, 1969	Nutritional Mix, 46 lb.**	108.3 lb.	144.4 lb.
	Miscible Oil (FC-435) 99%, 5 gal	11.8 gal	15.7 gal
July 14-17, 1969	Acarol 2E, 2.5 pints*	5.9 pints	7.9 pints
Nov. 18-25, 1969	Acarol 2E, 2.5 pints*	5.9 pints	7.9 pints
	Chlorobenzilate 4E, 1.25 pints	3.3 pints	4.4 pints
April 13-16, 1970	Nutritional Mix, 23 lb.**	54.2 lb.	72.2 lb.
	Miscible Oil (FC-435) 99%, 5 gal	11.8 gal	15.7 gal
July 7-10, 1970	Acarol 2E, 2.5 pints*	5.9 pints	7.9 pints
	Acarol 2E, 2.5 pints*		
Sept. 9-10, 1970	(All plots sprayed with Dilute Sprayer)	--	7.9 pints

*Geigy Co. experimental acaricide.

**Nutritional Mix contains copper, zinc, manganese, and boron. Custom formulated and applied to the growers specifications.

The percentage of citrus rust mite infested leaves was generally lower than on the fruit. However, these data also reflected the poorer control provided by the RSM and S.S. 757 at 6X, 1/8th gal. Fruit samples from plots sprayed by these 2 sprayers also had a significantly higher percentage of citrus rust mite damaged fruit as shown by the data presented in Table 4.

Populations of scale insects and whitefly larvae on the leaves generally remained quite low for the duration of the experiment in all plots. However, the data presented in Table 4 indicate a significantly higher percentage of scale insect damaged fruit in the tree tops from plots sprayed by the Myers 2A42 (Treatment 4) and the S.S. 607 Hi-con (Treatment 7) as compared with the dilute sprayer. There also was a significantly higher percentage of scale insect damaged fruit from the skirts of trees sprayed by the S.S. 607 Hi-con (Treatment 7) and the Kinkelder (Treatment 6) sprayers.

Damage to fruit due to melanose was significantly higher in the tree tops of those plots sprayed by the RSM (Treatment 2) and Myers

Table 3. Percent fruit infested with citrus rust mite following summer spray applied on July 7-10, 1970, Auburndale, Florida.

Treatment No.	Sprayer, concentration, gallons per tree, and ground speed	Percent citrus rust mite infestation on:* 7-23-70 Tree top	7-23-70 Tree skirt	8-8-70 Tree top	8-8-70 Tree skirt	8-24-70 Tree top	8-24-70 Tree skirt	9-2-70 Tree top	9-2-70 Tree skirt
1	Speed Sprayer 757 DOV 1X, dilute; 18 gal/tree; 1 mph	0.2a	0.2a	0.2a	0.0a	1.4a	0.8a	1.2a	0.2a
2	RSM Super 500, 15X, 1/20th dilute gal; 0.9 gal/tree; 1 mph	12.8ab	12.4b	7.2a	1.8a	58.6c	38.0c	35.4c	71.6c
3	Speed Sprayer 757 DOV 6X, 1/8th dilute gal; 2.25 gal/tree; 1 mph	17.6b	15.8b	7.0a	4.2a	47.6c	71.0d	65.0d	82.0c
4	Myers 2A42 6X, 1/8th dilute gal; 2.25 gal/tree; 1 mph	4.6a	1.8a	1.2a	0.4a	4.6ab	3.6a	11.4ab	4.2a
5	Speed Sprayer 757 DOV 3X, 1/4th dilute gal; 4.5 gal/tree; 2 mph	5.2ab	7.0ab	0.0a	0.6a	22.2b	23.0b	27.2bc	31.4b
6	Kinkelder Royal 15X, 1/20th dilute gal; 0.9 gal/tree; 1 mph	10.0ab	1.2a	0.0a	0.0a	20.4b	5.8ab	17.2abc	10.6ab
7	Speed Sprayer 607 Hi-con 15X, 1/20th dilute gal; 0.9 gal/tree; 1.5 mph	4.2a	1.6a	0.0a	0.0a	1.4a	1.2a	4.2a	2.6a

*Results of Duncan's test: Treatment means followed by the same letters are not considered significantly different at the 5% level.

Table 4. Percent fruit damaged by citrus rust mite, scale insects, and melanose from plots sprayed by various airblast sprayers.

Treatment No.	Sprayer, concentration, gallons per tree, and ground speed	Percent fruit damaged by:*, ** Citrus rust mite Tree top	Citrus rust mite Tree skirt	Scale insects Tree top	Scale insects Tree skirt	Melanose Tree top	Melanose Tree skirt
1	Speed Sprayer 757 DOV 1X, dilute; 18 gal/tree; 1 mph	9.0a	3.0a	19.6a	0.8a	8.8a	5.8a
2	RSM Super 500, 15X, 1/20th dilute gal; 0.9 gal/tree; 1 mph	57.6d	31.4b	36.4ab	2.8ab	26.6b	12.6a
3	Speed Sprayer 757 DOV 6X, 1/8th dilute gal; 2.25 gal/tree; 1 mph	49.4cd	37.6b	20.6a	4.6ab	16.8ab	13.2a
4	Myers 2A42 6X, 1/8th dilute gal; 2.25 gal/tree; 1 mph	37.4bcd	5.0a	52.0b	7.0ab	24.6b	8.0a
5	Speed Sprayer 757 DOV 3X, 1/4th dilute gal; 4.5 gal/tree; 2 mph	27.8abc	17.8ab	25.8a	7.0ab	9.2a	12.8a
6	Kinkelder Royal 15X, 1/20th dilute gal; 0.9 gal/tree; 1 mph	32.4bc	8.8a	39.6ab	12.0b	19.8ab	15.0a
7	Speed Sprayer 607 Hi-con 15X, 1/20th dilute gal; 0.9 gal/tree; 1.5 mph	23.0ab	5.0a	49.6b	23.0c	11.6a	11.2a

*Fruit harvested on January 11-12, 1971.

**Results of Duncan's test: Treatment means followed by the same letters are not considered significantly different at the 5% level.

2A42 (Treatment 4). However, no significant differences in melanose damage were detected on fruit from the tree skirts. Damage due to wind scarring was not connected with the use of any sprayer.

Mechanical problems were encountered with both the RSM and Kinkelder sprayers. During the 1970 summer spray, the RSM developed intermittent nozzle plugging from particles of unknown origin which persisted throughout the application. Although the sample trees were believed to be thoroughly sprayed, this plugging may be partially responsible for the poor citrus rust mite control. Poor agitation in the Kinkelder spray tank is believed to be responsible for the very heavy deposit of nutritional materials remaining in the tank following both postbloom applications.

The overall superiority of the dilute sprayer in the application of a citrus spray program was demonstrated in this experiment. A considerable amount of effort is still needed by sprayer manufacturers and research workers to develop a sprayer for low volume applications as effective as dilute applications for the Florida citrus grower.

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