SOIL APPLICATION OF SYSTEMIC INSECTICIDES FOR MITE CONTROL ON CHRYSANTHEMUMS

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ABSTRACT

Granular formulations of UC 21149 (Temik[R]), disulfoton (Di-Syston[R]), phorate (Thimet[R]) and CL 47031 were broadcast directly over bedded chrysanthemums. UC 21149 was the only compound that provided good control of the two-spotted spider mite, *Tetranychus urticae* (Koch). The higher rates of CL 47031 reduced the mite population somewhat, but also caused a considerable amount of marginal necrosis.

Rates of UC 21149 as low as 2 lbs active/acre provided very good mite control. Results also indicate that the effectiveness of UC 21149 is considerably reduced when the compound is combined with at least some fertilizers.

INTRODUCTION

Chrysanthemums are plagued with many arthropod pests, but none are consistently as damaging as mites. In discussing the control of mites, Kelsheimer (1957) suggested three foliar applications of recommended miticides be made at weekly intervals and indicated that established and flourishing populations are hard to control. Neiswander (1962) was among the first workers to utilize soil applications of systemic insecticides for mite control on chrysanthemums. His work carried out on potted plants in the greenhouse, showed that phorate and disulfoton protected the plants from mite injury until they were in bloom and ready for sale.

Since soil applications of systemic insecticides usually require fewer applications, provide better control because coverage is not as critical and do not leave residues on the foliage, tests were started with field-grown chrysanthemums.

MATERIALS AND METHODS

Tests were conducted with the cooperation of E. Rossi of Pineland Farms, J. Hoke of Arvida Flowers, Delray Beach, Fla. and E. Miller, Jr. of Miller Farms, Stuart, Florida. Plots consisted of 20 ft sections of 3 ft wide beds. Treatments were replicated four times.

Granular formulations of the compounds were applied directly over the plants with a shaker bottle. Overhead irrigation was utilized to dislodge most of the material that remained on the plants. The materials were not incorporated into the plant beds. Evaluations were made by picking 10 leaves of the same age from each plot and counting the number of mites observed. Except in the first test where a rating system was used, the average number of mites per leaf was used as an index. The mites found were identified as *Tetranychus urticae* (Koch) by H. Denmark, Division of Plant Industry, Florida Dept. of Agriculture.

RESULTS AND DISCUSSION

A preliminary test was initiated on April 19, 1965 to determine the effectiveness of four

Table 1. Mite control resulting from a single application of granular systemic compounds to 12 week old chrysanthemums. Test 1.

Treatment	Lbs AI/a	Average Rating * April 27	Average Rating * May 6
Check		5.37 d**	3.47 d**
UC 21149	10	1.05 a	1.15 a
UC 21149	20	1.00 a	1.07 a
UC 21149	30	1.00 a	1.07 a
UC 21149	40	1.00 a	1.10 a
CL 47031	10	4.55 cd	2.85 c
CL 47031	20	4.12 bc	2.32 b
CL 47031	30	3.27 b	1.95 b
Phorate	20	4.65 cd	3.90 e
Disulfoton	20	5.00 cd	3.32 d

* Rating Scale: 1 = 0 mites per leaf; 2 = 1-4; 3 = 5-9; 4 = 10-24; 5 = 25-49; 6 = 50+

** Duncan's Multiple Range Test. Means followed by the same letter are not significantly different at the 5% level.

Florida Agricultural Experiment Stations Journal Series No. 2535.

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Table 2. Mite control resulting from applications of granular UC 21149 at various dosages and intervals to chrysanthemums planted on Aug. 27, 1965. First insecticide application made on Sept. 16, 1965. Test 2.

Lbs AI/a of UC 21149 per application	Treatment interval	Average No. mites/leaf			
		Oct.		Nov.	
		7	28	11	24
0.0 (check)		1.9	11.2	1.5	0.3
10	1 appl.	0	1.1	6.4	0.8
10	6 wk	0	0.9	0	0
5	3 "	0	0.2	0	0.1
5	4 "	0	0.1	0.1	0
2.5	3 "	0	0.2	0	0.4
2.5	4 "	0	0.1	0.5	0

Table 3. Mite control resulting from applications of granular UC 21149 at 3 dosages and 3 intervals to chrysanthemums planted on Nov. 10, 1965. First insecticide application made on Nov. 24, 1965. Test 3.

Lbs AI/a of UC 21149 per application	Treatment interval	Average No. mites/leaf				
		Jan.			Feb.	
		6	13	21	4	11
0.0 (check)		2.0	5.0	8.5	2.6	3.6
5	3 wk	0	0	0	0	0
5	4 "	0	0	0	0	0
5	5 "	0	0	0	0	0.1
2.5	3 "	0	0	0	0	0.1
2.5	4 "	0	0	0	0	0.1
2.5	5 "	0	0	0	0	0.3

Table 4. Mite control resulting from 2 applications of granular UC 21149 made 5 weeks apart to chrysanthemums planted on Dec. 15, 1965. Test 4.

Lbs AI/a of UC 21149 per application	Average Number mites/leaf							
	Feb.			March				
	11	18	24	3	10	17	25	31
0.0 (check)	0.8	9.5	25.3	23.4	20.5	35.9	91.9	57.7
1.5	0.0	0.3	0.1	0.9	1.0	4.4	8.6	3.9
3.0	0.0	0.0	0.0	0.3	0.5	0.8	0.4	1.3
4.5	0.0	0.0	0.0	0.1	0.4	0.3	0.1	0.4
6.0	0.0	0.0	0.0	0.4	0.4	1.0	2.7	3.6

compounds, two at various dosage levels, on 12 week old plants. Treatments were evaluated on April 27 and May 6. The results are given in Table 1.

Neither phorate nor disulfoton was effective in controlling the two-spotted spider mite. CL 47031 was somewhat effective, particularly at the highest level used, but caused considerable marginal necrosis. UC 21149 provided excellent control at all rates used.

Since UC 21149 was the only material that provided good control, two tests were designed to obtain data on the dosage of UC 21149 needed and the frequency of application necessary to provide control until harvest. The results are given in Tables 2 and 3.

The results of Test 2 show that a single application at 10 lbs active/acre will not provide seasonal control and indicate that a dosage under five lbs applied every 3-4 weeks would probably provide satisfactory control. This was substantiated in Test 3 where 2.5 and 5.0 lb rates were applied on a 3, 4 or 5 week schedule.

Since the mite population was not high in either test it was felt that additional data, obtained under conditions of high population pressure, would be desirable. Thus a fourth test was initiated on chrysanthemums planted on December 15. This test included a dosage series ranging from 1.5-6.0 pounds. Since there were no indications that the control was breaking down on those plots that were treated at five week intervals, only two applications were utilized, the first on January 21, the second on March 3 for the 1.5 lb rate and March 7 for the remaining treatments. The results are given in Table 4.

The results of Test 4 indicate that the 1.5 lb rate is probably not adequate to provide good control during periods of high population pressure. A possible explanation for the counts being higher in the 6.0 lb plots than in the 3.0 or 4.5 lb plots is that all of the 6.0 lb plots were either next to check plots or at the ends of rows, thus being subjected to greater influence from non-treated areas.

Since chrystanthemums are fertilized every 3-4 weeks, the possibility of combining the granular UC 21149 with the fertilizer was considered as a means of reducing application costs. To determine the effects of storage on this combination, a quantity of fertilizer was mixed with the necessary amount of UC 21149 so that both would be applied at the correct rates. This mixture was made up one week before application and also on the day of application. The remaining plots were fertilized two days after the UC 21149 was applied. The fertilizer used was an 8-6-6 with minor elements. The major ingredients were sulfate and muriate of potash, ammonium nitrate, superphosphate and natural organics. The results are given in Table 5.

It is evident that UC 21149 loses much of its effectiveness when mixed with fertilizer at least of this type, and stored for a week. A significant decrease in effectiveness is also noted when the material is mixed and applied the same day.

Table 5. Effects of UC 21149 fertilizer mixtures on mite control when applied to chrysanthemums planted on Jan. 19, 1966. Treatments applied on Mar. 3 and April 7. Test 5.

Lbs AI/a of UC 21149 per application	Average No. mites/leaf			
	Mar. 31	Apr. 7	Apr. 15	Apr. 21
0.0 (check)	81.2	105.1	76.9	21.4
2.0 (a)	6.1	24.6	10.5	21.9
2.0 (b)	3.9	15.3	1.3	0.8
2.0 (c)	1.5	3.2	0.9	0.8
1.5 (c)	3.2	11.2	0.6	0.0
1.0 (c)	8.3	11.5	0.6	0.0

(a) Mixed with fertilizer 1 week prior to application

(b) Mixed with fertilizer on the day of application

(c) Fertilizer applied on separate days

The results of the various tests show that control of the two-spotted spider mite can be obtained until harvest by using two applications of UC 21149, each at 2-3 lbs active/acre; the first 3-4 weeks after putting the plants in the beds and the second five weeks later. Applications should be made several days before or after fertilizer applications. Iceberg, Yellow Iceberg, Shasta, Yellow Shasta, Dillon Beauregard and Bluechip varieties have been treated with rates up to 10 lbs active per acre without any injury.

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IN-THE-ROW AND BROADCAST APPLICATIONS OF SOIL FUMIGANTS FOR GLADIOLUS FLOWER PRODUCTION[1]

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ABSTRACT

Broadcast applications of Vorlex-201 and Vorlex at the rate of 35 gallons per acre increased gladiolus flower production 107 and 85 percent, whereas in-the-row applications (at 1/5 the broadast rate) yielded 41 to 67 percent, respectively, over the untreated controls. The test area was heavily infested with *Fusarium oxysporum* f. *gladioli*, *Stromatinia gladioli*, rootknot (*Melodidogyne incognita acrita*), sting (*Belonalaimus longicaudatus*), *stubby-root* (*Trichodorus christiei*) and stunt (*Tylenchorhyn-*

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[1]Florida Agricultural Experiment Stations Journal Series No. 2531.

chus capitatus) nematodes, and weeds such as Bermudagrass (*Cynodon dactylon*) and purple nutsedge (*Cyperus rotundus*).

INTRODUCTION

Intensive cropping of sandy soil to gladiolus impairs crop production through the accrual in the soil of nematodes, soil-borne disease organisms, and weeds. Often in the past growers have migrated from newly cleared areas at the end of the third crop season to escape those soil pests. The search for virgin uncultivated land has thus taken the grower farther and farther from the more frost-free areas near the Florida coast. Migration to previously cultivated land where gladiolus has not been grown means freedom from the specific *Fusarium* and *Stromatinia gladioli* which are highly pathogenic to gladiolus, but the land may have established infestations of nematodes and weeds capable of injuring the crop.

The advent of broad-spectrum fumigants opens the possibility of profitably re-cropping the same land year after year and controlling the soil pests with chemicals.

It is estimated that the preparation of new land for gladiolus production costs about $150 per acre, including clearing, leveling, ditching, constructing roadways, and establishing wells for irrigation. If the grower produces three crops of gladiolus on a piece of land then the cost of new land preparation may be prorated at $50 per acre per crop. To this must be added the additional costs involved in growing a crop far afield from the source of labor and the base of operations including packing house, maintenance shop, cold storage, and the like. This cost has been figured by growers to be approximately $4 per acre per mile.

In view of such costs, work was completed in 1961 (2) and 1965 (3) to show that broad-spectrum soil fumigants would permit growers to produce quality gladiolus on land heavily infested with soil pests but desirable in other ways. Gladiolus culture does not lend itself to strip fumigation as does vegetable production, for which in-the-row fumigation was designed. Therefore, although it has been demonstrated (2) that a single stream of fumigant in the planting bed can significantly improve crop yield, the method of application and the excessive care which must be taken at planting to insure against contamination of treated soil-volume have not been favored by the growers.

In order to isolate and control the strip of treated soil, it is desirable to bed the field at time of fumigation. The 2-week waiting period which is necessary after application of fumigants exposes the beds to erosion by heavy rains and complicates proper handling of the treated bed at planting. Also, since a wide deep furrow must be opened in the row to accept the corms at planting, it is difficult to protect the treated bed at planting. Also, since a wide deep covering the corms.

The obective of this study was to determine the feasibility of broadcast fumigaton prior to planting, assuming more costly broadcast application would lend itself profitably to grower practices. A test was initiated to measure the economic benefit to be derived from broadcast applications as opposed to carefully handled in-the-row treatments.

EXPERIMENTAL METHODS

The experiment was established on a field of Leon fine sand characterized by pH 7.6, moisture equivalent 7 percent and organic content 2.7 percent. At time of treating, the moisture content was 15 percent and the soil temperature at a 4-inch depth was 50° F. Single row 20-foot plots were treated December 1, 1965 with the following materials: Vorlex (methyl isthiocyanate 20% + D-D 80%) and Vorlex-201 (chloropicrin 15% + methyl isothiocyanate 17% + D-D 68%) at 35 gallons per acre broadcast. Two methods of application were used. (a) The material was injected with a single chisel 6 inches deep in a finished, formed bed. (b) The material was injected through 5 chisels spaced 8 inches apart and set 6 inches deep on the flat unbedded soil. The soil surface was compacted immediately with a roller. This simulated broadcast application of the entire area. In addition to the two fumigants a granular formulation of zinophos + Thimet containing 5 percent active ingredients of each material was applied at the rate of 100 pounds per acre on the flat surface of the soil and incorporated with a garden rake 2 inches deep. Five days later beds were constructed in the zinophos-Thimet-treated areas. After the waiting period of 2 weeks the beds were carefully pressed open with a "sock" attached inside the top of the bed-press to form a furrow 6 inches deep and 2 inches wide in which the corms were placed, 3 to the linear foot. The furrows were then closed by bed-pressing the bed back to form. In the areas that were broadcast fumigated, (b) above, corms were laid on the soil surface and beds were formed over them with a press. There were four replicates of each treatment.

Number 1 corms of 'June Bells' and 'Hopmans Glory' from hot-water-treated cormels grown on land not previously cropped to gladiolus were used in the test. The corms were soaked 15 minutes in a mixture of ½ pint parathion 8E and 4 pounds Dowicide B per 100 gallons of water.

Criteria for evaluation of the chemical treatments were the flower production index (FPI), the percent flower cut, the number and weight of corms dug after flower harvest and the economic profit derived from the treatment. Only the costs of chemicals were used in computing dollar gains per acre. The FPI was obtained by multiplying the number of marketable spikes by their respective grades. The percent flower cut was based on the number of marketable spikes per 100 corms planted. The number and weight of new corms was obtained after they were cleaned and graded. The economic benefit from the treatment was calculated on an acre planted to 28,000 corms. Conservative estimates for 1964 prices secured from growers were used in estimating the crop value. The cost of the fumigant applied was used in calculating the gross increase of the crop value due to soil treatment; cost of harvesting and handling the increased yield was not taken into consideration. Duncan's multiple range test (1) was used in the statistical analysis of the data.

Results and Discussion

Populations of sting, stubby-root, stunt, and rootknot nematodes recovered from the soil 12 weeks after treatment indicated that control of these species was maintained by Vorlex-201 and Vorlex for at least 3 months within the bed (Table 1).

Early weed control was estimated at 90 percent. Bermudagrass was controlled in broadcast-

Table 1. Effect of soil treatments (Vorlex and Vorlex-201 at 35 ga and Zinophos + Thimet 5 + 5 G at 100 pa) on nematodes and crop production.

Treatment	Nema Count[1] 12 wks	Flower production: FPI[2]	Flower production: Flower[3] cut (%)	Corm production: Corm loss (%)	Corm production: Wt. (lbs) per corm	Crop value[4]: $/acre over check	Crop value[4]: $/acre less fumigant cost
Vorlex, I-T-R	181c[5]	347bc	87b	22.5	.102cd	285	245
Vorlex, B'cast	92ab	384ab	87b	14.1	.117b	285	85
Vorlex-201, I-T-R	110b	294c	75c	12.5	.095c	116	67
Vorlex-201, B'cast	53a	431a	101a	13.3	.126a	470	225
Zino.+ Thimet, M	275d	197d	65c	11.6	.086d	-57	loss
Check	317d	208d	67c	15.8	.080e	--	--

[1]Included rootknot larvae, sting, stubby-root, and stunt nematodes.
[2]Flower production index = number of spikes x grade.
[3]Based on number of marketable spikes produced per 100 corms.
[4]Based on 28,000 corms per acre and the per cent flower cut.
[5]Values within a column followed by the same letter(s) are not significantly different at the 5% level as determined by analysis of variance.

treated plots of Vorlex-201 and Vorlex and down the center of the in-the-row treated beds. Nutsedge predominated in the surviving weed populations. Weeds on the shoulders of the in-the-row-treated beds were controlled by cultivation.

The broadcast application of Vorlex-201 and Vorlex improved the FPI 107 and 85 percent respectively over that from untreated checks. All treatments with Vorlex and Vorlex-201 improved the flower yield. The quality of the spikes was affected significantly by fumigation. The ratio of the FPI to the percent flower cut indicates that both fumigants applied broadcast improved the quality of the spikes, a factor of 4.4 and 4.2 to 3.1 for the check. A survey of large gladiolus growers in the state led to the conclusion that a 70-75 percent cut of marketable spikes is necessary to begin to show a profit on the flower crop. In the test under discussion the cut in untreated soil check was 67 percent; in that with Vorlex-201 applied broadcast the cut was 101 percent. Corm splitting was responsible for the multiple spikes per corm in the fumigated plots. Though a reduction in quality might have been expected with splitting, such was not the case.

Corm loss due to disease was greatest with in-the-row treatment with Vorlex. There was only a tendency for Vorlex-201 to reduce corm loss; however, corm size was definitely improved where Vorlex and Vorlex-201 was broadcast, .117 and .126 lbs per corm as compared to .080 lbs for the check. Rootknot was not found in representative samples of the corms investigated at the time of digging. The relatively cool spring may have suppressed activity of the rootknot nematode until late in the season. Since these data were taken after the corms were cleaned and graded, it may be assumed that the benefit to corm health could be adjudged a part of the economic benefit accruing from soil fumigation, even though such values were not included in the following crop value calculations.

The zinophos + Thimet treatment failed to increase yield. The percent flower cut was equivalent to that in the untreated chacks. The material did not control nematodes at the rate applied. Early in the season there was a transient yellowing of the foliage which may have been an expression of temporary phytotoxicity of the treatment.

The broadcast treatment of Vorlex-201 was superior at the 5 percent level in flower production to all other treatments except the broadcast treatment with Vorlex (Table 1). The FPI ratings were 431 and 384 for broadcast Vorlex-201 and Vorlex respectively. In-the-row single chisel application of Vorlex and Vorlex-201 were 374 and 294 respectively and significantly better than zinophos-Thimet or the check.

Economically the results were different with respect to crop gain because of 2 factors: namely, in-the-row applications required less material than broadcast applications and Vorlex is less expensive than Vorlex-201. The greatest dollar gain ($245 per acre) over no chemical treatment was with Vorlex applied in-the-row, followed by Vorlex-201 ($225 per acre) applied broadcast. The dollar gains by using Vorlex broadcast and Vorlex-201-in-the-row were relatively small ($85 and $67 per acre, respectively). The use of zinophos + Thimet resulted in no dollar gain.

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CONTROL OF ROOT MEALYBUG, *Geococcus coffeae* GREEN

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Introduction

The mealybug, *Geococcus coffeae* Green, was first recorded in Florida in 1958. H. M. Van Pelt, Plant Specialist, and H. A. Denmark, Chief Entomologist, Division of Plant Industry, found specimens on the roots of *Philodendron selloum* and *Dieffenbachia* sp. growing in a greenhouse in Apopka. Specimens were sent to the late Dr. H. Morrison, Coccidologist, United States Department of Agriculture, Insect Identification and Parasite Introduction Research Branch,

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