for *B. actinophylla* in evaluations on fungicides and fungicide-insecticide combinations, but the sensitivity of neanthe bella palm has apparently never been reported before these tests. Both species could be used by researchers and growers to determine the potential phytotoxicity of new and untried foliar-applied pesticides. In most cases, a chemical which will not injure either of these two species will probably not injure most other foliage plant species. This, however, should only be assumed after at least 4 weekly sprays have been applied to the test plant species with the previously-untried pesticide.

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CONTROL OF APHIDS AND MITES ON CUT CHRYSANTHEMUMS BY POST HARVEST ABSORPTION OF AZODRIN AND DEMETON[1]

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ABSTRACT

Chemical control of aphids and mites on detached chrysanthemums has never been developed. The absorption of pesticide through cut stems was demonstrated to be a promising method. Shortly after harvest cut stems were held in either 12,000 or 24,000 ppm solution of Azodrin or demeton for 48 hours at each concentration. Both materials controlled mites at each concentration but induced foliar chlorosis. Flowers were not injured by either material.

In a second experiment cut stems were held in concentrations up to 16,000 ppm Azodrin for 48 hours. Concentrations of 500 ppm or greater controlled aphids while concentrations at 2000 ppm or greater induced foliar chlorosis. Flowers were not injured at any of the tested Azodrin concentrations.

In a third experiment cut stems were held in either 600 or 1200 ppm Azodrin or demeton for 0.5, 1, and 4 hours. Stems exposed to Azodrin at 600 ppm for 0.5 hour were free of mite infestations without visual plant injury. Demeton at 600 ppm for 0.5 hour did not effectively control mite infestations and showed foliar chlorosis. Flowers on stems exposed to 1200 ppm Azodrin or demeton for 4 hours were not injured.

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[1]Mention of a trade name or chemical does not constitute endorsement by USDA or IFAS.

INTRODUCTION

Control of aphids [*Myzus persicae* (Sulzer)] and spider mites (*Tetranychus urticae* Koch) on mature chrysanthemums is a critical problem. Flowers are easily damaged by chemical sprays, coverage is often inadequate due to dense foliage, and spray residues are undesirable. Since pests quickly develop resistance to commonly used chemicals, there is a need for continual screening of new materials for phytotoxicity to flowers (5) and for pest control. Safe control measures are not always available and flowers with aphids and mites are frequently marketed.

No adequate pest control has been developed for detached flowers. Systemic insecticides for

pest control on intact flowers have been used by several investigators (1, 6), and use is a standard practice among flower growers. The insecticides are applied by drench or as granules to the soil or through the irrigation water, absorbed by plant roots and translocated throughout the plant system. Insects or mites that feed on the treated plants are killed. Application of systemic insecticides to trunk, bark or stem has also proven effective (2, 3, 4) for plant absorption.

Marousky (5) summarized techniques to open bud-cut flowers by absorption of 8-hydroxyquinoilne citrate (8-HQC) plus sucrose (S) through the cut stem. Flowers infested with aphids or mites were frequently encountered during experiments on opening bud-cut flowers in the laboratory (5). Some treatment for pest control was needed. Pilot studies indicated that insect control could be affected by uptake of a systemic pesticide. The purpose of the experiments reported herein was to obtain data concerning absorption time and optimal concentration of the insecticides for pest control without foliar chlorosis or flower injury.

Materials and Methods

Shortly after harvest, cut chrysanthemum stems were brought into the laboratory, trimmed to 24 inches and the foliage removed from the basal part of the stem. An experimental unit consisted of two stems placed in a quart mason jar containing experimental insecticide. Each unit was replicated three times in each experiment. During treatment and subsequent holding, cut flowers were held at 74°F, under continuous light intensity at 150 ft-c supplied by white fluorescent tubes. Relative humidity ranged from 50-70% during the experiments. Data were treated by analysis of variance and mean values separated by Duncans Multiple Range test.

Experiment 1. Freshly cut stems of 'Beauregard' chrysanthemums were held in a factorial of water or 200 ppm 8-hydroxyquinoline citrate + 0.5% sucrose containing 12000 ppm or 24000 ppm Azodrin® (3-hydroxy-N-methyl-cis-crotonamide dimethyl phosphate) or demeton (*O,O*-Diethyl O (and S)-2-(ethylthio)ethyl phosphorodithioate) for 48 hours. After treating, the stems were transferred to quart mason jars containing 200 ppm 8-hydroxyquinoline citrate + 0.5% sucrose. Ten adult mites were introduced onto each of two excised leaves per stem. The leaves were then held on moist cotton in open petri dishes at 74°F. Living mites (*Tetranychus urticae* Koch), were counted on each leaf after 4 days. Foliage and flowers were periodically examined for insecticide injury during the holding period.

Experiment 2. 'Iceland' chrysanthemum flowers naturally infested with green peach aphids [*Myzus persicae* (Sulzer)] were held in mason jars containing solutions of 0, 250, 1000, 2000, 4000, 8000, and 16000 ppm Azodrin for 48 hours in the laboratory. After treatment stems were removed and placed in a solution of 200 ppm 8-hydroxyquinoline citrate + 0.5% sucrose. Counts of aphids on peduncles and leaves were made after 48 hours. Foliage and flowers were periodically examined for insecticide injury during the holding period.

Experiment 3. Mite infested 'Iceberg' stems were held in solutions of 600 or 1200 ppm Azodrin or demeton for 0.5, 1, or 4 hours to test the effect of absorption time and concentration on pest mortality and injury. Stems were removed to distilled water after treatment and were held in the laboratory. Counts of mites on leaves were made 5 and 12 days after treatment. Foliage and flowers were periodically examined for insecticide injury during the holding period. Chlorosis was rated 1 to 5 where 1 = no chlorosis and 5 = severe chlorosis.

Results

Experiment 1. Mite populations were controlled on leaves of stems held in 12000 or 24000 ppm Azodrin or demeton (Table 1). However, these insecticide concentrations induced foliar chlorosis (Fig. 1). Both Azodrin and demeton caused necrotic leaf margins and interveinal yellowing. Leaves of stems held in demeton had interveinal necrotic areas. No differences were observed in mite control from insecticides in water or in 8-hydroxyquinoline citrate + 0.5% sucrose.

Experiment 2. Number of live aphids on peduncles and on leaves were significantly reduced

Table 1. Effect of two concentrations of Azodrin and demeton in water and 200 ppm 8-hydroxyquinoline citrate + 0.5% sucrose solution on spider mites on leaves of 'Beauregard' chrysanthemums after 48 hours[1]. (Exp. No. 1).

Insecticide	Rate	Mite mortality[2]	
		Water	200 ppm 8-HQC + 0.5% S
		%	%
Check	--	25a	10a
Azodrin	12000 ppm	90 b	97 b
Azodrin	24000 ppm	100 b	100 b
Demeton	12000 ppm	75 b	65 b
Demeton	24000 ppm	78 b	87 b

[1]Stems were exposed to Azodrin or demeton in water or in 200 ppm 8-HQC + 0.5% sucrose for 48 hrs then all stems placed in 200 ppm 8-hydroxyquinoline citrate + 0.5% sucrose.

[2]Numbers followed by different letter(s) are significantly different at 1%.

Figure 1.—Foliar chlorosis of 'Beauregard' chrysanthemums induced by Azodrin and demeton. (Left to right, control, 12000 ppm Azodrin, 12000 ppm demetron).

by all concentrations of Azodrin after 48 hours (Table 2). However, the number of aphids on flowers or the number of flowers with aphids was not reduced by any concentration of Azodrin. Foliar chlorosis was slight on stems held in 2000 ppm and became more pronounced as concentration increased, but flowers were not injured.

Experiment 3. Table 3 shows mite mortality on leaves from stems held for 0.5, 1.0 and 4.0 hours in two concentrations of Azodrin and demeton. All treatments with Azodrin were effective. Demeton at 600 ppm or 1200 ppm for 0.5 or 1 hour did not increase mite mortality, however, demeton at 1200 ppm for 4 hours was effective. Condition of foliage is shown by ratings in Table 4. More severe chlorosis occurred on lower foliage in all treatments. Severity of foliar chlorosis increased with absorption time and increased concentration of either pesticide. Damage to lower foliage was greater with demeton than Azodrin. This phenonemon was reported by other workers (3) to be more severe on actively transpiring leaves. Flowers were uninjured by any treatment.

Table 2. Effect of concentrations of Azodrin on number of aphids per peduncle, per leaf and per flower and on foliar chlorosis of 'Iceland' chrysanthemums (Exp. No. 2).

Azodrin concentration (ppm)	Number of aphids per[2] Peduncle	Leaf	Flower	Foliar chlorosis[1]
0	57a	7d	2a	0
250	8b	5d	2a	0
500	2b	3c	4a	0
1000	2b	4c	5a	0
2000	1b	3bc	3a	1
4000	1b	2abc	3a	2
8000	1b	0abc	1a	2
16000	1b	1a	2a	5

[1]Chlorosis rating: 0 = no injury, 1 = slight, 2 = mild, 3 = moderate, 4 = heavy, 5 = severe. Chlorosis determined after 7 days.

[2]Numbers followed by different letter(s) within a given column are significantly different at 1%.

Table 3. Effect of Azodrin and demeton concentrations and exposure time on percent mite mortality on 'Iceberg' chrysanthemums (Exp. No. 3).

Insecticide	Rate	% Mite mortality 0.5 hr	1.0 hr	4.0 hr
Check		-	-	9a
Azodrin	600 ppm	100c	94c	100c
Azodrin	1200 ppm	93c	100c	100c
Demeton	600 ppm	0a	31ab	25ab
Demeton	1200 ppm	0a	22ab	100c

[1]Check stems held in water for 4 hours during treatment.

[2]All numbers followed by different letter(s) are significantly different at 1%.

Discussion

The technique of introducing chemical pesticides into cut flower stems by absorption has not previously been demonstrated. The development and adaptation of this technique to commercial production will fill a critical need and bring the floriculture industry one step closer to pest free cut flowers.

The principal difficulty encountered was phytotoxicity induced by insecticides. Foliar symptoms of toxicity includer interveinal chlorosis and necrosis, yellowing, darkened leaf margins, veinal discoloration (blotching) and loss of turgor. Damage appeared more severe on lower foliage in all experiments but at no time were flowers injured. Similar toxicity has been shown from Azodrin on

Table 4. Effect of Azodrin and demeton concentration and absorption time on foliar chlorosis of 'White Iceberg' chrysanthemums[1]. (Exp. No. 3).

Insecticide rate (ppm)	Lower foliage 0.5 hr	1.0 hr	4.0 hr	Upper foliage 0.5 hr	1.0 hr	4.0 hr
Check[2]	--	--	0.8	--	--	0.3
Azodrin 600	0.7	1.2	2.2	0.0	0.5	1.8
Azodrin 1200	1.5	1.2	2.0	0.5	0.5	2.5
Demeton 600	2.5	1.7	2.0	0.8	1.2	0.8
Demeton 1200	2.2	0.7	2.5	0.7	0.7	1.5

[1]Chlorosis rating: 0 = no injury, 1 = slight, 2 = mild, 3 = moderate, 4 = heavy, 5 = severe.

[2]Check stems held in water for 4.0 hrs during treatment.

cotton plants and insecticide accumulation in leaves was related to transpiration rate (3).

The influence of cultivar, plant condition (e.g. wilting), soluble salts in water or other intrinsic factors, as well as the influence of environmental components such as relative humidity, temperature or air pollutants relative to the application and success of this technique are unknown. Future investigations should include research conducted under certain of the defined environmental conditions prevalent in Florida to perfect insecticide absorption by cut stems for commercial use.

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COMBINATIONS OF FUNGICIDES AND INSECTICIDES FOR CONTROL OF DISEASE, INSECTS AND MITES ON CHRYSANTHEMUMS

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ABSTRACT

Two experiments were conducted with tank-mixed fungicides and insecticides on two varieties of chrysanthemums during fall and spring seasons. Benomyl fungicide 50W controlled Ascochyta blight, green peach aphids and reduced populations of two spotted spider mites. Azinphosmethyl 2E controlled leaf miners, two spotted spider mites, thrips and significantly reduced Ascochyta blight. The fungicidal efficiency of benomyl, chlorothalonil, zinc ion maneb, and captan was improved when tank mixed with azinphosmethyl. Chlorothalonil-azinphosmethyl mixtures were phytotoxic to flowers.

INTRODUCTION

Florida's subtropical climate permits chrysanthemums to be produced outdoors the year around. It is also conducive to the development of diseases and insects, therefore diligent pest control is required to protect chrysanthemum crops. Growers continually need up-to-date information on what chemicals and combinations will most efficiently and safely control pests on chrysanthemum crops (flowers, cuttings and pots) which have a wholesale value in excess of $15,000 per acre. Using ineffective products, or ones not safe to plants, or using excessive quantities will increase costs, hazards to plants and man and the probability of soil and air pollution problems.

Chemicals with different kinds of biological activity, composition and low mammalian toxicity are being developed commercially. Systemic insecticides are well known but systemic fungicides such as benomyl (Benlate 50W) only recently became available commercially. The biological insecticide Dipel, a preparation of spores of *Bacillus thuringensis* HD-1 Berl., causes a bacterial disease of lepidopterous larvae. A botanical insecticide, pyrethrum, extracted from a species of chrysanthemum grown mainly in Africa, is available as Pyrenone. Limited information is available on the performance of these products on chrysanthemums.

The objectives of these experiments were to evaluate a systemic fungicide, a systemic insecticide, a biological insecticide, a botanical insecticide, commercial standards and selected combinations of the chemicals for their effects on diseases, insects and phytotoxicity on chrysanthemums.

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