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Whitefly Infestation on Chrysanthemum and Poinsettia Treated with Plant and Insect Growth Regulators[1]

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Abstract. **The insect growth regulator (IGR) kinoprene reduced infestation by immature stages of greenhouse whitefly (*Trialeurodes vaporariorum* Westw.) on 'Dramatic' and 'Puritan' chrysanthemum (*Chrysanthemum morifolium* Ramat.) and 'Annette Hegg Lady' and 'Eckespoint C-1' poinsettia (*Poinsettia pulcherrima* Wild.). Three foliar applications at 2-week intervals were more effective than 1 or 2 applications. The plant growth regulators (PGR) ancymidol and chlormequat reduced whitefly infestation on both cultivars of chrysanthemum and 'Annette Hegg Lady' poinsettia.**

The greenhouse whitefly is a persistent pest of many species in the greenhouse and has been shown to exhibit a variable preference for cultivars of the same species as in poinsettia (2) in which the degree of infestation has been associated with bract color, chlorophyll content of leaves, and trichome configuration (1). PGR's have altered the observed degree of infestation of treated poinsettias (3).

IGR's offer an alternative to conventional insecticides in their use either alone or as part of an integrated pest control program. Nassar et al. (4) reported on a series of 2,4-dienoate compounds having morphological activity as well as being directly toxic when topically applied to the greenbug, *Schizaphis graninum* (Rondani), and observed that one of these, kinoprene[3], at 0.1% caused lasting sterility of the adult greenbug as well as the emergence of nymphs from their embryonic molt while still within the adult. Staal et al. (5) found specific instars of the citrus mealybug *Planococus citri* (Risso) to be controlled by a topical application of kinoprene at 0.01 to 0.1%.

Van Emden (6) suggested that pest control be developed from the integration of plant resistance, pesticides, and the many other factors which might reduce plant susceptibility. The present research was undertaken to observe the effect of two PGR's and the timing and concentration of an IGR (kinoprene) in the control of greenhouse whitefly on selected cultivars of poinsettia and chrysanthemum.

Materials and Methods

Cuttings of 'Dramatic' and 'Puritan' chrysanthemum and of 'Annette Hegg Lady' and 'Eckespoint C-1' poinsettia were rooted individually under mist in 12.7 cm pots in mid-September and provided long day conditions until October 12. Plant growth in the greenhouse was under conditions considered satisfactory for good commercial production of these crops.

A split plot experimental design was employed in which whole plots consisted of chrysanthemum or poinsettia cultivars and split-plot treatments were the 4 × 3 × 3 factorial combinations of 4 kinoprene concentrations applied at 1, 2, or 3 times with either no PGR, ancymidol[4], or chlormequat[5].

PGR were applied on October 8 in the following amounts per pot:

	Chrysanthemum	Poinsettia
Ancymidol	0.36 mg	0.72 mg
Chlormequat	750 mg	1500 mg

Kinoprene was applied as a foliar spray once, twice, or three times at 2-week intervals beginning October 12 and at concentrations of 0, 0.1, 0.2 and 0.4%. There were 3 single pot replications of each factorial combination giving a total of 216 plants of each species.

Cut branches of whitefly infested foliage were placed among the experimental plants on October 13 and remained there for 72 hr while the adult whitefly migrated without restriction to new foliage. Data were taken at 180° ray flower development for chrysanthemums and at anthesis for poinsettia on the relative degree of infestation of the 5 uppermost green leaves by the immature stages of whitefly following visual ratings according to the following system:

	Lower leaf surface infested by whitefly (%)	
Rating	Chrysanthemum	Poinsettia
1	<10	<10
2	11-30	11-30
3	31-50	31-50
4	>50	51-70
5	–	>70
6	–	(actual leaf injury)

An ancillary study evaluated the toxicity of kinoprene to 'Eckespoint C-1' and 'Annette Hegg Lady' foliage and bract tissue. Upper and lower surfaces were treated separately with the untreated surface protected from chemical contact.

Results and Discussion

The effects of kinoprene on whitefly development are documented through E.P.A. registration[3] although the effects upon host plants are not. This IGR had no effect upon growth and flowering of chrysanthemum and little or no significant effect on poinsettia growth.

Poinsettia foliage showed no foliar toxicity to kinoprene at the rates used. Bract injury was observed in the form of a loss of pigmentation 24 hr after treatment of 'Annette Hegg Lady' and 48 hr after treatment of 'Eckespoint C-1'. Only bracts which were mature at the time of treatment were injured while younger bracts developed normally. The bract undersurface was more sensitive to the chemical than the upper surface. Injury was confined to the treated surface at the lower concentrations of kinoprene but phytotoxicity appeared on both surfaces when either surface received 0.4% kinoprene (Fig. 1).

Chlormequat reduced the whitefly observed on 'Puritan' and 'Annette Hegg Lady' but resulted in a greater infestation on 'Eckespoint C-1'. Ancymidol had a similar effect on poinsettia

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[3]2-propynyl(E,E)-3,7,11-trimethyl-2,4,-dodecadienate now available as *Enstar 5E,* Zoecon Corp. E.P.A. Reg. No. 2095-4-AA-38017.

[4]α-cyclopropyl-α-(p-methoxyphenyl)-5-pyrimidinemethanol. *A-Rest,* Elanco Products Co., E.P.A. Reg. No. 1471-94-AA.

[5](2-chloroethyl)trimethylammonium chloride. *Cycocel,* American Cyanamid Co., E.P.A. Reg. No. 241-74-AA.

Fig. 1. Injury to bracts of 'Annette Hegg Lady' (left) and 'Eckespoint C-1' (right) poinsettias showing necrotic flecking of mature bracts 72 hr following treatment with 0.4% kinoprene.

Table 1. Influence of no PGR, chlormequat, or ancymidol on the mean infestation by whitefly on 2 cultivars each of chrysanthemum and poinsettia.

	Whitefly infestation[z]			
	Chrysanthemum		Poinsettia	
Treatment	'Dramatic'	'Puritan'	'Annette Hegg Lady'	'Eckespoint C-1'
No PGR	1.29 BC[y]	1.60 A	2.52 D[y]	3.22 C
Chlormequat	1.20 C	1.34 B	2.03 E	4.22 A
Ancymidol	1.00 D	1.00 D	2.08 E	3.69 B

[z]1.0 = least infestation, mean of 36 plants averaged over 4 concentrations and 3 applications of kinoprene at 180° ray flower development for chrysanthemum and at anthesis for poinsettia.

[y]Mean separation within species by Duncan's multiple range test, 1% level.

Table 2. Influence of kinoprene on the mean infestation by whitefly on 2 cultivars each of chrysanthemum and poinsettia treated 1, 2, or 3 times at bi-weekly applications of .1, .2, .4%.

Kinoprene concn (%)	Whitefly infestation[z]			
	Number of applications			
	1	2	3	Means
		Chrysanthemum		
0	1.71 A[y]	1.49 AB	1.54 AB	1.58 L
0.1	1.48 B	1.44 B	1.04 C	1.32 M
0.2	1.50 AB	1.37 B	1.06 C	1.31 M
0.4	1.36 B	1.32 B	1.02 C	1.23 M
Means	1.51 L	1.40 L	1.16 M	
		Poinsettia		
0	3.94 A[y]	3.73 A	3.74 A	3.81 L
0.1	3.63 BC	3.37 CD	2.84 E	3.28 M
0.2	3.23 D	2.78 E	1.87 FG	2.63 N
0.4	2.61 E	2.13 F	1.67 G	2.13 O
Means	3.35 L	3.00 M	2.53 N	

[z]1.0 = least infestation, mean of 12 plants for no PGR and chlormequat at 180° ray flower development for chrysanthemum, and 18 plants for no PGR, ancymidol, and chlormequat at anthesis for poinsettia.

[y]Mean separation within species by Duncan's multiple range test, 1% level.

Table 3. Influence of no PGR, ancymidol, or chlormequat, and several concentrations of kinoprene on the mean relative infestation by whitefly on 2 cultivars each of chrysanthemum and poinsettia averaged for 3 applications.

Kinoprene concn (%)	Whitefly infestation[z]		
	PGR treatment		
	No PGR	Chlormequat	Ancymidol
		Chrysanthemum	
0	1.67 A[y]	1.48 B	1.00 F
0.1	1.33 CD	1.31 CD	1.00 F
0.2	1.43 BC	1.19 DE	1.00 F
0.4	1.35 CD	1.10 EF	1.00 F
		Poinsettia	
0	3.46 D[y]	4.05 A	3.90 B
0.1	3.10 E	3.68 C	3.08 E
0.2	2.49 G	2.93 F	2.47 G
0.4	2.46 G	1.85 I	2.09 H

[z]1.0 = least infestation, mean of 18 plants at 180° ray flower development for chrysanthemum and at anthesis for poinsettia.

[y]Mean separation within species by Duncan's multiple range test, 1% level.

but reduced the whitefly infestation on both cultivars of chrysanthemum (Table 1).

Kinoprene reduced whitefly infestation of both species but there was no benefit of increasing concentrations of kinoprene in the relatively lightly infested chrysanthemums. The heavier whitefly population on poinsettia was further reduced by increasing levels of kinoprene. Three applications of kinoprene were more effective than 1 or 2 applications on chrysanthemum while on poinsettia there were successive reductions in whitefly population with each additional bi-weekly kinoprene application. Least infestation was recorded for chrysanthemums treated 3 times with any concentration of kinoprene or on poinsettias treated 3 times with 0.4% kinoprene (Table 2).

Since ancymidol was effective in controlling whitefly on chrysanthemum there was no opportunity for interaction with kinoprene but application of the relatively ineffective chlormequat to chrysanthemum gave essentially the same whitefly control when plants were treated with 0.4% kinoprene. With poinsettias the use of 0.4% kinoprene in conjunction with either PGR resulted in the least whitefly infestation (Table 3).

While the amount of PGR applied was in excess of the amount recommended, the possibility exists of effectively reducing whitefly infestation through modification of the plant making it less attractive to the insect. It would be expected that the use of recommended amounts of these PGR would also have beneficial effects and a place in an integrated control program for the greenhouse whitefly on these crops.

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