EFFECT OF PESTICIDES ON CYMBIDIUM ORCHID POLLEN-CAP MITE AND ITS PREDATOR *HYPOASPIS* SP.

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ABSTRACT

Pots of orchid-growing media augmented with pollen-cap mite, *Tyrophagus neiswanderi*, and its predator, *Hypoaspis* sp., were drenched with carbaryl, deltametrin, dimethoate and methiocarb to compare their efficacy for mite control with natural predation. Mite populations were monitored by heat extraction from 50 ml of potting media on days 0, 2, 7 and 14 after treatment and compared with water treated controls. All pesticide treatments initially reduced pollen-cap mite numbers ($P<0.05$), but after 14 days only methiocarb sustained this reduction to a similar level achieved by the predation of *Hypoaspis* sp. in the controls. Dimethoate gave the least effective control of pollen-cap mite and caused the greatest reduction in *Hypoasis* sp. populations. The ability of these four pesticides, plus taufluvalinate, acephate and methamidophos, to reduce movement of pollen-cap mite was assessed. Flower stems (350 mm), with double-sided sticky tape encircling the top, were dipped in pesticide and stood in media with pollen-cap mite. After 48 h only methiocarb reduced ($P<0.05$) the number of mites moving up the flower stem.

Keywords: *Tyrophagus neiswanderi*, *Hypoasis* sp., biological control, insecticides, cymbidium orchids.

INTRODUCTION

Pollen-cap mites (*Tyrophagus neiswanderi* (Johnston et Bruce), (Acari: Acaridae)) cause damage to pollen-caps in cymbidium orchids (*Cymbidium* spp.) which results in discolouration of the pollen-caps and premature senescence of blooms (Martin 1993b). Flowers exhibiting symptoms of this disorder cannot be exported, and some growers claim up 25% of their crop can be affected. The primary cause of pollen-cap damage is physiological, resulting from premature germination of the pollen or the collapse of enlarged pollen mother cells (Workman 2001). These disorders cause pollen-caps to become raised allowing pollen-cap mites to enter and feed on the pollen. Pollen-cap mites belong to the family of mould mites and they are usually found feeding on decaying material in the orchid growing media. They often carry fungal spores on their setae which they can transfer to the pollen. It is believed that this fungal contamination can increase the rate of development and severity of the condition.

Apart from a report that suggests adhesive substances for the control of pollen-cap mite in phalaenopsis orchids (Kadono & Endo 1996), there is no published information on the control measures for this mite in orchids. *Tyrophagus neiswanderi* has also been reported damaging greenhouse cucumbers (Fischer 1993) and dicofol is recommended for its control in this crop (Martin 1993a). Despite the lack of information on effective pesticides, growers with crops exhibiting pollen-cap disorder symptoms often resort to pesticide applications and either spray the plants or drench the orchid growing media.

Hypoaspis sp. (Acari: Laelapidae), an effective predator of pollen-cap mite which is active in growing media, has recently been identified from Cymbidium orchids at Helensville (P.J. Workman, unpubl. data). The current practice of drenching potting media with pesticides may disrupt the natural control of pollen cap mite by *Hypoaspis* sp.

An alternative is to spray pesticides onto the plants to prevent the mites from reaching the flowers. This paper examines the effect of four pesticides on pollen-cap mite and *Hypoaspis* sp. when applied as drenches, and the ability of seven pesticides to restrict the movement of pollen-cap mite up orchid stems when applied directly to the plant.

MATERIALS AND METHODS

Drenching orchid-growing media with pesticides

Pollen-cap mite collected from infected pollen-caps were reared in a mixture of bran (1000 ml), wheat germ (60 ml), brewers yeast (50 ml) and water (50 ml) in vented containers at 25°C. After 2 weeks equal volumes of pollen-cap mite/bran mix were added to sterilised potting media together with *Hypoaspis* sp., which had been isolated from orchid potting media and reared on pollen cap mite in the bran mixture. After a further week the numbers of both species of mite were estimated by taking three 1 ml samples which were decanted, filtered and examined under a stereo-microscope. A 25 ml portion of this pollen-cap mite/ *Hypoaspis* culture (586 pollen-cap mites and 5.6 *Hypoaspis* /ml) was carefully mixed in a plastic bag with orchid potting media (1000 ml), dried blood (25 ml) and treatment solution (100 ml) and placed into 150 mm diameter pots. There were four pesticide treatments and two water-treated experimental controls, one with pollen-cap mites plus *Hypoaspis* predators and one that was augmented with only pollen cap mites (Table 1). Each treatment was replicated five times. The dried blood was added as a food source for the pollen-cap mite. Directly after the treatments were applied and on days 2, 7, and 14 after treatment, 50 ml samples of the potting media were taken from each pot for heat extraction of the mites. The samples in containers (55 mm diameter by 27 mm high) with netting (2 mm diameter mesh) over the base were placed in glass funnels filled with water that almost touched the netting. A heat source (15 watt light bulb) was placed above each funnel to dry the potting media. After 2 days the contents of the funnel were filtered and the numbers of pollen-cap mites and predators were recorded using a stereo-microscope. The data were transformed using natural logarithms prior to analysis of variance.

TABLE 1: Pesticides and concentrations used in drenching orchid growing media augmented with pollen-cap mite and *Hypoaspis* sp and stem dipping trials. The control with *Hypoaspis* was not included in the stem dipping trials.

Treatment	Product	Formulation	Product/100 litres water	Concentration of active ingredient
Pesticides used in drench trial and first section of stem dipping trial				
carbaryl	Carbaryl	800 g/litre WP	150 g	1200 mg/litre
dimethoate	Rogor	400 g/litre EC	80 ml	320 mg/litre
deltamethrin	Decis Forte	27.5 g/litre EC	36 ml	9.9 mg/litre
methiocarb	Mesurol	750 g/litre WP	100 g	750 mg/litre
Control with *Hypoaspis*				
Control without *Hypospis*				
Pesticides used in second section of stem dipping trial				
taufluvalinate	Mavrik	240 g/litre SC	40 ml	96 mg/litre
acephate	Orthene	195 g/litre EC	100 ml	195 mg/litre
methamidophos	Tameron	600 g/litre SC	150 ml	900 mg/litre
methiocarb	Mesurol	750 g/litre WP	100 g	750 mg/litre
Control				

Pesticide dipping of cymbidium orchid stems

The ability of pesticides to restrict the movement of pollen-cap mites up orchid plants was tested by dipping sections of flower stems (350 mm long) in pesticide solutions so

that all but the top 50 mm of each stem was covered. A band of double-sided sticky tape (25 mm wide) was applied to encircle the top of the stem. The stems were placed in pots (150 mm diameter) with 100 ml of the stem in the potting medium (1000 ml) which had been augmented with bran/pollen-cap mite mix (200 ml) from the rearing containers. The pots were placed in a heated glasshouse. There were five replicates for each treatment. The double-sided tape was removed after 24 h, transferred to glass slides, examined under a stereo-microscope and the number of pollen-cap mites recorded. The sticky tape was reapplied to the stem and the process repeated after 48 h.

The trial was repeated twice. In the first trial the same pesticides and concentrations as in the drench trial were used and in the second the methiocarb treatment was repeated with three additional pesticides (Table 1). Citowet (25 ml/100 litres) was added to all of the dip treatments. An analysis of variance of the total number of pollen cap mites caught 48 h after treatment was performed.

RESULTS

Drenching orchid-growing media with pesticides

Methiocarb and deltamethrin were the only drench treatments that reduced pollen-cap mite numbers on day 2 ($P<0.05$) (Table 2). The reduction of pollen-cap mite numbers in the deltamethrin treatment was of short duration as numbers had increased by day 7, whereas pollen cap mite numbers in the methiocarb treatment remained low for the duration of the trial ($P<0.05$) . After 14 days the methiocarb treatment, and the control

TABLE 2: Mean number of pollen-cap mite and *Hypoaspis* sp. extracted from 50 ml of treated orchid growing media drenched with four insecticides or untreated controls. Back transformed values are presented with natural log data in parenthesis.

	Control					
	With predator	Without predator	Carbaryl	Deltamthrin	Methiocarb	Dimethoate
Pollen cap mite						
Day 0	415 (6.03)[1]	341 (5.83)	296 (5.69)	203 (5.32)	162 (5.09)	201 (5.31)
Day 2	419 (6.04)	752 (6.62)	236 (5.46)	123 (4.81)	10.9 (2.39)	312 (5.74)
Day 7	268 (5.59)	539 (6.29)	334 (5.81)	367 (5.91)	124 (4.82)	419 (6.04)
Day 14	40.0 (3.87)	331 (5.80)	160 (5.07)	169 (5.13)	43.3 (3.77)	345 (5.84)
Hypoaspis sp.						
Day 0	7.36 (2.12)	0	8.98 (2.30)	7.78 (2.17)	10.4 (2.44)	11.3 (2.51)
Day 2	9.85 (3.38)	0	5.32 (1.84)	1.83 (1.04)	10.3 (2.42)	0.33 (0.29)
Day 7	17.4 (2.91)	0	4.41 (1.69)	7.14 (2.10)	8.29 (2.23)	0.74 (0.56)
Day 14	27.3 (3.34)	0	26.9 (3.33)	10.97 (2.48)	24.4 (3.24)	0.88 (0.63)

[1]Values in parenthesis can be compared using the following LSD ($P<0.05$) values. For pollen-cap mite LSD=0.880 between treatments and LSD=0.848 within treatments over time. For *Hypoaspis* sp. LSD=0.795 between treatments and LSD=0.800 within treatments over time.

with predators, had lower numbers of pollen-cap mites than all other treatments. In control treatment with predators, pollen-cap mite declined throughout the trial, while in the control treatment without predators, pollen-cap mite numbers initially increased on day 2, but then declined, possibly due to lack of food.

Hypoaspis sp. numbers in the control treatment with the predators increased for the period of the trial. Numbers of the predator were reduced by dimethoate and deltamethrin drenches from days 2 to 14 compared to the control with *Hypoaspis* sp. ($P<0.05$). While carbaryl reduced *Hypoaspis* sp. population initially, at the end of the trial numbers of predators for this treatment, and methiocarb, were similar to control. Dimethoate was the least effective treatment because it gave poor control of pollen cap mites and suppressed predator numbers for 14 days. Methiocarb was the most effective insecticide treatment in reducing pollen cap mite numbers in the presence of the predators but it was no more effective than predators alone.

Pesticide dipping of Cymbidium orchid stems

In both trials methiocarb was the only pesticide that reduced the number of pollen-cap mites traversing treated orchid stem ($P< 0.05$) (Table 3). The number of pollen-cap mites caught on the sticky tape at the top of the stem for the remaining six pesticides was not different from the water treated stems ($P>0.05$).

TABLE 3: Total pollen-cap mite caught after 48 h on sticky tape after traversing 250 mm of pesticide-or water-treated orchid stems.

Insecticide Trial 1	Mean number of mites/stem	Insecticide Trial 2	Mean number of mites/stem
carbaryl	623	taufluvalinate	806
dimethoate	791	acephate	921
deltamethrin	641	methamidophos	907
methiocarb	215	methiocarb	182
control	812	control	867
LSD ($P<0.05$)	191.0	LSD ($P<0.05$)	205.6

DISCUSSION

When orchid growers find pollen-cap mites under darkened pollen-caps of their flowers, they often conclude that these mites are the primary cause of the damage. However, pollen-cap disorders usually have physiological origins which cause the pollen-caps to lift, giving the mites access to the pollen (Workman 2001). Where the disorder is caused by enlarged pollen mother cells, these cells rapidly break down and the symptoms are present as soon as or even before the flowers open. This disorder appears to have a strong genetic component and is restricted to certain culivars (e.g. Allegria x St Rex). Because pollen with enlarged mother cells breaks down so rapidly the presence of pollen-cap mites causes little additional damage. However, where prematurely germinated pollen is present, the pollen-cap discolours very slowly. It is thought that this disorder is mainly caused by climatic factors. In flowers with prematurely germinating pollen, the pollen-cap mites can increase the rate of development and severity of pollen-cap discoloration because they can introduce fungal infections. It is recommended that growers inspect the quality of the pollen in each of their cultivars before pesticide application is considered.

Because pollen-cap mites originate from the potting media, growers often try to control infestations by drenching their pots of orchids with pesticides, sometimes several times a season. Our trials indicate that if *Hypoaspis* sp. is present in potting media there is no advantage in drenching with pesticide as even methiocarb, the most effective treatment, gave no greater reduction in pollen-cap mite numbers than the water-treated control. Drenching orchid plants with pesticides such as dimethoate may even exacerbate the

problem by suppressing naturally occurring predators. To date the *Hypoaspis* predators have been isolated from only one greenhouse, but if they are found to be widely distributed, drenching orchids with pesticides is not recommended.

Cymbidium cultivars with prematurely germinating pollen are at risk of increased pollen-cap discoloration if the pollen is invaded with pollen-cap mites. In crops with this disorder the pollen should be regularly inspected to assess mite numbers. If it is considered necessary to control pollen-cap mites then pesticides should be applied topically. However, pollen-cap mites in flowers are protected from pesticides by the pollen-cap and the mites need to be controlled as they move up the plants. Methiocarb was the only material that reduced the number of pollen-cap mites moving up the flower stem. Methiocarb is not registered for use on ornamentals, so further work is required to identify effective pesticides that will prevent migration of pollen-cap mites up orchids.

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