EVALUATION OF FUNGICIDES FOR CONTROL OF FAIRY RINGSPOT DISEASE IN CARNATIONS

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SUMMARY

The efficacy of twelve fungicides as protectants and/or eradicants against fairy ringspot disease of carnation (*Dianthus caryophyllus* Eur. inc. Br) caused by *Cladosporium echinulatum* (Berkeley) de Vries, was assessed in a greenhouse pot trial. Each fungicide was applied either 3 days before, or 3 days after, inoculation with fungal spores. Chlorothalonil, maneb and prochloraz, with the addition of a wetting agent, were found to be effective protectants. The systemic chemicals prochloraz and pyrifenoxy were effective as eradicants.

INTRODUCTION

Fairy ringspot disease, caused by the fungal pathogen *Cladosporium echinulatum*, (Berkeley) de Vries, affects the leaves, stems and flower calyxes of susceptible carnation (*Dianthus caryophyllus* Eur. inc. Br) cultivars. Defoliation and stunting of plants has occurred following severe infections. The disease has been recognised as a potential problem of spray carnations in the United Kingdom (Nathaniels 1983). A recent survey of New Zealand spray carnation growers showed that some new spray and Mediterranean standard carnation cultivars are highly susceptible to fairy ringspot, especially in the winter (Braithwaite unpublished data).

Many growers in New Zealand have recently experienced difficulty in controlling fairy ringspot with the protectant fungicides available. This paper reports the results of a pot trial which evaluated the effectiveness of two commonly used protectant fungicides and ten systemic fungicides in controlling fairy ringspot.

METHODS

The fungicide trial was conducted on 6-month old carnation plants (growth stage-shoot elongation), cultivar Mei Fu, in an environmentally controlled greenhouse at Lincoln. Plants were propagated from cuttings and planted in a bark/sand/soil mix in PB3 (13 cm diameter) planter bags.

A spore suspension was prepared from 5 week old cultures grown on 10% V8 Juice agar using a 0.1% aqueous solution of Tween 20 (a wetting agent). The resultant suspension with a concentration of 9.3×10^4 spores/ml was applied to plants on 8 June 1988 to run-off using a Badger air brush applying 0.3 ml/sec at 6.7 kPa. Immediately after inoculation a plastic bag was placed over each plant to maintain high relative humidity (necessary for infection) and then removed 3 days later.

The protectant and eradicant properties of 12 fungicides (Table 1) were tested. Each fungicide or a control treatment (water) was applied to plants either 3 days prior to or 3 days after pathogen inoculation. All treatments included the wetting agent Tween 20 at a concentration of 0.1%. The pre-inoculation fungicide treatments were applied on 5 June and the post-inoculation treatments on 11 June. All plants were sprayed to run-off with a Canyon, hand-held pneumatic sprayer. The experiment consisted of 13 pre-inoculation and 13 post-inoculation treatments (one plant per treatment), arranged in a randomised block design and replicated three times.

Plants were assessed for disease on 22 June and 1 July, 14 and 23 days respectively after pathogen inoculation. Three stems per plant were selected randomly for disease assessment and the total number of leaves, infected leaves and lesions per leaf were recorded. The disease levels for each treatment are expressed as the percent number of

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TABLE 1: Fungicides applied to carnations

Common name	Trade name	Percent ai	Application rate (g ai/100 litres)
maneb	Manex	45	225
chlorothalonil	Bravo 500F	50	150
prochloraz	Octave 50 WP	50	50
myclobutanil	Systhane 40 WP	40	10
pyrifenox	Dorado 25 WP	25	10
San 619	(experimental)	10	4.5
carbendazim	Delsene 75	75	23
flusilazol	Nustar	20	3
bitertanol	Baycor 50 WP	50	25
hexaconazole	Anvil	5	5
triforine	Saprol	19	19
fenpropimorph	Corbel	75	45

infected leaves per stem. All data were subjected to an arcsine transformation prior to analysis of variance.

RESULTS

Results are shown in Table 2. The incidence of fairy ringspot disease was high in the absence of fungicides. Maneb, chlorothalonil, prochloraz, myclobutanil, pyrifenox, San 619 and carbendazim, applied as protectants significantly ($P=0.01$) reduced the incidence of fairy ringspot disease at both assessments, compared to the control. In addition maneb, chlorothalonil and prochloraz reduced the observed incidence of leaf infection to less than 2%.

Prochloraz, pyrifenox and myclobutanil, applied as eradicants, significantly ($P=0.01$) reduced incidence of fairy ringspot disease, at both assessments compared to the control. The prochloraz and pyrifenox eradicant treatments reduced the incidence of leaf infection to less than 3%, which was significantly lower ($P=0.01$) than in those treated with myclobutanil. In contrast to pre-inoculation treatments, disease incidence for maneb and chlorothalonil applied after infection was high.

TABLE 2: Incidence of fairy ringspot disease on spray carnation plants (cultivar Mei Fu). Arcsine transformed means are presented with back transformed means in brackets.

Treatment	Assessment 1 (% infected leaves per stem)				Assessment 2 (% infected leaves per stem)			
	Pre-inoculation		Post-inoculation		Pre-inoculation		Post-inoculation	
maneb	0.03**	(0.1)	0.85	(55.6)	0.00**	(0.0)	1.14	(82.8)
chlorothalonil	0.11**	(1.1)	1.22	(88.0)	0.03**	(0.1)	1.41	(97.3)
prochloraz	0.06**	(0.4)	0.07**	(0.5)	0.12**	(1.5)	0.13**	(1.6)
myclobutanil	0.23**	(5.1)	0.64**	(35.5)	0.31**	(9.3)	0.69**	(40.3)
pyrifenox	0.26**	(6.7)	0.17**	(2.7)	0.33**	(10.6)	0.16**	(2.4)
San 619	0.30**	(9.9)	0.82	(53.1)	0.35**	(12.0)	0.87*	(58.1)
carbendazim	0.45**	(18.7)	1.15	(82.9)	0.43**	(17.5)	1.18	(85.3)
flusilazol	0.69	(40.9)	0.85	(56.7)	0.68*	(40.0)	0.95	(65.8)
bitertanol	0.60	(32.1)	1.00	(70.6)	0.73*	(43.9)	1.07	(76.5)
hexaconazole	0.68	(39.0)	0.70*	(41.8)	0.74	(45.3)	0.87*	(57.9)
triforine	0.67	(38.4)	1.24	(89.7)	0.77	(48.6)	1.08	(78.0)
fenpropimorph	0.96	(66.9)	1.27	(91.4)	0.99	(70.0)	1.29	(92.3)
control (water)	0.84	(55.0)	1.08	(77.9)	1.03	(73.4)	1.23	(89.7)
LSD (5%)	0.29		0.29		0.30		0.30	
LSD (1%)	0.38		0.38		0.40		0.40	

* indicates treatment significantly different from the control at $P=0.05$.

**indicates treatments significantly different from the control at $P=0.01$.

Protective treatments with flusilazol and bitertanol (assessment two only) and eradicator treatments with hexaconazole (assessments one and two) and San 619 (assessment two only) also significantly ($P = 0.05$) reduced the incidence of fairy ring spot disease, but disease control was considered to be commercially unacceptable.

DISCUSSION

At the rates used in this trial the fungicides maneb, chlorothalonil, and prochloraz provided effective protection against infection by *C. echinulatum*. However, both formulations of maneb and chlorothalonil may cause phytotoxicity to carnations. The recommended rate of maneb, applied as a flowable formulation, caused serious growth distortions to all treated carnation plants. This formulation of maneb has now been withdrawn and replaced with ManexII, which contains 48% mancozeb. Subsequent trials with a wettable powder formulation of maneb and flowable and wettable powder formulations of mancozeb did not cause phytotoxic effects on treated carnations. Blossom damage has occurred to carnations after the application of chlorothalonil (see label) and this product should therefore only be used before petal colour shows.

Of the three fungicides shown to be capable of reducing newly established infections, prochloraz and pyrifenoxy were clearly the most effective. Excessive use of either of these fungicides may increase the risk of selecting for less sensitive strains of *C. echinulatum*. Prochloraz and pyrifenoxy inhibit a single metabolic pathway and belong to the group of fungicides known as Demethylation Inhibitors (DMI's). Resistance to this group of fungicides has been implicated in disease control failures of powdery mildew of glasshouse ornamentals (Powell 1983).

Broad spectrum protectant fungicides are more cost-effective than site-specific fungicides. They are therefore best used for routine disease protection, saving the site-specific chemicals for when conditions are most favourable to *C. echinulatum* infection.

This research is to be extended to test the performance of the most promising fungicides under commercial greenhouse conditions. The effectiveness of another dithiocarbamate fungicide (mancozeb) and fungicide mixtures will also be evaluated. There may also be a need for a resistance monitoring programme to monitor sensitivity changes of *C. echinulatum* to DMI fungicides.

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REFERENCES

- Nathaniels, N.Q.R., 1983. Ringspot or fairy ringspot of carnations. Ministry of Agriculture Fisheries and Food. Technical Bulletin 83/51.
Powell, C.C., 1983. Fungicide resistance problems on glasshouse ornamentals. *Plant Disease* 67: 334.