Column Stocks: Evaluation of fungicides for control of downy mildew and crop safety - 1993 (PC90)

Final Report (June 1993)

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Title:	Protected column stocks - Evaluation of fungicide treatments for control of downy mildew and crop safety
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APPLICATION

The objective of the project was to provide information on the efficacy, cost and crop-safety of fungicide treatments for control of downy mildew on column stocks. Treatments were identified which did not cause crop damage. The costs of different treatments were determined.

SUMMARY OF RESULTS

The objectives of the work were: (1) to evaluate a range of fungicide products and programmes for efficacy and crop safety, (2) to determine if there were alternative products to the current standards (Filex and Favour) which could provide good disease control at a lower cost.

An experiment was established on a commercial nursery in a crop of column stocks grown with overhead irrigation in an unheated polythene tunnel . Plants were sprayed at high volume with water or sprayed or drenched with fungicide on four occasions at 14-day intervals starting three days after planting. A leaf-tip scorch occurred on lower leaves of 5% of plants drenched with Filex after the first treatment but not after subsequent treatments. High volume sprays of Aliette, Bravo 500, Curzate M, Favour, Filex, Ripost or Zineb W.P., or drenches of Aliette, did not cause crop damage.

No natural infection by downy mildew occurred and the disease failed to spread into the crop when affected plants were planted around the trial area.

A low incidence of pythium root rot occurred in the crop. There was no significant difference between treatments in the number of plants affected.

All fungicide treatments appeared to improve bloom quality at cutting but there were no significant differences between treatments.

ACTION POINTS FOR GROWERS

1. Filex applied as a drench at a rate of 500 ml product / 100 l and at 2 l/m^2 may cause leaf-tip scorch on lower leaves of young plants.

2. High volume sprays of Aliette (200g product / 100 l), Bravo 500 (220 ml /100 l), Favour (400 ml/100 l) or Zineb W.P. (200g/100 l) did not cause crop damage at any stage from treatment four days after planting to one week before cutting.

3. At the rates used in this work, the cost of fungicide applied as a high volume spray to 100 m^2 of crop ranged from 5 p (Zineb W.P.) to 82p (Favour). A Filex drench cost £38.40 / 100 m^2

INTRODUCTION

Downy mildew of column stocks (*Matthiola incana*) is caused by the fungus *Peronospora parasitica*. It is a common disease of the crop and is particularly troublesome on young plants and on crops grown with poor ventilation and with overhead irrigation. It most commonly affects plants in April and May. Experimental work in New Zealand (Jafar, 1963) indicated that *P. parasitica* from the cultivated stock affects only *M. incana* and *M. bicornis* and not other cruciferous plants.

Downy mildew produces yellow blotches on the upper leaf surface and an obvious white mycelium below, making stems unmarketable if infection is severe, or downgrading them (more leaves need to be removed). Filex has a label recommendation for control of downy mildew on ornamentals and is often used on column stocks. Aliette and Fongarid have label recommendations for control of root diseases of pot plants and these products also have activity against downy mildew. Bravo 500, Favour and Zineb W.P. may be used on protected column stocks at growers own risk under the long-term off-label arrangements. These products also have activity against downy mildew. Curzate M and Ripost have label recommendations for control of potato blight, and may be active against column stocks downy mildew. In a few instances crop damage has been reported by growers following fungicide treatment of column stocks with Favour for control of downy mildew.

Losses caused by downy mildew vary from year to year according, in part, to weather and growing conditions. In May 1991 some crops were very severely affected while last year the disease occurred at relatively low levels.

There is no reference to resistant varieties in technical information on growing the crop and in discussion with colleagues and growers none were aware of marked differences in varietal susceptibility.

MATERIALS AND METHODS

Crop details

The crop was grown with overhead irrigation in a polythene tunnel (36 x 8 m) . Soil was steam-sterilised before planting and base fertiliser (7 : 12 : 12) was incorporated at 1.27 kg/100 m^2 (1 cwt/acre). The previous crop was chrysanthemum. Seedlings of column stocks (Royal Sluis, medium early, mixed colours) were planted on 28 March at 65/m^2. There were four beds, each 1.22 m wide, running along the tunnel length.

Experimental design and analysis

Treatments were arranged in a randomised block design with each bed as a replicate block. Plot size was 1.50 x 1.22m. There were guard plots, each at least 2 m in length, at each end of a block. Data were examined by analysis of variance.

Treatments

	Product	Rate applied	Active ingredient
1	Water (control)	-	
2	Filex	150 ml/ 100 l	propamocarb HCl (722 g/l)
3	Favour 600 SC	400 ml/ 100 l	metalaxyl + thiram (100 : 500 g/l)
4	Favour 600 SC	200 ml/ 100 l	metalaxyl + thiram (100 : 500 g/l)
5	Zineb WP	200 g / 100 l	zineb (70%)
6	Aliette	200 g / 100 l	fosetyl - Al (80%)
7	Aliette	100 g / 100 l	fosetyl-Al (80%)
8	Curzate M	200 g / 100 l	cymoxanil + moncozeb (4.5 : 68%)
9	Ripost WDG	250 g / 100 l	cymoxanil + mancozeb + oxadixyl (3.2 : 56 : 8%)
10	Bravo 500	220 ml/ 100 l	chlorothalonil (500 g/l)
11	Aliette drench (200 g/100 l) then three sprays (200 g/100 l)		
12	Filex drench (500 g/100 l) then three sprays (150 g/100 l)		
13	Filex drench (500 g/100 l) then alternating sprays of Favour (400 ml) and Filex (150 ml)		

Experimental permits were obtained from MAFF Pesticide Safety Division to use Curzate M and Ripost.

Sprays were applied from a knapsack sprayer using a lance fitted with a 015 - F110 flat-fan nozzle at 3 bars pressure. Sprays were applied to the point of run-off; the first two treatments were at 1000 l/ha, the third at 1250 l/ha and the fourth at 1500 l/ha.

Drenches were applied at 2 l / m^2 using a watering can.

Aliette and Filex drenches, all Aliette sprays and the first Filex spray were rinsed off plants with water (1000 - 1500 l/ha) after application, as recommended on product labels.

Infector plants

Twenty plants affected by downy mildew were planted around the edge of the trial area on 30 April. The crop was irrigated heavily after this introduction and the tunnel was kept closed for three days.

Assessment

The crop was examined for downy mildew every 14 days. The central 100 plants (10 rows of 10) in each plot were examined for evidence of leaf scorch on 15 April and the incidence of affected plants was noted. The same areas were assessed for the number of stunted plants on 29 April. Samples of stunted plants were examined for root and stem base pathogens. Bloom quality was assessed at cutting on 21 May. Ten plants were selected at random from the central 100 of each plot and assessed on a 1 to 4 scale:

1 - poor bloom; small and/or asymmetric shape and loose, irregular arrangement of flowers (unmarketable).

2 - moderate bloom; slightly small and/or asymmetric shape, or irregular arrangement of flowers.

3 - good bloom; large and symmetric in shape; generally tight arrangement of flowers with occasional gaps.

4 - excellent bloom, large and symmetric in shape, tight arrangement of flowers on stalk with no gaps.

A weighted flower quality index (0 - 100) was calculated according to the proportion of flowers in each category using the formula:

$$\text{Index} = \frac{(\text{No flowers in category 1}) + 2\,(\text{No in 2}) + 3\,(\text{No in 3}) + 4\,(\text{No in 4})}{\text{Total number of flowers assessed}} \times \frac{100}{1}$$

Crop diary

28 March	Seedlings planted
1 April	First fungicide treatment
15 April	Second fungicide treatment and phytotoxicity assessment
29 April	Third fungicide treatment and pythium assessment
30 April	Infector plants introduced
13 May	Fourth fungicide treatment
21 May	Flowers cut; quality assessment

Cost of fungicide treatment

The costs of fungicides (excluding VAT) were obtained from a local horticultural distributor in April 1993. The cost of each treatment was then calculated assuming sprays were applied in 1000 l water/ha and drenches at 2l/ m^2.

RESULTS

Disease

No natural infection by downy mildew occurred and the disease failed to spread into the crop when infector plants were planted around the trial area.

Small patches of slightly stunted and yellowing plants occurred in the trial. Samples of affected plants collected on 29 April were found to have poor roots and tests revealed a *Pythium* sp. consistently present in them. No *Rhizoctonia* sp. was found. The mean incidence of plants with pythium root rot was 3.4%; there were no significant differences between treatments (Table 1).

Table 1. Effect of fungicide treatment on incidence of pythium root rot and flower quality at cutting.

Treatment		Pythium (mean % plants affected) 29 April	Flower quality (0 - 100) 21 May
1	Water	2.5	59.4
2	Filex spray	11.0	72.5
3	Favour spray	0.0	65.6
4	Favour spray	7.3	66.3
5	Zineb spray	0.8	69.4
6	Aliette spray	1.5	63.8
7	Aliette spray	2.8	67.5
8	Curzate M spray	1.5	63.8
9	Ripost spray	0.5	70.0
10	Bravo 500 spray	1.8	65.6
11	Aliette drench then sprays	1.8	70.6
12	Filex drench then sprays	11.0	63.8
13	Filex drench then Favour and Filex sprays	2.0	68.1
SED (36 df)		5.66	5.65
Significance		NS	NS

Flower quality: 0 - poor, 100 - excellent

Phytotoxicity

Two weeks after the first fungicide treatment a white or pale-fawn leaf tip scorch was evident on the bottom two or three leaves of occasional plants treated with a Filex drench. No symptoms were observed in other treatments, or following subsequent fungicide treatments.

Flower quality

All fungicide treatments appeared to improve the mean flower quality (Table 1) although differences were not statistically significant.

Cost of fungicide treatment

The cost of a single application of each treatment is shown in Table 2. The cost of applying a drench treatment is considerably more expensive than applying a high-volume spray.

Treatments

1	Control	
2	Filex sprays at 150 ml/100 l	(pot plant rate)
3	Favour sprays at 400 ml/100 l	(lettuce downy mildew rate)
4	Favour sprays at 200 ml/100 l	(half-rate)
5	Zineb sprays at 200g/100 l	(lettuce downy mildew rate)
6	Aliette sprays at 200 g/100 l	(hop downy mildew rate)
7	Aliette sprays at 100g/100 l	(pot plant rate)
8	Curzate M sprays at 200 g/100 l	(potato blight rate)
9	Ripost sprays at 250 g/100 l	(potato blight rate)
10	Bravo 500 sprays at 220 ml/100 l	(potato blight rate)
11	Aliette drench (200 g/100 l) then sprays (200 g/100 l)	
12	Filex drench (500 ml/100 l) then sprays (150 ml/100 l)	
13	Filex drench (500 ml/100 l) then Favour (400 ml/100 l) and Filex (150 ml/100 l)	

Table 2. Cost of fungicide treatments

		Cost/unit (kg or l)	Cost/100 l solution at treatment rate	Cost/ 100 m^2 (one spray or drench)
1	Control	-	-	-
2	Filex	£38.40/l	£5.73	57p
3	Favour (H)	£20.44/l	£8.17	82p
4	Favour (L)	£20.44/l	£4.09	41p
5	Zineb	£2.24/kg	£0.45	5p
6	Aliette (H)	£22.47/kg	£4.50	45p
7	Aliette (L)	£22.47/kg	£2.25	22p
8	Curzate M	£10/kg	£2.00	20p
9	Ripost	£10/kg	£2.50	25p
10	Bravo 500	£7.50/l	£1.65	16p
11	Aliette (D) + (S)	£22.47/kg	£4.50	£9.00 + 45p
12	Filex (D) + (S)	£38.40/l	£19.20	£38.40 + 57p
13	Filex (D) + (S)	£38.40/l	£19.20	£38.40 + 82p + 57p

H - high rate D - drench
L - low rate S - spray

Calculated assuming sprays applied at 1000 l/ha and drenches at 2 l/m^2

DISCUSSION

The crop was of a relatively short duration (8 weeks) and hence the opportunity for natural infection to occur was dependent on weather favourable to downy mildew during this time. Periods of misty and wet weather occurred in parts of Norfolk in the month after the trial was established and there were several reports of downy mildew affecting column stocks within a few miles of the trial site, although not on the grower's own crop on the host nursery. Both glasshouse and polythene tunnel crops were affected. One glasshouse crop which had been well ventilated and treated with one drench of Filex and one spray of Favour was severely affected.

Downy mildew spreads by means of aerially-dispersed asexual spores (conidia) and this is believed to be the usual method by which the disease arrives on a nursery. Resting spores (oospores) have not been reported although they are known in other crops affected by *P.parasitica*. If *P.parasitica* does not survive between crops, occurrence of downy mildew on a nursery is dependent on influx of conidia and lack of disease in the trial reported here may reflect an absence of incoming air currents carrying conidia. The possibility of *P. parasitica* surviving on a nursery, either as oospores in soil or debris, or as conidia, may warrant further investigation. Conidia of some forms of *P. parasitica* have been shown to remain viable for more than 100 days at low temperatures and in the absence of moisture (Krober, 1970).

Infection and sporulation of *P. parasitica* on *Matthiola* spp. is optimal at 15.5 - 21°C. No spore germination occurs above 27° C (Jafar 1963). Warm, sunny weather occurred in early May immediately after introduction of infector plants and this probably resulted in temperatures in excess of 27°C in the tunnel. This probably prevented disease spread from infector plants to the crop.

The experimental work described here indicates that several different fungicides can be used safely on protected column stocks. However, before a cost-effective and durable fungicide programme can be devised, further information on fungicide efficacy is required. Some control of the disease has been achieved by spraying weekly with zineb (Jaffar, 1963) or every 3 - 4 days with a copper oxychloride - zineb mixture (Bertus, 1968). Favour and Filex are widely used at present and generally to good effect, although in two crops in 1993 (in Cambs and Norfolk) the disease appeared still to be active seven days after treatment with Favour.

The large differences in costs between some of the fungicide programmes used here emphasise the need for further work on the economics and efficacy of fungicide treatment. With the knowledge obtained from this experiment it is recommended that any new work on the disease should be in an early (February) crop grown from seed (in order to lengthen crop duration); that it is located on a nursery with a history of downy mildew; and that conidia of *P. parasitica* or affected leaves or plants are placed in the house as soon as seedlings emerge. These measures should increase the probability of downy mildew affecting a crop. Improved knowledge of the survival of *P. parasitica* between crops would also help in the development of low cost, effective spray programmes.

CONCLUSIONS

1. Filex applied as a drench at a rate of 500 ml product / 100l and 2 l /m^2 may cause a leaf tip scorch on lower leaves of young plants.

2. High volume sprays of four products permitted on protected column stocks (Bravo 500, Favour and Zineb) and two products not currently permitted (Curzate M and Ripost), did not cause crop damage.

3. Application of a post-planting fungicide treatment as a drench is considerably more expensive than as a high-volume spray.

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