EVALUATION OF FUNGICIDE PROGRAMMES COMPATIBLE WITH INTEGRATED CONTROL OF EUROPEAN RED MITE

J.T.S. WALKER, G.T. BAYNON¹, P.W. SHAW and D. CASSIDY²

Entomology Division, DSIR, Havelock North and Appleby

¹Rohm and Haas New Zealand Ltd., Auckland

²Division of Horticulture and Processing, DSIR, Appleby

SUMMARY

The black spot/powdery mildew fungicide, myclobutanil, was evaluated for its effect on integrated mite control of European red mite by its predator, *Typhlodromus pyri* on apple. Applications were made at 7-11 day intervals during the russet sensitive period, between late September and mid-November. From mid-November trees were treated with either mancozeb, metiram or captan in a regular programme until late summer. Myclobutanil provided excellent disease control and fruit finish with no adverse effects on predatory mites. Mite control was outstanding when the myclobutanil programme was followed by captan but when followed by mancozeb or metiram control was disrupted.

INTRODUCTION

Integrated mite control (IMC), based on organophosphate insecticide resistant *Typhlodromus pyri*, is a widely accepted strategy for control of European red mite (*Panonychus ulmi*) in New Zealand apple orchards. Successful IMC requires the orchardist to avoid the use of pesticides that disrupt control by predatory mites and many commonly used insecticides, miticides and fungicides are compatible with IMC (Wearing and Ashley 1982). Compatible fungicides include captan, dodine, thiram and a new group of fungicides, the ergosterol biosynthesis inhibitors (EBI's) such as myclobutanil. The only widely used fungicides that are disruptive to IMC are mancozeb and metiram from the ethylene-bisdithiocarbamate (EDBC) group (Wearing and Proffitt 1982; Wearing and Wilton 1984).

A regular programme of fungicides is required for control of black spot (*Venturia inaequalis*) and powdery mildew (*Podosphaera leucotricha*) on apple and their use dominates orchard spraying activities until mid-summer. The choice of a fungicide programme must not only provide disease control and excellent fruit finish, but also consider effects on predatory mites. Recently, the risk of fungal resistance has also become an important consideration. Mancozeb and metiram are protectant fungicides which are widely used in early summer when alternative products, such as captan or dodine, are not used because they increase the risk of russet damage. However, to minimise disruption to IMC it is recommended that mancozeb and metiram be used only during the russet-sensitive period of fruit development, from mid September (tight cluster bud stage) until late November (second cover).

The impact of metiram and mancozeb on IMC when applied in early and mid-summer has been investigated in field trials. Wearing and Shaw (unpublished data) found that both products suppressed *T. pyri* populations and disrupted mite control in mid and late summer, with each additional application causing greater disruption. Walker and Shaw (unpublished data) examined a black spot fungicide programme which minimised use of mancozeb or metiram in early summer (four applications at 10-14 day intervals) but mite populations still reached damaging levels by late summer. The effects of mancozeb and metiram on *T. pyri* have also been investigated in laboratory studies. Baynon and Penman (1987) did not find significant mortality to adults or nymphs with either product, but field rates of both fungicides reduced the hatch rate of young eggs. All field studies have indicated some disruption to IMC where either of these products are used in early summer, a time which is important in the

Proc. 41st N.Z. Weed and Pest Control Conf.

seasonal development of *T. pyri* populations.

No reported studies have examined the effect on IMC of either mancozeb or metiram used in mid or late summer only. The aim of this study was to formulate a fungicide programme to control black spot that was compatible with IMC. The programme was based on use of myclobutanil during the russet-sensitive period in early summer, followed by mid and late summer use of either mancozeb, metiram or captan. These were compared with a standard programme based on full-season use of metiram.

MATERIALS AND METHODS

The trial was conducted at the DSIR Research Orchard, Appleby, Nelson, on a 7 year old block of "Royal Gala" apples which contained OP-resistant *T. pyri* and had no recent problems with mite control. All trees in the block were sprayed with two applications of dodine (Syllit 40W) prior to the commencement of the experimental treatments. An oil spray, normally recommended for mite control in an IMC programme (Wearing and Ashley 1982), was not applied. There were four fungicide treatments plus an untreated control (Table 1) replicated five times and arranged in a randomised complete block design. Each replicate consisted of a single tree which was separated from the adjacent in-row treatment by a guard tree.

TABLE 1: The experimental fungicide treatments, their period of use and rates.

Treatment	Sept 23 — Nov 18	Rate g ai/100 litres	Nov 18 — Jan 29	Rate g ai/100 litres
A	myclobutanil	4.5	mancozeb	100
B	myclobutanil	4.5	captan	100
C	myclobutanil	4.5	metiram	100
D	metiram	100	metiram	100
E	untreated		untreated	

Fungicides were applied by hand lance using a high pressure sprayer (8-10 litres per tree) from September 23, 1987 (tight cluster). In Treatments A, B and C myclobutanil (Systhane 40W) was applied at 7-11 day intervals depending on weather conditions. After each black spot infection period myclobutanil was re-applied within 4 days and a 10 day use pattern resumed. Under this programme a total of eight applications of myclobutanil were made between September 23 and November 18, 1987 with an average interval of 8.4 days between applications. Treatment D represented a standard black spot control programme based on metiram (Polyram 2000). Eight applications of metiram were applied up to November 18 together with three applications of bitertanol (Baycor 50WP, 50% ai) and one of thiophanate-methyl (Topsin M-4A, 40% ai), due to the occurrence of black spot infection periods.

The protectant fungicides mancozeb (Dithane M45), captan (Orthocide 80W) and metiram were applied to Treatments A, B and C respectively from November 18, commencing at the final application of myclobutanil. Six applications were required in each of the three treatments, at 6-18 day intervals, depending on weather conditions. The final application was on January 29, 1988. Four applications of dodine were also required between late November and mid-February for black spot infection periods occurring during that time.

Fungicides were also applied for control of powdery mildew. On Treatments A, B and C triadimefon (Bayleton 5DF, 5% ai) was applied after November 18. On Treatment D, nitrothal-isopropyl (Pallitop 48% ai) was applied until November 18 and thereafter triadimefon was used. Insect control was a two-weekly programme of azinphos-methyl (Gusathion, 50% ai) applied by airblast sprayer to all treatments.

Mite populations in each treatment were monitored by recording active stages of ERM and egg and active stages of *T. pyri* on 50 leaf samples (10 leaves per treatment replicate). Samples from each replicate were pooled to give one sample count per treatment. Leaves were brushed using a mite brushing machine and mites counted using a binocular microscope. Samples were collected weekly from late October until mid-

December and fortnightly thereafter. Additional leaf samples were collected on November 2, December 7 and January 11. Each replicate was recorded separately to permit statistical analysis of the mite counts in each treatment at these times.

The effect of each treatment on black spot control and fruit finish was determined by randomly sampling 100 fruit at harvest (March 8, 1988) from each of the five replicates. Russet was recorded in accordance with MAF export grade standards, i.e. any fruit with rough russet or >10% smooth russet was downgraded.

RESULTS

The effect of the fungicide treatments on seasonal changes in ERM and *T. pyri* numbers is shown in Figures 1A-1E. In all treatments numbers of ERM remained low and essentially static throughout November, then increased slightly in early December as summer eggs hatched. ERM numbers did not increase appreciably until late January and then only in treatments receiving either mancozeb or metiram. In these treatments mite numbers peaked in mid-March and were marginally higher in the two metiram programmes (Treatments C and D). In contrast, ERM numbers remained below 2 per leaf on captan treated and untreated trees (Treatments B and E) throughout the season.

Predator numbers on trees receiving myclobutanil during flowering (Figs. 1A-1C) were low, but similar, during early November. In Treatment D, during the same period, there were fewer *T. pyri* eggs and active stages (Fig. 1D) after six applications of metiram. Predators increased in all treatments during November, but the smallest increase occurred in Treatment D when by December 7 numbers of predator eggs and active stages were significantly lower ($P < 0.01$) than in Treatments B (captan) and E (untreated). Counts of predators in Treatments B and E were consistently higher than in other treatments until late January when numbers declined due to lack of food (Figs. 1B and 1E). *T. pyri* active stages were more numerous between mid-December and late January in Treatments A (mancozeb) and C (metiram) than in Treatment D, where metiram had been applied throughout, but counts of eggs were low and similar in all three treatments. Predator numbers did, however, increase in Treatments A, C and D during February and March, in response to an increasing food supply.

Harvest assessment of fruit showed that each fungicidal treatment provided a high level of black spot control (Table 2.) All treatments were significantly different ($P < 0.01$) to Treatment E (untreated). There were no significant differences in the percentage of fruit downgraded due to russet between any of the treatments (Table 2). All fungicide treatments yielded fruit of excellent appearance.

TABLE 2: Percentage of fruit in each treatment with black spot and the percentage of fruit failing export grade standards due to russet.

Treatment	Fruit with black spot %	Downgraded for russet %
A Myclobutanil/mancozeb	6.2	1.6
B Myclobutanil/captan	2.4	1.4
C Myclobutanil/metiram	4.4	2.2
D Metiram	0.8	2.2
E Untreated	99.4	1.6

DISCUSSION

Myclobutanil applied between late September and mid-November was neither toxic nor disruptive to *T. pyri*, numbers of which were not significantly different from those in untreated trees in early December. However, numbers of *T. pyri* from those in untreated trees in early December. However, numbers of *T. pyri* (both eggs and active stages) in Treatment D were suppressed, and suppression continued until late February, or for approximately 4 weeks after the final application of metiram on January 29. Season-long suppression of *T. pyri* by the metiram applications contributed to an unfavourable prey:predator ratio (>7:1) by early February which resulted in damaging levels of ERM during late summer.

Fig. 1: The numbers of European red mite (—■) and *Typhlodromus pyri* active stages (—▲) and eggs (—●) per leaf on apple trees treated for the control of black spot with:

A a myclobutanil/mancozeb programme

B a myclobutanil/captan programme

C a myclobutanil/metiram programme

D a season-long metiram programme

E untreated

Arrows indicate date of final myclobutanil application

Use of myclobutanil followed by mancozeb (Treatment A) or metiram (Treatment C) permitted greater survival of *T. pyri* during December and January but the mancozeb and metiram applications still caused some suppression. Despite initially low levels of ERM, unfavourable prey:predator ratios still developed in these treatments during mid-February and late January respectively, resulting in high numbers of ERM in mid-March. Numbers of predators in both treatments remained almost static for 3-4 weeks after applications of mancozeb or metiram ceased. In contrast, numbers of predatory mites in the myclobutanil/captan programme were, for the greater part of the season, more numerous than ERM. Control in this treatment was complete and similar to untreated trees with prey:predator ratios favourable (< 2:1) at all times.

The black spot present in each treatment probably resulted from an extended spray interval in late December which coincided with a serious infection period and from the high incidence of the disease in adjacent, untreated guard and control trees. Due to the frequency of serious infection periods, in this programme, in which myclobutanil served as both a protectant and an eradicant, more applications were required than anticipated. From a fungicide resistance management perspective it would be desirable to reduce the number of applications to five or six per season.

A fungicide programme based on myclobutanil, during the early period of fruit development and captan from mid/late November would be desirable for several reasons. It has no disruptive effect on IMC and would simultaneously provide control of both black spot and powdery mildew. The resulting fruit finish would also be commercially acceptable. For an orchardist wishing to maximise the benefits of IMC, use of mancozeb or metiram should be minimised.

ACKNOWLEDGEMENTS

The authors would like to thank the field staff at the DSIR Research Orchard, Appleby for their assistance with application of the treatments. The technical assistance of Ms V. Cruickshank and Ms V. White is also gratefully acknowledged.

REFERENCES

- Baynon, G.T. and Penman, D.R., 1987. The effects of mancozeb and metiram on the predatory mite, *Typhlodromus pyri*. *Proc. 40th NZ Weed and Pest Control Conf.*: 104-107.
- Wearing, C.H. and Ashley, E., 1982. A recommended spray programme for integrated mite control on apples. *Orchardist of NZ* 55: 27-29.
- Wearing, C.H. and Proffit, C.A., 1982. Integrated control of apple pests in New Zealand. 18. Introduction and establishment of the organophosphate-resistant predatory mite *Typhlodromus pyri* in the Waikato. *Proc. 35th NZ Weed and Pest Control. Conf.*: 22-26.
- Wearing, C.H. and Wilton, W.J.W., 1984. Black spot fungicides and integrated mite control. *Orchardist of NZ* 57: 30-31.