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# NITROTHAL-ISOPROPYL IN ADMIXTURES WITH ZINEB-POLYETHYLENE THIURAM DISULPHIDE COMPLEX AND SULPHUR FOR THE CONTROL OF POWDERY MILDEW AND SCAB ON APPLE

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Summary Preliminary replicated field trials showed nitrothal-isopropyl (BAS 3000F) to be very effective for the control of apple mildew with a high degree of crop safety. Subsequent large-scale orchard trials, the results of which are contained in this report, confirmed these findings. Admixtures containing nitrothal-isopropyl:- BAS 38501F for the control of apple mildew and BAS 37900F for the control of apple mildew and apple scab, exhibited mildew control superior to several other standard fungicides when applied at equal or longer spray intervals. BAS 37900F also provided good control of apple scab when used as protectant sprays. Tree appearance and fruit quality were excellent with either product and results showed a reduction of fruit skin russet with BAS 37900F compared to some standard fungicides.

Résumé Des essais préliminaires à répétition en champs ont montré la grande efficacité du nitrothal-isopropyl (BAS 3000F) à l'égard de l'oïdium du pommier avec une absence de phytotoxicité. Par la suite des essais à grande échelle en verger, dont les résultats figurent ci-après, ont confirmé ces conclusions. Des associations à base de nitrothal-isopropyl:- avec BAS 38501F pour le contrôle de l'oïdium du pommier, et avec BAS 37900F pour lutter contre l'oidium et en même temps la tavelure, appliquées à la même cadence ou à des intervalles plus longs que plusieurs autres fongicides standard, ont montré un contrôle de l'oïdium supérieur à ceux-ci. Le BAS 37900F employé en traitements préventifs a donné aussi un contrôle efficace de la tavelure. L'aspect des arbres et la qualité des fruits étaient excellents avec les deux produits, et les résultats ont mis en évidence une réduction de la rugosité des fruits avec BAS 37900F comparée à certains produits de référence.

## INTRODUCTION

In replicated field trials, nitrothal-isopropyl (BAS 3000F) consistently gave superior control of apple powdery mildew (Podosphaera leucotricha) when compared with standard fungicides at spray intervals of up to 14 days and with no adverse effect on fruit finish (Phillips et al 1973). Nitrothal-isopropyl is not systemic and has predominantly protectant properties; good curative activity has, however, also been reported (Frick 1972). This fungicide is of low toxicity to mammals, bees and earthworms and Gruys has reported on its safety to predators in relation to integrated pest management (Gruys 1978).

This paper covers the subsequent development in the United Kingdom of two commercial products containing nitrothal-isopropyl i) BAS 38501F (trade name Kumulan) for the control of apple mildew and ii) BAS 37900F (trade name Pallinal) for the control of apple mildew and apple scab (Venturia inaequalis).

Large-scale orchard trials in 1975 and 1976 compared the efficacy of BAS 37900F, a wettable powder containing 12.5% nitrothal-isopropyl plus 60% zineb-polyethylene thiuram disulphide complex, with various standard fungicides. Applications commenced at early pink bud and continued until terminal buds closed.

In 1976 a full programme of 37900F was compared with a split programme in which 37900F, applied from early pink bud until mid-June when scab protection was no longer required, was followed by BAS 38501F, a wettable powder containing 16.7% nitrothal-isopropyl plus 53.3% sulphur, until terminal buds closed. Trials in 1977 compared full programmes of 37900F and 38501F for effects on fruit quality.

East Malling Research Station reported that certain new mildew fungicides increase skin russet and reduce fruit size of some cultivars (Butt et al 1973). Our assessments thus included fruit quality and size.

## METHOD AND MATERIALS

Site and experimental details are shown in Tables 1 and 2. Trial sites covered a wide geographical and climatic range and included the cultivar Cox's Orange Pippin together with many other cultivars. All sites were known to have had a moderate or severe incidence of mildew. Treatments were applied to unreplicated plots which varied in area from 0.4 ha to 1.6 ha, depending on spray volume and machine tank capacity. The plots were arranged as adjacent strips in one orchard at each site.

In 1975, 37900F was compared with various standard fungicides applied at their respective recommended rates. In 1976 and 1977, however, when both 37900F and 38501F were under test, it was not possible to include a third treatment as a standard in all trials. Prior to the first application of the experimental treatments the trials received the growers' normal spray programmes which at the majority of sites consisted of an eradicant scab fungicide.

## Table 1

## Trial details

| Trial | Year | Location | Standard fungicide (days between sprays) | Days between sprays: BAS 37900F | Days between sprays: BAS 37900F/ 38501F |
|---|---|---|---|---|---|
| A | 1975 | Kent | binapacryl (7) | a 7, b 14 | - |
| B | " | Kent | dinocap (7) | a 7, b 14 | - |
| C | " | Kent | thiophanate-methyl (14) | 14 | - |
| D | 1975 and 1976 | Gwent | dinocap (14) | 14 | 14 (1976 ONLY) |
| E | 1975 | Essex | dinocap (10) | 10 | - |
| F | 1976 | Kent | - | 14 | 14 |
| G | " | Kent | bupirimate (10) | 10 | 10 |
| H | " | Kent | - | 7 | 7 |
| I | " | Kent | pyrazophos + binapacryl (14) | 14 | 14 |
| J | " | Kent | - | 14 | 14 |
| K | " | Kent | - | 14 | 14 |
| L | " | Sussex | - | 14 | 14 |
| M | " | Hereford | - | 14 | 14 |
| N | " | Worcs. | - | 14 | 14 |
| O | " | Soms. | dinocap (7) | 7 | - |
| P | " | Essex | binapacryl (10) | 14 | 14 |
| Q | " | Essex | - | 10 | 10 |
| R | " | Essex | - | 7 | 7 |
| S | " | Suffolk | binapacryl (10) | 10 | - |
| T | " | Suffolk | i) binapacryl (10)<br>ii) pyrazophos (10) + binapacryl<br>iii) triforine (10)<br>iv) ditalimfos (10) | 10 | - |
| | | | | | BAS 38501F |
| U | 1977 | Kent | - | 14 | 14 |
| V | " | Kent | - | 14 | 14 |

Trials D G H K, M to P and R were continued in 1977 but with treatments as in trials U and V.

Table 2

Rates of the combined active ingredients per application (kg/ha)

| | Spray interval | | |
|---|---|---|---|
| | 7 days | 10 days | 14 days |
| BAS 37900F | 1.63 | 2.47 | 3.26 |
| BAS 38501F | 1.19 | 1.79 | 2.39 |

All treatments were applied with orchard mist blowers using water volumes ranging from 400 to 1125 l/ha according to the practice of each grower.

Assessments of secondary mildew were made on cv. Cox in all trials (except cv. Crispin in trial 0), immediately the spray programmes ended. Every leaf on 50 - 100 shoots per plot (depending on severity of infection) was assessed as healthy or mildewed. The shoots were randomly selected on trees in two parallel rows as close to the centre of each plot as possible. Leaf scab was absent from all trials and fruit scab occurred only once, in trial 0 in 1976, when an assessment was made after the fruit had been in refrigerated storage for three weeks. An unsprayed plot had been included in this trial; thus 37900F was compared with untreated trees and with captan, the standard scab fungicide. Fruit was recorded as healthy or scabbed on 1000 apples per plot. In 1976 and 1977, 200 - 500 Cox fruits per plot were picked at random and assessed for cracks and russet on a scale 0 to 10, where 0 = no russet and 10 = 100% surface area russeted. These samples were weighed to give an average weight per fruit.

RESULTS

Table 3

Comparison of spray programmes based on nitrothal-isopropyl and various standard fungicides for the control of apple powdery mildew, 1975 and 1976

| Trial | Leaves with secondary mildew (%) | | | |
|---|---|---|---|---|
| | Standard fungicide | 37900F | 37900F/ 38501F | Reduction by 37900F as % of standard |
| 7-day interval | | | | |
| A a. | 29.3 | 13.0 | - | 55.6 |
| B a. | 80.8 | 53.8 | - | 33.4 |
| 0 | 4.7 | 2.5 | - | 46.8 |
| Mean | | | | 39.7 |
| 10-day interval | | | | |
| E | 37.4 | 25.7 | - | 31.3 |
| G | 27.7 | 19.9 | 14.2 | 28.2 |
| S | 20.4 | 11.0 | - | 46.1 |
| Mean | | | | 33.7 |

Table 3 cont'd ...

Table 3 (cont'd)

Comparison of spray programmes based on nitrothal-isopropyl and various standard fungicides for the control of apple powdery mildew, 1975 and 1976

| Trial | Leaves with secondary mildew (%) Standard fungicide | 37900F | 37900F/ 38501F | Reduction by 37900F as % of standard |
|---|---|---|---|---|
| 14-day interval | | | | |
| A b. | 29.3 (7) | 23.2 | - | 20.8 |
| B b. | 68.0 (7) | 56.6 | - | 16.8 |
| C | 29.4 | 25.1 | - | 14.6 |
| D (1975) | 23.0 | 15.6 | - | 32.2 |
| D (1976) | 23.5 | 3.3 | 3.5 | 86.0 |
| I | 31.2 | 29.5 | 28.2 | 5.5 |
| P | 12.6 (10) | 7.1 | 6.1 | 43.7 |
| Mean | | | | 26.1 |
| Mean of trials D (76), G I and P | 23.8 | 15.0 | 13.0 | |
| Reduction by 37900F/38501F as % of Standard | | | 45.4 | |

Table 4

Control of apple powdery mildew by BAS 37900F in comparison with a split programme of BAS 37900F/BAS 38501F, 1976

| | Leaves with secondary mildew (%) 37900F | 37900F/38501F |
|---|---|---|
| Mean of trials D,F,G,H,I,J,L,P,Q and R | 17.3 | 14.4 |
| Reduction by 37900F/38501F as % of 37900F | | 16.8 |

Mildew levels on trials K,M,N and T were too low to give satisfactory assess-assessments for inclusion in Tables 3 and 4.

Table 5

Apple scab recorded in trial O, 1976

| Number per 1000 fruits | Untreated control | Captan | 37900F |
|---|---|---|---|
| Scabbed fruits | 22 | 12 | 1 |
| Fruits with severe russet | 104 | 2 | 1 |

It was noted at the time of assessment (Table 5) that most scab lesions had "dried-up", indicating that many infections had occurred early, probably in late June before a period of very dry weather in July. There was also a relatively large number of apples from the untreated plot with severe russet; as russet was scarce in the treated plots it seems probable that this condition was caused by the early infection of scab. Accordingly trial O is omitted from Table 6.

Table 6

Effect of BAS 37900F on apple fruit skin quality in comparison with various standard fungicides, 1976 (cv. Cox's Orange Pippin)

| Trial | Average russet score | | Cracked fruits (%) | |
|---|---|---|---|---|
| | Standard fungicide | 37900F | Standard | 37900F |
| D | 0.7 | 0.5 | 0.0 | 0.0 |
| G | 4.1 | 3.3 | 32.3 | 20.0 |
| I | 3.5 | 3.9 | 16.5 | 26.7 |
| P | 1.2 | 1.1 | 9.7 | 9.0 |
| S | 2.1 | 1.5 | 6.0 | 5.7 |
| T i) | 0.8 | 0.8 | 0.7 | 3.7 |
| ii) | 1.0 | 0.8 | 2.0 | 3.0 |
| iii) | 1.2 | 0.8 | 3.0 | 3.0 |
| iv) | 1.2 | 0.8 | 2.3 | 3.0 |
| Mean | 1.8 | 1.5 | 8.1 | 8.2 |

Table 7

Effects of two programmes based on nitrothal-isopropyl on the quality of apple fruit skins, cv. Cox's Orange Pippin

| | Average russet score | | Cracked fruits (%) | |
|---|---|---|---|---|
| 1976 | 37900F | 37900F/38501F | 37900F | 37900F/38501F |
| Mean of 13 trials | 1.5 | 1.5 | 10.2 | 10.1 |
| 1977 | 37900F | 38501F | 37900F | 38501F |
| Mean of 9 trials | 1.4 | 1.5 | 10.0 | 12.3 |

Table 8

Average fruit weight (g)

| | | | |
|---|---|---|---|
| 1976 | Standard fungicide | 37900F | 37900F/38501F |
| Mean of 5 trials | 103.1 | 101.9 | 109.3 |
| 1977 | | 37900F | 38501F |
| Mean of 9 trials | - | 96.5 | 94.8 |

## DISCUSSION

### Mildew Control

Results of trials in 1975 and 1976 show mean reductions of 40%, 34% and 26% with 37900F at 7-, 10- and 14-day intervals respectively, compared to the various standard fungicides (Table 3). Furthermore, application of 37900F at 14-day intervals gave better control than dinocap or binapacryl at shorter spray intervals (sites Ab, Bb and P). The cumulative effects of two seasons applications can be seen at trial D. In 1975, 37900F gave a 32% increase in control; in 1976 the increase in control had risen to 86% compared with the dinocap programme which provided approximately the same level of mildew in both years.

With a split programme of 37900F and 38501F an even greater increase in relative control was achieved; the split programme reduced mildew to 45% below the standard fungicides (Table 3) and to 17% below 37900F used alone (Table 4). It seems probable that this additional improvement is due to the sulphur content of 38501F because the quantity of applied nitrothal-isopropyl in both products is the same. The quantity of sulphur applied is relatively small, however, (approx. 1.8 kg/ha per 14-day application) and so there may be some synergism between nitrothal-isopropyl and sulphur, although this hypothesis has yet to be confirmed.

From these results it can be seen that the products based on nitrothal-isopropyl were consistently better than several standard fungicides, even at the 14-day spray interval which offers a reduction of labour requirement and a saving of fuel compared with 7 and 10-day intervals. It is clear from Table 3 that the spray interval should be shortened during periods of severe infection or rapid extension growth to maintain adequate control and improve control relative to some standard fungicides. 37900F and 38501F are non-systemic and therefore perhaps more reliable in periods when poor uptake and translocation might impede the performance of systemic fungicides.

### Scab Control

In the one trial where scab occurred, 37900F gave better control of fruit infections than did captan (Table 5).

In trials at the Horticultural Centre, Loughgall, N. Ireland (Meakin 1976, 1977), 37900F reduced both leaf and fruit scab by 94 - 99%. Similar results from New Zealand, the USA and Europe (BASF 1960 - 1975) together with experience of commercial usage in the UK have shown that 37900F provides good scab control when used as a protectant programme.

### Fruit Quality

The data presented in Table 6 show that although in comparison with some standard fungicides (with the exception of trial I) 37900F had no deleterious effect on fruit cracking, it reduced fruit russeting overall by 16%. The trend of reduced russeting and therefore superior fruit finish has also been seen in trials at Long Ashton Research Station (Byrde et al 1976), Luddington E.H.S. (Luddington 1976) and East Malling Research Station (Butt et al 1976). There were no major differences in fruit russeting, cracking or fruit size between 37900F and 38501F (Tables 7 and 8). The general appearance of trees and the quality of fruit was excellent with both products, with no apparent adverse effects on any of the apple cultivars (listed over) in the trials.

| | | |
|---|---|---|
| Acme Carl | Golden Delicious | Monarch |
| Bramley | Idared | Queen Cox |
| Cox's Orange Pippin | James Grieve | Red Delicious |
| Crispin | Jonathan | Red Miller |
| Discovery | Lambourne | Winston |
| Egremont Russet | Laxton Superb | Worcester Pearmain |
| Fortune | Merton Worcester | |

There were no problems of compatibility when either of the products was mixed and applied with the growers' usual range of pesticides and nutrient sprays.

BAS 3700F and 38501F offer effective and safe programmes for the control of apple powdery mildew and scab on numerous cultivars, with improvement over some standard fungicides even at 14-day intervals. Both products are of low toxicity to beneficial predators, earthworms and bees and have been confirmed as suitable for, and have been used in, integrated pest management programmes. (Gurzes and Cranham 1978).

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# EFFICACY OF IPRODIONE FOR THE CONTROL OF BROWN ROT AND FOLIAR DISEASES OF SWEET AND MORELLO CHERRY, PLUM, PEACH AND APRICOT

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Summary Iprodione was tested in Roumania in 1978 and 1979 against brown rot (Monilia laxa) on sweet cherry, Morello cherry, plum, peach and apricot.

Iprodione, applied in spray programmes at concentrations from 0.05 to 0.1% gave outstanding control of M.laxa on all the stone fruits tested.

In addition, iprodione showed good activity against various foliar fungi: Polystigma rubrum, Coryneum beijerinckii, Coccocymes hiemalis and Fusicladium pruni.

Iprodione was compatible with several insecticides and acaricides and the mixtures were non-phytotoxic.

On peaches, iprodione at 0.05% reduced losses due to fungal rots in store.

Resumé L'iprodione a été expérimenté en Roumanie en 1978 et en 1979 contre les monilioses des arbres fruitiers, causées par Monilia laxa sur des espèces fruitières telles que le cerisier, le griottier, le prunier, le pêcher et l'abricotier.

L'iprodione, appliqué dans les programmes de pulvérisations aux concentrations de 0.05% à 0.1%, a assuré une protection remarquable de M.laxa sur tous les fruits à royoux traités.

En ourte l'iprodione a montré une bonne activité contra plusieurs maladies des feuillages: Polystigma rubrum, Coryneum beijerinckii, Coccocymes hiemalis et Fusicladium pruni.

L'iprodione a été compatible avec plusieurs insecticides et acaricides et les mélanges n' étaient pas phytotoxiques.

Appliqué à 0.05% sur les pêches, l'iprodione a reduit les pertes dûes aux pourritures provoqués pars les champignons lors du stockage.

## INTRODUCTION

Under Roumanian climatic conditions, losses caused by Monilia spp. on late-and mid-season varieties of plum, cherry and peach rise to an average of 12-50% in untreated orchards. Other pathogens cause leaf-fall and a consequent reduction in photosynthesis; the most important of these foliar diseases are caused by Polystigma rubrum on plum, Coryneum beijerinckii on plum, sweet and Morello cherry, apricot and peach, Coccocymes hiemalis on sweet and Morello cherry and Taphrina deformans on peach.

To prevent these crop losses fungicide trials have been carried out in the principle stone-fruit producing countries. Particularly interesting results have been obtained with iprodione. In 1978 and 1979, numerous trials were therefore carried out in Roumania to test this chemical against M.laxa and other pathogens on the species of stone fruit mentioned above.

## MATERIALS AND METHODS

Iprodione, as a 50% a.i. formulation (Rovral®), was tested at concentrations from 0.05% to 0.1% on the following species: plum (cv. Vinat romanesc); sweet cherry (Boambe of Cotnari); Morello cherry (Timpurii of Clu); peach (Cardinal); apricot (Best of Hungary). The age of the trees was between 8 and 10 years. Spray volume depended on the species: 1000 l/ha on plum and Morello cherry, 2000 l/ha on peach and apricot and 3000 l/ha on sweet cherry. All the trials contained five replicates. Treatments were carried out according to spray programmes recommended by the crop protection services: six applications of fungicide to plum and sweet and Morello cherry, seven to peach and three to apricot. Comparison of efficacy was made with various fungicides.

In anticipation of the need to simultaneously control fungal diseases and various pests (e.g. Laspeyresia funebrana, Hyalopterus pruni, Bryobia rubrioculus and Panonychus ulmi) iprodione was often applied mixed with one of the following: fenbutatin oxide + cypermethrin, cartap, fenbutatin oxide, fenvalerate, cyhexatin, propargite, chlorofenizon, chlorofenvinphos, dimethoate, cypermethrin or decamethrin.

On peach (cv. Alberta), applications were also made 14, 7 and 1 day before harvest in order to reduce losses in stores at 4-5°C (80% r.h.) or at ambient temperature (75-80% r.h.).

Trials on plum and sweet and Morello cherry were at the Fruit Tree Research Institute of Pitesti-Maracineni; those on peach and apricot at the testing stations of the Institute of Constanda and Craioca.

Disease assessments were made on samples of 1500 fruit or 900 leaves in each treatment as frequency of attack (% infected). Notes were made of any spray damage (scale 0-6) (0 = zero area affected, 6 = >75% area affected).

## RESULTS

### Plum trials

Control plots had 22-26% of fruit infected with M.laxa; plots treated with iprodione (0.05 and 0.075%) showed no attack by this fungus (Tables 1 and 2).

Iprodione also gave good control of P.rubrum, because only 0.2-8.5% of leaves showed traces of attack whereas in the non-treated plots there was a 25-32.5% attack of leaves (Tables 1 and 2). All mixtures containing iprodione reduced C.beijerinckii (18.9-39.4% leaves infected) in comparison with untreated controls (43.7-71%). A low infection of Fusicladium pruni was also well controlled.

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Table 1

Efficacy of iprodione against fruit and leaf diseases of plum in 1978

| Treatment and % concn | | Number of sprays | % fruit with Monilia | % leaves with | | Phyto-toxicity on leaves | Yield | |
|---|---|---|---|---|---|---|---|---|
| | | | | Polystigma | Coryneum | | kg/tree | % of Control |
| Control * | | 2 | 22 | 32.5 | 43.7 | 0 | 21.0 | - |
| iprodione + cartap | 0.075<br>0.05 | 6 | 0 | 2.7 | 23.6 | 0 | 47.0 | 223.8 |
| iprodione + chlorfenvinphos | 0.075<br>0.024 | 6 | 0 | 4.0 | 31.6 | 0 | 43.0 | 200.0 |
| iprodione + fenbutatin oxide | 0.075<br>0.025 | 6 | 0 | 8.5 | 27.0 | 0 | 44.0 | 209.5 |
| procymidone + cartap | 0.075<br>0.05 | 6 | 0 | 3.3 | 29.0 | 0 | 41.1 | 197.7 |
| mancozeb + fenbutatin oxide | 0.16<br>0.025 | 6 | 3.0 | 0.1 | 15.3 | 0 | 42.8 | 203.8 |
| thiophanate-methyl + cartap | 0.05<br>0.05 | 6 | 0 | 3.5 | 32.0 | 0 | 41.0 | 195.2 |

* Bordeaux Mixture applied twice pre-blossom

Table 2

Efficacy of iprodione against fruit and leaf diseases of plum in 1979

| Treatment and % concn | | Number of sprays | % fruit with | | % leaves with | | Phyto-toxicity on leaves |
|---|---|---|---|---|---|---|---|
| | | | Monilia | Fusicladium | Polystigma | Coryneum | |
| Control* | | 2 | 26.0 | 1.4 | 25.0 | 71.0 | 0 |
| iprodione + fenbutatin oxide + cypermethrin | 0.05<br>0.0125<br>0.030 | 6 | 0 | 0 | 4.4 | 18.9 | 0 |
| ipridione + fenbutatin oxide + cypermethrin | 0.05<br>0.015<br>0.030 | 6 | 0 | 0 | 6.5 | 21.7 | 0 |
| iprodione + chlorofenizon | 0.05<br>0.05 | 6 | 0 | 0.1 | 0.2 | 33.4 | 0 |
| iprodione + propargite | 0.05<br>0.067 | 6 | 0 | 0 | 0.6 | 39.4 | 0 |
| iprodione + cyhexatin | 0.075<br>0.015 | 6 | 0 | 0.1 | 1.5 | 25.4 | 0 |
| iprodione + fenvalerate | 0.015<br>0.015 | 6 | 0 | 0 | 1.1 | 28.5 | 0 |
| captan + dicofol | 0.125<br>0.04 | 6 | 5.0 | 0 | 0.1 | 43.8 | 0 |
| procymidone + fenvalerate | 0.05<br>0.021 | 6 | 0 | 0 | 1.0 | 18.9 | 0 |

* Bordeaux Mixture applied twice pre-blossom

## Sweet cherry trials

On sweet cherry, six applications of iprodione completely control M.laxa, whether used alone or in mixture (Table 3).

Table 3

Efficacy of iprodione against fruit and leaf diseases of sweet cherry in 1978 and 1979

| Treatment and % concn | | Year | No. of sprays | % fruit with Monilia | % leaves with | | Phyto-toxicity on leaves |
|---|---|---|---|---|---|---|---|
| | | | | | Coryneum | Coccomyces | |
| Control* | | 1978 | 2 | 12.0 | 35.0 | 100 | 0 |
| | | 1979 | 2 | 35.0 | 27.0 | 87.3 | 0 |
| iprodione | 0.1 | 1978 | 6 | 0 | 3.5 | 3.5 | 0 |
| | | 1979 | 6 | 0 | 3.0 | 2.5 | 0 |
| iprodione | 0.075 | 1978 | 6 | 0 | 4.0 | 6.5 | 0 |
| | | 1979 | 6 | 0 | 5.0 | 6.0 | 0 |
| iprodione + dimethoate | 0.05<br>0.035 | 1978 | 6 | 0 | 1.5 | 11.1 | 0 |
| | | 1979 | 6 | 0 | 3.9 | 12.1 | 0 |
| iprodione + dimethoate | 0.075<br>0.035 | 1978 | 6 | 0 | 2.1 | 1.0 | 0 |
| | | 1979 | 6 | 0 | 3.8 | 5.9 | 0 |
| iprodione + cypermethrin | 0.05<br>0.005 | 1978 | 6 | 0 | 0.5 | 0.5 | 0 |
| | | 1979 | 6 | 0 | 0 | 0 | 0 |
| iprodione + decamethrin | 0.05<br>0.005 | 1978 | 6 | 0 | 7.0 | 0 | 0 |
| | | 1979 | 6 | 0 | 7.0 | 0 | 0 |
| iprodione + fenvalerate | 0.05<br>0.004 | 1978 | 6 | 0 | 0.5 | 1.0 | 0 |
| | | 1979 | 6 | 0 | 0.8 | 1.1 | 0 |
| thiophanate-methyl + dimethoate | 0.05<br>0.035 | 1978 | 6 | 1.0 | 5.0 | 15.0 | 0 |
| | | 1979 | 6 | 1.5 | 3.9 | 18.7 | 0 |

* Bordeaux Mixture applied twice pre-blossom

Against C.hiemalis, iprodione, alone or in mixture, reduced attack from 87.3 — 100% to a level varying from 0-12.1%.

Spectacular reduction of C.beijerinckii was also achieved; 27-35% on the control compared with 0-7% on plots treated with iprodione.

## Morello cherry trials

On Morello cherry, six applications of iprodione (0.075%) alone or in mixtures with decamethrin or cypermethrin, completely controlled M.laxa; iprodione was also active against Coccomyces hiemalis and Coryneum beijerinckii (Table 4).

Table 4

Efficacy of iprodione against fruit and leaf diseases of Morello cherry in 1978-1979

| Treatment and % concn | | Year | No. of sprays | % fruit with Monilia | % leaves with | | Phyto-toxicity on leaves |
|---|---|---|---|---|---|---|---|
| | | | | | Coryneum | Coccomyces | |
| control* | | 1978 | 2 | 17.0 | 35.0 | 100 | 0 |
| | | 1979 | 2 | 26.0 | 20.2 | 84.2 | 0 |
| iprodione | 0.075 | 1978 | 6 | 0 | 5.0 | 7.0 | 0 |
| | | 1979 | 6 | 0 | 7.0 | 9.0 | 0 |
| iprodione + decamethrin | 0.075<br>0.0063 | 1978<br>1979 | 6<br>6 | 0<br>0 | 4.5<br>6.7 | 5.0<br>1.1 | 0<br>0 |
| iprodione + cypermethrin | 0.075<br>0.005 | 1978<br>1979 | 6<br>6 | 0<br>0 | 2.0<br>3.7 | 2.5<br>0.3 | 0<br>0 |
| benomyl | 0.025 | 1978 | 6 | 0 | 5.0 | 7.0 | 0 |
| | | 1979 | 6 | 0 | 13.8 | 8.6 | 0 |
| thiophanate-methyl | 0.05 | 1978 | 6 | 0 | 3.0 | 6.5 | 0 |
| | | 1979 | 6 | 0 | 4.8 | 9.5 | 0 |
| carbendazim | 0.035 | 1978 | 6 | 0 | 5.0 | 4.5 | 0 |
| | | 1979 | 6 | 0 | 6.8 | 9.0 | 0 |
| procymidone | 0.075 | 1978 | 6 | 0 | 5.0 | 15.0 | 0 |
| | | 1979 | 6 | 0 | 7.5 | 20.2 | 0 |

* Bordeaux Mixture applied twice pre-blossom

Apricot trials

On apricots, three applications of iprodione (0.075-0.1%) gave 92% protection against M.laxa on shoots, and at least 82% protection on fruit. C.beijerinckii was also reduced (Table 5).

Table 5

Efficacy of iprodione against fruit and leaf diseases on apricot in 1979

| Treatments and % concn | | No. of sprays | % shoots with Monilia | % fruit with Monilia | % leaves with Coryneum |
|---|---|---|---|---|---|
| iprodione | 0.075 | 3 | 8.0 | 16.0 | 16.0 |
| iprodione | 0.1 | 3 | 8.0 | 18.0 | 13.0 |
| thiophanate-methyl | 0.05 | 3 | 13.0 | 27.0 | 29.0 |
| control | | 0 | 53.0 | 50.0 | 50.0 |

## Peach trials

On peach, seven applications of iprodione (0.075%) gave 99.1% control of M.laxa, and an average yield of 37.3 kg/tree (Table 6).

Table 6

Efficacy of iprodione against M.laxa on peach in 1979

| Treatments and % concn | | No. of sprays | % fruit with Monilia | Yield | |
|---|---|---|---|---|---|
| | | | | kg/tree | % of control |
| iprodione | 0.075 | 7 | 0.9 | 37.3 | 163.8 |
| procymidone | 0.075 | 7 | 0.6 | 34.2 | 150.4 |
| thiophanate-methyl | 0.05 | 7 | 1.7 | 39.5 | 178.0 |
| control* | | 3 | 19.1 | 22.7 | - |

* Thiophanate-methyl applied three times before blossom.

In another trial on peach, pre-harvest treatments were applied 1, 7 or 14 days before harvest to reduce rots; fruit was stored for 15 days post-harvest.

The total loss of untreated peaches stored at ambient was 19.4%, of which 11.6% were caused by parasitic fungi. Likewise, losses for cold-stored peaches were 13.8%, 7.9% being caused by M.laxa, Aspergillus niger, Rhizopus, Penicillium expansum, Fusarium, Botrytis cinerea and other fungi.

For peaches treated in the orchard with iprodione, losses caused by parasitic fungi were considerably reduced regardless of pre-harvest spray interval. Total losses by weight after 15 days storage at 4-5°C were 5.7 - 6.2%, of which only 0.2-0.9% were caused by parasitic fungi, with 5.3-5.5% from water loss (Table 7).

For peaches stored at ambient, total losses were 10 - 13.3%, of which 2.2 - 3.9% were due to fungal diseases, and 7.4 - 7.8% to water loss, after 15 days storage.

Table 7

Losses in peaches due to water loss and fungal rots during 15 days storage after treatment with pre-harvest iprodione sprays in 1979

| Treatments at 0.05% in 2000 l/ha | Time of treatment (days before harvest) | Method of storage | Water losses | | Fungal losses | | Total losses | |
|---|---|---|---|---|---|---|---|---|
| | | | % | % of control | % | % of control | % | % of control |
| control | - | Ambient | 7.8 | - | 11.6 | - | 19.4 | - |
| | | Cold | 5.9 | - | 7.9 | - | 13.8 | - |
| iprodione | 14 | Ambient | 7.4 | 94.9 | 3.9 | 33.6 | 13.3 | 58.2 |
| | | Cold | 5.3 | 89.8 | 0.9 | 11.4 | 6.2 | 45.0 |
| | 7 | Ambient | 7.8 | 100 | 3.4 | 29.3 | 11.2 | 57.7 |
| | | Cold | 5.5 | 93.2 | 0.4 | 5.1 | 5.9 | 42.8 |
| | 1 | Ambient | 7.8 | 100 | 2.2 | 19.0 | 10.0 | 51.5 |
| | | Cold | 5.5 | 93.2 | 0.2 | 2.5 | 5.7 | 41.3 |
| thiophanate-methyl | 14 | Ambient | 7.6 | 97.4 | 4.9 | 24.1 | 12.5 | 64.4 |
| | | Cold | 5.5 | 93.2 | 1.7 | 21.5 | 7.2 | 52.2 |
| | 7 | Ambient | 7.9 | 100 | 3.8 | 32.8 | 11.6 | 59.7 |
| | | Cold | 5.3 | 89.8 | 1.3 | 16.5 | 6.6 | 47.8 |
| | 1 | Ambient | 7.7 | 89.7 | 2.4 | 20.7 | 10.1 | 52.1 |
| | | Cold | 5.4 | 91.5 | 0.7 | 8.9 | 6.1 | 44.2 |

## CONCLUSIONS

1. On plum and cherry (6 applications), apricot (3) and peach (7), iprodione at concentrations of 0.05–0.1% gave outstanding control of M.laxa. Furthermore, iprodione exhibits an interesting additional activity against P.rubrum, C.hiemalis and F.pruni; efficacy of iprodione against C.beikerinckii is poorer.

2. Iprodione (0.05%, 0.075% and 0.1%) is fully compatible with the following pesticides: decamethrin, cypermethrin, cartap, dimethoate, fenbutatin oxide, propargite, chlorofenizon, chorofenvinphos, fenbutatin oxide + cypermethrin, fenvalerate and cyhexatin. Mixtures may therefore be used for the simultaneous control of parasitic insects, red spider mite and fungal diseases. All mixtures were non-phytotoxic.

3. On peach, iprodione at 0.05% applied 1-14 days before harvest reduced losses due to fungal rots during 15 days storage at 4-5°C or at ambient temperature.