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# CARROT: CONTROL OF CAVITY SPOT IN EARLY (POLYTHENE COVERED) AND LATE (OVERWINTERED) CROPS

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**AUTHENTICATION**

I declare that this work was done under my supervision according to the procedures described herein and that this report represents a true and accurate record of the results obtained.

Signed .....

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Summary

I. Early Protected Carrot Crops

Five replicated trials were conducted on commercial farm crops during the period 1987-1989. In four trials, carried out in the first 2 years of the project, cavity spot developed at moderate-severe levels. In the remaining trial in 1989 symptoms consistent with those of cavity spot were not recorded, perhaps a reflection of the low soil moisture levels in this very dry season.

Treatment with metalaxyl as Fubol 58WP or Favour 600FW was very effective in controlling the disease at all sites where the disease occurred. Only when the rate of application was reduced to 3 kg(l) product/ha did control deteriorate significantly. There was no advantage in increased water volumes above 500 l/ha or split application treatments. The timing of fungicide application appeared not to be critical. Treatment with metalaxyl immediately post-drilling in February-March or on removal of the polythene cover in May appeared equally effective. Control of cavity spot with such a late fungicide application conflicts with results from trials on maincrop carrots where treatment 8-12 weeks after drilling is usually ineffective. This aspect of fungicide timing on early crops warrants further investigation as it may offer an opportunity to more fully understand the aetiology of the disease.

II. Overwintered Maincrop Carrots

HRI/ADAS Sites

By late Autumn cavity spot had developed in all four trials though at variable levels (8-45%). By the second harvest following overwintering the incidence of cavity spot was higher in the untreated plots of all four trials (26-62%). Whether this represents a genuine increase in the incidence or severity of cavity spot remains uncertain and open to further investigation.

Treatment with metalaxyl as Fubol 58WP or Favour 600FW at 12 kg(l)product/ha at various timings fully supported earlier studies and demonstrated that

early application of metalaxyl is essential for effective control of cavity spot. A reduced rate (6 kg(1) product/ha) of metalaxyl consistently gave effective control at the HRI/ADAS trial sites. This contrasts to some extent with results from earlier studies.

Seed treatment with Polycote Prime containing iprodione, metalaxyl and thiabendazole (Seedcote Systems, Thetford, Norfolk) gave a significant reduction in the incidence of cavity spot in two trials though the level of control achieved was unsatisfactory as compared with soil applied Fubol 58WP/Favour 600FW at 6 or 12 kg(1)product/ha. Seed treatment with Polycote Prime did not provide additional control when used in conjunction with soil applied Fubol 58WP or Favour 600FW. In 1989 an experimental seed treatment of Polycote Prime, containing 4 times the loading of metalaxyl as compared with the commercial product, was very effective against cavity spot at one of the two trial sites (HRI, Stockbridge House). Control was not significantly different to that achieved with soil applied applications of Fubol 58WP or Favour 600FW at 12 kg(1)product/ha. Germination and subsequent emergence were not impaired by this treatment. The use of seed treatments containing high doses of metalaxyl warrants urgent study as it may offer potential for the development of a relatively inexpensive treatment which would significantly reduce fungicide inputs whilst at the same time having a minimal effect on beneficial organisms in the soil.

Ground limestone ($CaCO_3$) applied alone at 10 tonnes/ha in 1989 gave a significant reduction in the incidence of cavity spot at the first harvest in November. However, the effect failed to persist through to the second harvest in February-March. The same treatment applied in conjunction with metalaxyl was effective in all four trials, though no additional benefit was gained as compared with metalaxyl applied alone. Clearly ground limestone, used to increase soil pH, may provide a further opportunity to reduce fungicide input. Additional studies are required to determine this.

Commercial Farm Crops

Two trials were undertaken in each year of the investigation with six trials completed in total. Only two trials developed symptoms consistent with those of cavity spot though this was at moderate-severe levels. In neither trial did the incidence and severity of the disease increase following overwintering. Roots from one trial in 1987 (Burscough) exhibited unusual symptoms (russetted areas, fine vertical cracking) by the first harvest in November. Pythium sulcatum was considered to be the primary cause following consistent isolation from the affected tissues. P. sulcatum exhibits a poor response to metalaxyl treatment (White, 1988) and this may account for the lack of control with the fungicide treatments used. In the same trial, following overwintering, a crown rot developed causing severe damage throughout the crop including the trial area. Again, none of the experimental treatments provided effective control. The primary cause was not determined and no evidence was found to suggest an association between the two symptoms observed in this trial. Crown rot is currently being investigated in a separate study funded by the Horticultural Development Council (Project No. FV36).

In the two trials where cavity spot occurred metalaxyl applied as Fubol 58WP or Favour 600FW was generally very effective in reducing the incidence and severity of the disease when applied at 12 kg(l)product/ha 0-4 weeks post-drilling. Reduced application rates (6 and 3 kg(l)/ha) were less effective than the full recommended rate in these commercial trial sites and this supports the earlier held view that reduced rates can give variable control. Repeat applications of metalaxyl prior to straw covering for frost protection overwinter did not provide additional control, though this is not surprising as the disease severity did not increase during this period.

On the assumption that secondary soil fungi, eg Fusarium, Rhizoctonia, may be responsible for aggravating cavity spot during the overwintering period a broad spectrum fungicide mixture containing benomyl (Benlate; Du Pont) and tolclofos-methyl (Basilex; Fisons Horticulture) was applied either four weeks post-drilling or prior to straw application in the Autumn following earlier metalaxyl application at drilling. However, neither of the broad

spectrum treatments provided additional control of cavity spot, as compared with a single application of metalaxyl applied early and this tended to discount this hypothesis.

The application of ground limestone in 1988 resulted in a significant reduction in the incidence of cavity spot at the first harvest in November. However as occurred in the HRI/ADAS trial sites the effect failed to persist through to the second harvest in April 1989.

## Introduction

Cavity spot has caused considerable losses to commercial carrot crops for more than 25 years (Baker 1972) and numerous research programmes have been undertaken over the years to determine the cause of the disorder.

Since cavity spot was first described by Guba *et al*. in 1961 many hypotheses have been proposed to account for the slightly sunken, elliptical lesions on carrot roots. Calcium deficiency (Maynard *et al*., 1961; Perry & Harrison, 1979a), anaerobic bacteria (Perry & Harrison, 1979b; Perry, 1983), soil ammonium levels (Scaife *et al*., 1980), fungus gnat larvae (Hafidh & Kelly, 1982) and *Olpidium brassicae* (Tomlinson & Faithfull, 1984;) have all been suggested as incitants of the disorder. However, none of these hypotheses have been confirmed.

The first major advance towards identifying the cause of cavity spot was an observation by Lyshol and co-workers in Norway in 1984 while investigating the cause of carrot root dieback. They observed that where cavity spot occurred the disorder was significantly reduced following treatment with metalaxyl. Subsequent work (White, 1986) has demonstrated that fungi in the genus *Pythium*, notably *P. violae* and to a lesser extent *P. sulcatum* are responsible for the disorder known as cavity spot.

Replicated trials work in the UK (Perry, 1984; Gladders & Crompton, 1984; Gladders & McPherson, 1986) provided valuable data which assisted the manufacturers of metalaxyl (Ciba-Geigy PLC, Basle, Switzerland) in obtaining an On-Label recommendation for a fungicide mixture containing 10% metalaxyl + 48% mancozeb, marketed as Fubol 58WP.

During the three year period of this investigation a marketing decision by Ciba-Geigy caused us to use an alternative product containing 10% metalaxyl + 48% thiram (SL329, subsequently marketed as Favour 600FW) in many trials reported here. However, following re-evaluation by Ciba-Geigy Favour 600FW will not now be made available for use on carrots and Fubol 58WP will continue to be marketed instead. The primary active ingredient, metalaxyl, remains constant at 10% in both products and we know from earlier work that

the two dithiocarbamate components, thiram and mancozeb, are unlikely to provide significant control of cavity spot. Indeed, metalaxyl applied alone (Ridomil 25WP or metalaxyl granules) has been demonstrated to be equally effective (Gladders & McPherson, 1986).

The work undertaken during the 3 year period of this investigation has been in the two main areas outlined below. The programme has run concurrently with other HDC studies by Dr G White at HRI, Wellesbourne aimed at developing monoclonal antibody systems to identify sites at high risk from cavity spot. Progress of this work is reported elsewhere.

## I. Early Crops Grown Under Polythene

The importance of cavity spot on early crops grown under polythene is unclear. The disease has been regarded by some growers and advisers to be of little importance due to the relatively short cropping period (ca. 5 months). Yet others, perhaps speaking from their own commercial experience have considered cavity spot to be a major limiting factor in production of early crops.

The aim of this part of the investigation was to carry out a series of field trials on commercial farm crops to:-

a. determine the incidence and relative importance of cavity spot on early crops

b. identify effective fungicides

c. optimise the timing and rate of application of fungicides for cavity spot control.

Three trials were carried out in 1987 and one each in 1988 and 1989.

## II. Overwintered Maincrop Carrots

Prior to this investigation limited experimental work had already been undertaken on maincrop carrots to determine the effectiveness of a range of fungicides applied at different rates and timings for control (Gladders & McPherson, 1986).

The aim of this part of the investigation was to carry out a series of trials on commercial farm crops and at HRI/ADAS sites to:-

a. support earlier work to define the optimum rate and timing of metalaxyl application

b. determine whether cavity spot has the potential to develop overwinter

c. maintain fungicide efficacy during the overwintering phase of the crop

d. examine alternative methods of control

e. examine the potential of seed treatments containing metalaxyl for control of cavity spot.

In 1987/88 two trials were carried out in commercial crops in Lancashire. In 1988/89 and 1989/90 four trials were carried out in each year. Two were conducted at HRI/ADAS sites together with two in commercial crops in Lancashire. The trial sites in Lancashire were selected where possible to provide contrasting soil types (mineral v organic) which have been shown in previous trials to affect the level of control with metalaxyl. On soils with a high organic matter content metalaxyl has generally been slightly less effective. This has been assumed to be due to binding of the fungicide to organic matter in the soil (Sharom & Edgington, 1982) and is therefore less available to control the primary incitant of the disease.

## Materials and Methods

### Site details and treatment dates

### Early Protected Crops

Five trials were conducted on early polythene covered crops during the period February-July, 1987-1989. Site details and treatment dates are shown in Table 1.

Table 1: Site details and treatment dates for the early polythene covered carrot trials conducted during the period 1987-1989.

| Treatment details | 1987 | | | 1988 | 1989 |
|---|---|---|---|---|---|
| | Burscough Lancashire | Holywell Suffolk | West Stow Suffolk | Burscough Lancashire | Kenny Hill Cambridgeshire |
| Soil type | Mineral | Mineral | Mineral | Mineral | Mineral |
| Variety | Nantucket | Nanco | Presto | Nantucket | Primo |
| Drilling date | 28.2.87 | 19.2.87 | 19.2.87 | 24.2.88 | 02.2.89 |
| Early treatment | 03.3.87 | 24.2.87 | 19.2.87 | 25.2.88 | 05.2.89 |
| Polythene applied | 03.3.87 | 03.3.87 | 19.2.87 | 25.2.88 | 06.2.89 |
| Polythene removed | 21.5.87 | 25.5.87 | 25.5.87 | 15.5.88 | 10.5.89 |
| Late treatment | 21.5.87 | 01.6.87 | 01.6.87 | 19.5.88 | 12.5.89 |
| Harvest date | 14.7.87 | 22.7.87 | 29.7.87 | 20.7.88 | 25.7.89 |

### Overwintered Maincrops

Two trials were conducted at HRI, Stockbridge House (HRISH), Cawood, Selby, Yorkshire and at Arthur Rickwood EHF (AREHF) Mepal, Ely, Cambridgeshire in both 1988 and 1989. Site details and treatment dates are shown in Table 2.

Table 2: Site details and treatment dates for the overwintered maincrop carrot trials at HRI/ADAS sites during the period 1988/89-1989/90.

| Treatment details | 1988 | | 1989 | |
|---|---|---|---|---|
| | HRISH | AREHF | HRISH* | AREHF |
| Soil type | Mineral | Loamy peat over sand | Mineral | Loamy peat over sand |
| Variety | Chantenay Supreme | Chantenay Supreme | Chantenay Supreme | Chantenay Supreme |
| Pre-drilling treatment | - | - | 18.05.89 | 12.05.89 |
| Drilling date | 20.05.88 | 11.05.88 | 22.05.89 | 15.05.89 |
| Treatment dates ( 0 wk) | 23.05.88 | 12.05.88 | 31.05.89 | 15.05.89 |
| " " ( 4 wk) | 17.06.88 | 22.06.88 | - | - |
| " " ( 6 wk) | - | - | 11.07.89 | 27.06.89 |
| " " ( 8 wk) | 15.07.88 | 08.07.88 | - | - |
| " " (12 wk) | 17.08.88 | 07.08.88 | 29.08.89 | 07.08.89 |
| " " (pre-straw) | - | - | 22.11.89 | 07.11.89 |
| First harvest date | 24.10.88 | 08.11.88 | 22.11.89 | 02.11.89 |
| Straw application date | 25.10.88 | 08.11.88 | 23.11.89 | 07.11.89 |
| Second harvest date | 22.02.89 | 09.03.89 | 13.03.90 | 01.02.90 |

* Basamid treatment (HRISH only) applied in 1989 on 17.4.89. Each plot was sheeted down immediately after application with polythene. The polythene cover was removed one week prior to drilling on 15.5.89

Two trials were conducted on contrasting soil types in Lancashire in each year of the investigation. Sites were chosen to provide a high risk of cavity spot occurrence. Site details and treatment dates are shown in Table 3.

Table 3: Site details and treatment dates for the overwintered maincrop carrot trials on commercial farms in Lancashire during 1987-1989.

| Treatment details | 1987 | | 1988 | | 1989 | |
|---|---|---|---|---|---|---|
| | Burscough | Halsall | Martin Mere | Skelmersdale | Burscough | Skelmersdale |
| Soil type | Mineral | Organic* | Mineral | Organic* | Mineral | Organic* |
| Variety | Nanco | Nanco | Nairobi | Nairobi | Narman | Nairobi |
| Drilling Date | 25.05.87 | 05.06.87 | 19.05.88 | 04.06.88 | 19.05.89 | 24.05.89 |
| Treatment dates ( 0 wk) | 28.05.87 | 08.06.87 | 27.05.88 | 10.06.88 | 19.05.89 | 24.05.89 |
| " " ( 4 wk) | 26.06.87 | 03.07.87 | 23.06.88 | 06.07.88 | 19.06.89 | 19.06.89 |
| " " ( 6 wk) | - | - | - | - | 03.07.89 | 03.07.89 |
| " " ( 8 wk) | - | - | 18.07.88 | 01.08.88 | - | - |
| " " (12 wk) | - | - | 11.08.88 | 22.08.88 | 18.08.89 | 18.08.89 |
| " " (pre-straw) | 02.11.87 | 02.11.87 | 24.10.88 | 24.10.88 | 30.10.89 | 30.10.89 |
| " " (early spring) | - | - | - | - | 16.02.90 | 16.02.90 |
| First harvest date | 22.10.87 | 21.10.87 | 28.10.88 | 28.10.88 | 09.11.89 | 13.11.89 |
| Straw application date | 06.11.87 | 06.11.87 | 11.11.88 | 14.11.88 | 10.11.89 | 16.11.89 |
| Second harvest date | 04.03.88 | 04.03.88 | 22.04.89 | 22.04.89 | 12.03.90 | 07.03.90 |

* Organic sites in Lancashire were on "Moss" soils.

Trial design

All trials were of a randomised block design with four replicates. Plot sizes differed slightly to cater for local cultivation systems but approximated to a single bed or double row at least 3 m in length giving a plot size of between 5-10 $m^2$.

Crop Husbandry

All treatments other than those listed in Tables 4-6 were carried out to standard commercial practice and are unlikely to have influenced the results obtained.

Treatments

Fungicide treatments varied between trials though the metalaxyl based products, Fubol 58WP and Favour 600FW (SL329) predominated. In some trials Fubol 58WP was chosen whereas in others Favour 600FW was used instead. The rate of the primary active ingredient, metalaxyl, is the same in both products and equivalent control should be expected. The alternating use of Fubol 58WP and/or Favour 600FW in this trial series was a result of marketing decisions by the manufacturers, Ciba-Geigy and was outside our control.

The fungicide and chemical treatments used in the early protected trials and the overwintered maincrop trial at HRI/ADAS sites and on commercial farms are presented in Tables 4-6 respectively.

Table 4: List of rates and timing of fungicide application in the early polythene covered cavity spot trials conducted during the period 1987-1989.

| Treatment | Rate of application of product | Fungicide timing | | 1987 | | | 1988 | 1989 |
|---|---|---|---|---|---|---|---|---|
| | | Post-drilling | Polythene removal | BC | HW | WS | BC | KH |
| Untreated | - | - | - | + | + | + | + | + |
| Favour 600FW | 3 l/500 l water/ha | + | - | + | + | + | + | - |
| " " | 6 l/500 l water/ha | + | - | + | + | + | + | + |
| " " | 12 l/500 l water/ha | + | - | + | + | + | + | + |
| " " | 12 l/2000 l water/ha | + | - | + | + | + | + | + |
| " " | 3 l/500 l water/ha (x 2) | + | + | + | + | + | + | + |
| " " | 6 l/500 l water/ha (x 2) | + | + | + | + | + | + | + |
| " " | 12 l/500 l water/ha (x 2) | + | + | + | + | + | + | + |
| " " | 12 l/500 l water/ha | - | + | + | + | + | + | + |
| " " | 12 l/500 l water/ha* | + | - | - | - | - | + | + |
| Fubol 58WP | 12 kg/500 l water/ha | + | - | + | + | - | + | + |

*band applied treatment

BC - Burscough, Lancashire HW - Holywell, Suffolk

WS - West Stow, Suffolk KH - Kenny Hill, Cambridgeshire

Table 5: List of rates and timing of fungicide application in the overwintered maincrop carrot trials at HRI/ADAS sites during 1988-1989.

| Treatments | Rate of application of product | Fungicide timing (Weeks pre and post-drilling) | | | | | | | 1988 | 1989 |
|---|---|---|---|---|---|---|---|---|---|---|
| | | -1 | 0 | 4 | 6 | 8 | 12 | 20 | | |
| Untreated | - | | | | | | | | + | + |
| Polycote Prime s.d.⊕ | Commercial loading | | + | | | | | | + | + |
| Elguard RT s.d. | " " | | + | | | | | | + | – |
| Polycote Prime s.d.⊕ | 4 x metalaxyl loading | | + | | | | | | – | + |
| Fubol 58WP/Favour 600FW* | 12 kg(l)/500l water/ha | + | | | | | | | – | +θ |
| Fubol 58WP/Favour 600FW* | " " " " " " | | + | | | | | | + | + |
| Fubol 58WP/Favour 600FW* or ⊕ | " " " " " " | | | + | | | | | + | – |
| Fubol 58WP/Favour 600FW* | " " " " " " | | | | + | | | | – | + |
| Fubol 58WP/Favour 600FW* | " " " " " " | | | | | + | | | + | – |
| Fubol 58WP/Favour 600FW* | " " " " " " | | | | | | + | | + | + |
| Fubol 58WP/Favour 600FW x 2* | " " " " " " | | + | + | | | | | + | – |
| Fubol 58WP/Favour 600FW x 2* | " " " " " " | | + | | | | | + | – | + |
| Fubol 58WP/Favour 600FW x 2* | 6 kg(l)/500 l water/ha | | + | + | | | | | + | – |
| Fubol 58WP/Favour 600FW⊕ | " " " " " " | | + | | | | | | – | + |
| Fubol*58FP/Favour 600FW⊕ | " " " " " " | | | + | | | | | + | – |
| $CaCo_3$ | 10 t/ha | + | | | | | | | – | + |
| $CaCo_3$(1) + Fubol/Favour (2)* | 10 t/ha + 12 kg(l)/500l/ha | +(1) | +(2) | | | | | | +a | + |
| Basamid* | 380 kg/ha | + | | | | | | | – | +o |

* Elguard RT seed dressing (contains iprodione and thiram)
⊕ Polycote Prime seed dressing (contains iprodione, metalaxyl and thiabendazole)
θ Including a band applied treatment in 1989
a Treatment applied at 0-4 wks post-drilling in 1988
o Basamid applied at HRI, Stockbridge House only in 1989

Table 6: List of rates and timing of fungicide application in the overwintered maincrop carrot trials at commercial sites in Lancashire during 1987-1989.

| Treatments | Rate of application | Fungicide timing (Weeks post-drilling) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 0 | 4 | 6 | 8 | 12 | 20* | 1987 | 1988 | 1989 |
| Untreated | - | | | | | | | + | + | + |
| Fubol 58WP/Favour 600FW | 12 kg(1)/500l water/ha | + | | | | | | + | +&θ | +&θ |
| " " " | " " " " " " " | | + | | | | | + | + | - |
| " " " | " " " " " " " | | | + | | | | - | - | + |
| " " " | " " " " " " " | | | | + | | | - | + | - |
| " " " | " " " " " " " | | | | | + | | - | + | + |
| " " " | " " " " " " " | | | | | | + | - | - | + |
| " " " | 6 kg(1)/500l water/ha | + | | | | | | + | + | +θ |
| " " " | 3 kg(1)/500l water/ha | + | | | | | | + | - | - |
| " " " | 12 kg(1)/500l water/ha | + | + | | | | | - | + | - |
| " " " | 6 kg(1)/500l water/ha | + | + | | | | | - | + | - |
| " " " | 12 kg(1)/500l water/ha | + | | | | | + | + | - | + |
| Fubol/Favour(1) + Benlate & Basilex(2) | 12 kg(1)/ha + 1kg & 10kg/ha | +(1) | | | | | +(2) | + | +s | +a |
| " " " " | " " " " " " " " | +(1)+(2) | | | | | | + | - | - |
| Fubol/Favour + Agral (1%) | 12 kg(1)/ha + 5l/ha | + | | | | | | + | - | + |
| Agral (1%) | 5l/500l water/ha | + | + | | | | | + | - | +d |
| $H_3PO_3$ (phosphorus acid) | 10l/500l water/ha | + | | | | | | - | + | - |
| Ground limestone ($CaCO_3$) | 10 tonnes/ha | + | | | | | | - | + | - |
| " " " | 3.5tonnes/10,000l water/ha | + | | + | + | + | + | - | - | + |

* - pre-straw treatment in the Autumn
θ - band applied treatment
a - Benlate applied at 10 kg/ha
s - Benlate applied at 2.5 kg/ha
d - Repeat treatment with Agral in 1989 only.

Fungicide application

Unless otherwise specified fungicides and other chemical treatments in the trials were applied with an Oxford Precision knapsack sprayer using a hand held boom operating at 2-2.5 bars. Band applications of fungicides were made by treating a narrow 15 cm (6") band over the drilled row(s) using a single fan nozzle.

Seed treatments, used in the HRI/ADAS maincrop trials, including Polycote Prime with an increased metalaxyl loading (4x) was carried out by Seedcote Systems, Thetford, Norfolk. Seed was drilled using a tractor mounted Ojard drill.

The ground limestone applications were made by dusting the lime over the plot surface by hand using small "pepper-pot" shakers. At the HRI/ADAS sites the limestone was incorporated by lightly raking into the top 1-2 cm of soil prior to drilling (except HRI, Stockbridge House in 1988). At the commercial sites the limestone was applied post-drilling and not incorporated and in 1989 a lower application was applied on five separate occasions.

The Basamid treatment at HRI, Stockbridge House in 1989 was carried out in accordance with the manufacturers recommendations. Individual plots were treated on 17 April and sheeted down immediately. The polythene covers were removed 7-10 days prior to drilling on 15 May and a cress test carried out satisfactorily.

Emergence counts

Seedling counts were made in selected trials shortly after 100% emergence to ensure germination and subsequent establishment was not affected by any of the treatments. Emergence counts were made by either counting seedlings in 4 x 0.25 m row/plot or alternatively 2 x 0.5 m row depending on the system of cultivation.

Disease assessments

At each harvest date a standard plot area was lifted to provide a minimum of 100 roots. All harvested roots were returned to the laboratory for assessment. The foliage was removed and each root washed gently by hand to remove excess soil. The harvested area varied between trials.

In 1987 cavity spot was assessed using a 0-3 scale of severity where:-

0 = Cavity spot not detected
1 = Single, small cavity <1-2 mm diameter
2 = Scattered, small cavities <1-2 mm diameter
3 = Frequent small cavities <1-2 mm but tending to coalesce or occasional large cavities >2 mm diameter (unmarketable)

In June 1988 and 1989 trials an assessment key, based on a scale of 0-5, developed by NIAB (Sweet et al 1986) was used.

In each year a disease index was calculated using either of the following formulae depending on the number of disease categories ie 0-3(1) or 0-5(2):

1. $$\frac{1\,(1) + 2\,(2) + 3\,(3)}{\text{No of roots assessed}} \times \frac{100}{3}$$

2. $$\frac{1\,(1) + 2\,(2) + 3\,(3) + 4\,(4) + 5\,(5)}{\text{No of roots assessed}} \times \frac{100}{5}$$

Yield Assessments

Although entire plot yields were not recorded in all trials, the weight of roots in the harvested lengths of row was determined in each year. Yield data is presented in Tables 7-17.

## Statistical Analysis

All the data presented has been subjected to an analysis of variance. Angular transformations have been made where indicated by a skew distribution. Treatment means have been separated using Duncan's Multiple Range Test. Figures with different letters in the suffix within each column in the tables indicate significant differences (P = 0.05).

## Results

### Early Protected Crops

The results are presented in summary in Tables 7-10. Individual plot results are tabulated in the Appendix (Tables 7A-10A).

Cavity spot developed at moderate-severe levels in all three trials conducted in 1987 and in the single trial carried out in 1988. In 1989 cavity spot was not detected throughout the trial period at Kenny Hill, Cambridgeshire. This may be a reflection of the very dry spring and early summer period.

Metalaxyl applied immediately post-drilling at 6 and 12 kg(l) product/ha as Fubol 58WP or Favour 600FW was very effective in reducing the incidence and severity of cavity spot at all sites where the disease occurred. Control of the disease with a significantly reduced rate of Favour 600FW (3 l product/ha) was variable. However, at two sites (Burscough, 1987 & 1988) Favour 600FW at 31 product/ha gave a level of cavity spot control not significantly different from that obtained with the same fungicide applied at 12 l product/ha (Tables 7 and 10). In one of these trials (Burscough, 1987) the disease incidence was very high (Table 7). At the remaining sites this low rate of metalaxyl gave little or no control of cavity spot (Tables 8 and 9).

A single application of Favour 600FW at 12l product/ha applied immediately following removal of the polythene cover in May, quite surprisingly, also gave effective control of cavity spot in all four trials where the disease occurred. This result contrasts markedly with earlier trials and those reported here on maincrop carrots where metalaxyl application 8-12 weeks post-drilling is usually ineffective. Yet in these early crops the same treatment applied 11-14 weeks post-drilling was as effective as the same treatment applied immediately post-drilling. This aspect requires further study as it may offer further insight into the aetiology of the disease and the mode of action of metalaxyl.

Split application treatments (post-drilling and at cover removal) were generally no more effective than single applications applied post-drilling and on removal of the polythene in May. The only exception was at Holywell in 1987 where repeat treatment with Favour 600FW at 12 l product/ha significantly reduced the percentage of roots with cavity spot as compared with a single application at the same rate post-drilling.

The band applied fungicide (Favour 600FW) at Burscough (mineral soil) in 1988 also gave effective control of cavity spot. This method of application has the potential to reduce fungicide inputs significantly. Previous studies on maincrop carrots (Gladders & McPherson, 1986) have demonstrated that metalaxyl is generally more effective on mineral soils than on those with a high organic matter content. Other studies have shown band applied treatments on organic soils to be significantly less effective (unpublished data).

No significant differences were detected in the weight of the harvested carrots as compared with the untreated in any of the trials.

Table 7: Harvest assessments for the early protected carrot trial at Burscough, Lancashire, 1987.

| Treatments | Timing of application: Post drilling | Timing of application: Polythene removal | % Roots with cavity spot* | Cavity spot index* | % Roots marketable | Weight of harvested roots (kg) |
|---|---|---|---|---|---|---|
| Untreated | - | - | $49.6^{c}$ | $31.7^{c}$ | $78.5^{a}$ | 3.0 |
| Favour 600FW 3 1/500 l water/ha | + | - | $16.7^{b}$ | $9.7^{b}$ | $99.6^{b}$ | 3.7 |
| Favour 600FW 6 1/500 l water/ha | + | - | $7.0^{a}$ | $4.1^{a}$ | $100.0^{b}$ | 3.4 |
| Favour 600FW 12 1/500 l water/ha | + | - | $10.1^{ab}$ | $5.8^{ab}$ | $100.0^{b}$ | 3.7 |
| Favour 600FW 12 1/2000 l water/ha | + | - | $8.1^{a}$ | $4.6^{a}$ | $100.0^{b}$ | 3.8 |
| Favour 600FW 3 1/500 l water/ha x 2 | + | + | $4.7^{a}$ | $2.7^{a}$ | $100.0^{b}$ | 3.7 |
| Favour 600FW 6 1/500 l water/ha x 2 | + | + | $3.1^{a}$ | $1.8^{a}$ | $100.0^{b}$ | 3.6 |
| Favour 600FW 12 1/500 l water/ha x 2 | + | + | $4.3^{a}$ | $2.5^{a}$ | $100.0^{b}$ | 3.6 |
| Favour 600FW 12 1/500 l water/ha | - | + | $7.2^{a}$ | $4.3^{a}$ | $99.7^{b}$ | 3.4 |
| Fubol 58WP 12 kg/500 l water/ha | + | - | $2.3^{a}$ | $1.3^{a}$ | $100.0^{b}$ | 3.7 |
| CV(%) | | | 41.2 | 40.0 | 2.7 | NSD |
| SED (27 degrees of freedom) | | | 3.29 | 1.94 | 1.88 | 14.6 |
| | | | | | | 0.37 |

* Data subjected to angular transformation. Actual data is presented in the Appendix (Table 7A)

Harvested - 14 July 1987

Figures with the same letter in the suffix within each column do not differ significantly (P = 0.05)

Table 8: Harvest assessments for the early protected carrot trial at Holywell, Suffolk, 1987.

| Treatments | Timing of application: Post drilling | Timing of application: Polythene removal | % Roots with cavity spot* | Cavity spot index* | % Roots marketable* | Weight of harvested roots (kg) |
|---|---|---|---|---|---|---|
| Untreated | - | - | $18.8^{e}$ | $13.5^{d}$ | $76.9^{a}$ | 3.3 |
| Favour 600FW 3 l/500 l water/ha | + | - | $15.2^{de}$ | $10.8^{cd}$ | $78.6^{ab}$ | 3.4 |
| Favour 600FW 6 l/500 l water/ha | + | - | $9.1^{cd}$ | $7.5^{bc}$ | $85.3^{cd}$ | 3.5 |
| Favour 600FW 12 l/500 l water/ha | + | - | $10.3^{bcd}$ | $7.6^{bc}$ | $83.2^{bc}$ | 3.7 |
| Favour 600FW 12 l/2000 l water/ha | + | - | $8.7^{abc}$ | $4.0^{ab}$ | $88.0^{cd}$ | 3.8 |
| Favour 600FW 3 l/500 l water/ha x 2 | + | + | $5.3^{ab}$ | $4.3^{ab}$ | $85.7^{cd}$ | 3.4 |
| Favour 600FW 6 l/500 l water/ha x 2 | + | + | $4.9^{ab}$ | $3.3^{ab}$ | $88.6^{cd}$ | 3.5 |
| Favour 600FW 12 l/500 l water/ha x 2 | + | + | $0.0^{a}$ | $0.0^{a}$ | $90.0^{d}$ | 3.5 |
| Favour 600FW 12 l/500 l water/ha | - | + | $2.9^{a}$ | $2.6^{a}$ | $87.1^{cd}$ | 4.1 |
| Fubol 58WP 12 kg/500 l water/ha | + | - | $6.0^{abc}$ | $4.5^{ab}$ | $85.1^{cd}$ | 3.8 |
| CV(%) | | | 50.8 | 51.4 | 4.52 | NSD |
| SED (27 degrees of freedom) | | | 2.91 | 2.12 | 2.71 | 14.3 / 0.36 |

* Data subjected to angular transformation. Actual data is presented in the Appendix (Table 8A)

Harvested - 22 July 1987.

Figures with the same letter in the suffix within each column do not differ significantly (P = 0.05)

Table 9: Harvest assessments for the early protected carrot trial at West Stow, Suffolk, 1987.

| Treatments | Timing of application: Post drilling | Timing of application: Polythene removal | % Roots with cavity spot* | Cavity spot index* | % Roots marketable* | Weight of harvested roots (kg) |
|---|---|---|---|---|---|---|
| Untreated | - | - | $41.2^{b}$ | $39.5^{b}$ | $51.5^{a}$ | $9.58^{ab}$ |
| Favour 600FW 3 l/500 l water/ha | + | - | $29.7^{ab}$ | $25.4^{abc}$ | $67.0^{abc}$ | $7.95^{a}$ |
| Favour 600FW 6 l/500 l water/ha | + | - | $30.3^{ab}$ | $27.4^{bc}$ | $64.2^{ab}$ | $8.13^{a}$ |
| Favour 600FW 12 l/500 l water/ha | + | - | $18.6^{a}$ | $14.2^{ab}$ | $78.7^{bc}$ | $8.53^{ab}$ |
| Favour 600FW 12 l/2000 l water/ha | + | - | $16.7^{a}$ | $11.4^{ab}$ | $82.8^{c}$ | $9.33^{ab}$ |
| Favour 600FW 3 l/500 l water/ha x 2 | + | + | $18.5^{a}$ | $13.7^{ab}$ | $79.5^{bc}$ | $8.00^{a}$ |
| Favour 600FW 6 l/500 l water/ha x 2 | + | + | $20.6^{a}$ | $14.6^{ab}$ | $79.4^{bc}$ | $8.38^{ab}$ |
| Favour 600FW 12 l/500 l water/ha x 2 | + | + | $12.0^{a}$ | $8.3^{a}$ | $84.6^{c}$ | $9.98^{b}$ |
| Favour 600FW 12 l/500 l water/ha | - | + | $12.5^{a}$ | $10.4^{ab}$ | $81.0^{bc}$ | $9.09^{ab}$ |
| CV(%) | | | 50.4 | 58.1 | 14.4 | 12.1 |
| SED (24 degrees of freedom) | | | 7.91 | 7.53 | 7.56 | 0.75 |

* Data subjected to angular transformation. Actual data is presented in the Appendix (Table 9A)

Harvested - 29 July 1987.

Figures with the same letter in the suffix within each column do not differ significantly (P = 0.05)

Table 10: Harvest assessments for the early protected carrot trial at Burscough, Lancashire, 1988.

| Treatments | Timing of application Post drilling | Polythene removal | % Roots with cavity spot* | Cavity spot index* | % Roots marketable* | Weight of harvested roots (kg) |
|---|---|---|---|---|---|---|
| Untreated | - | - | 24.4$^{b}$ | 16.1$^{b}$ | 82.1$^{b}$ | 6.8 |
| Favour 600FW 3 1/500 l water/ha | + | - | 11.0$^{a}$ | 5.2$^{a}$ | 90.0$^{a}$ | 6.7 |
| Favour 600FW 6 1/500 l water/ha | + | - | 7.9$^{a}$ | 3.7$^{a}$ | 90.0$^{a}$ | 5.8 |
| Favour 600FW 12 1/500 l water/ha | + | - | 6.1$^{a}$ | 2.7$^{a}$ | 90.0$^{a}$ | 6.8 |
| Favour 600FW 12 1/2000 l water/ha | + | - | 7.4$^{a}$ | 3.5$^{a}$ | 90.0$^{a}$ | 6.2 |
| Favour 600FW 3 1/500 l water/ha x 2 | + | + | 5.8$^{a}$ | 2.6$^{a}$ | 90.0$^{a}$ | 6.7 |
| Favour 600FW 6 1/500 l water/ha x 2 | + | + | 4.1$^{a}$ | 1.8$^{a}$ | 90.0$^{a}$ | 6.2 |
| Favour 600FW 12 1/500 l water/ha x 2 | + | + | 9.5$^{a}$ | 4.6$^{a}$ | 90.0$^{a}$ | 6.1 |
| Favour 600FW 12 1/500 l water/ha | -$^{b}$ | + | 10.0$^{a}$ | 4.7$^{a}$ | 88.6$^{a}$ | 5.9 |
| Favour 600FW 12 1/500 l water/ha | +$^{b}$ | - | 7.9$^{a}$ | 3.6$^{a}$ | 90.0$^{a}$ | 6.8 |
| Fubol 58WP 12 kg/500 l water/ha | + | - | 4.5$^{a}$ | 2.0$^{a}$ | 90.0$^{a}$ | 6.2 |
| | | | | | | NSD |
| CV(%) | | | 63.1 | 99.2 | 1.24 | 11.8 |
| SED (30 degrees of freedom) | | | 3.87 | 3.22 | 0.78 | 0.53 |

* Data subjected to angular transformation. Actual data is presented in the Appendix (Table 10A)
b Band applied fungicide

Harvested - 20 July 1988.

Figures with the same letter in the suffix within each column do not differ significantly (P = 0.05)

Overwintered Maincrop Trials

HRI/ADAS Sites

The results are presented in summary in Tables 11-14. Individual plots results are tabulated in the Appendix (Tables 11A-14A).

Seedling emergence was satisfactory in all treatments except where ground limestone ($CaCo_3$) was applied to the soil surface at Stockbridge House in 1988. In this treatment seedling emergence was significantly reduced (Table 11). Lime application at Arthur Rickwood was incorporated prior to drilling and emergence was unaffected. This method of application was adopted satisfactorily in both trials in 1989.

At Arthur Rickwood in 1988 seed treatment with Elguard RT (iprodione/thiram) enhanced seedling emergence significantly compared with the untreated seed whereas Polycote Prime (iprodione/metalaxyl/thiabendazole) did not. A satisfactory explanation for this differential germination and subsequent emergence was not found though a seed-borne infection cannot be discounted.

By the first harvest in the Autumn cavity spot levels were moderate-high in the two trials conducted in 1988 (Stockbridge House - 31% roots affected; Arthur Rickwood - 45% roots affected). In the two trials carried out in 1989 the incidence of cavity spot was lower. (Stockbridge House - 16% roots affected, Arthur Rickwood - 8% roots affected).

Following overwintering the number of roots affected by cavity spot had increased in all four trials. (Tables 11-14)

Seed treatment with Polycote Prime gave a slight, but significant, reduction in cavity spot in two trials, though not consistently at both harvests (Stockbridge House: H2-1988, H1-1989). Seed treatment with Elguard RT (iprodione/thiram) was not effective against cavity spot (Tables 11 & 12). In 1989 a four-fold increase in the metalaxyl loading was incorporated into the Polycote Prime seed treatment, by Seedcote Systems, Thetford, Norfolk. At Stockbridge House where cavity spot levels ranged from 16-27% in the untreated plots this experimental

seed treatment was very effective and significantly reduced the percentage of roots affected. The level of control achieved with this experimental seed treatment was not significantly different from that obtained with soil applied treatments at the full commercial rate.

At Arthur Rickwood in 1989 cavity spot levels were very low at the first harvest and few significant differences were noted. The incidence of the disease increased overwinter yet none of the treatments gave significant control at the second harvest. An explanation for this has not been determined, though it does perhaps indicate that the disease has the potential to develop late in the season, the fungicide failing to persist to maintain effective control.

Applications of metalaxyl, either as Fubol 58WP or Favour 600FW were very effective in reducing the incidence of cavity spot at all four sites (H1 only at Arthur Rickwood in 1989), providing the treatment was applied early. Late applications (12 weeks post-drilling) were totally ineffective.

The use of Polycote Prime seed treatment in conjunction with soil applied fungicides at 12 kg(1) product/ha did not provide additional control, though in all four trials a reduced rate (6 kg(1) product/ha) in conjunction with Polycote Prime was as effective as a single soil applied treatment with Fubol 58WP or Favour 600FW at the full rate.

Split application treatments did not provide additional control of cavity spot as compared with a single early application in any of the four trials .

As in previous trials application of Fubol 58WP as a band application in the trials in 1989 was very effective and provided an opportunity to reduce fungicide inputs.

Soil sterilisation with Basamid in 1989 (Stockbridge House only) was very effective in controlling cavity spot when disease assessments were carried out in the Autumn. However, in the Spring cavity spot levels in the Basamid treated plots were not significantly different from the untreated. This result gives a clear indication that cavity spot has the potential to develop overwinter, though it does raise the question why late (Autumn) applications of metalaxyl are ineffective? One hypothesis is that P. violae may become active again in

early spring as soil temperatures rise and perhaps metalaxyl applied in late Autumn fails to persist overwinter. In 1989 a February applied treatment was made to the two commercial trials in Lancashire following overwintering. Unfortunately, however, cavity spot did not develop and we were unable to examine this hypothesis further. Clearly this aspect requires further study.

Interestingly, ground limestone ($CaCo_3$) gave a significant reduction in the incidence of cavity spot at both trial sites in the Autumn and this supports earlier studies by Scaife et al, 1983 and White, 1988. Unfortunately the effect did not persist through to the second harvest in the Spring, and this provides another clear indication that cavity spot has the potential to develop overwinter. Where ground limestone was applied in conjunction with metalaxyl no additional control was achieved as compared to metalaxyl based treatments applied alone.

Plot yields were generally unaffected by the experimental treatments. However, the only exception in this trials series was at Arthur Rickwood in 1988. In this trial Elguard RT seed treatment improved emergence yet the plot yields were significantly reduced (Table 10), perhaps a reflection of above optimum population levels and increased interplant competition.

Table 11: Emergence counts and harvest assessments for the overwintered cavity spot trial at HRI, Stockbridge House, 1988

| Treatments[#] | Timing of application (Weeks post-drilling) | | | | Plants/1m row | % Roots with cavity spot | | Cavity spot index | | % Roots marketable | | Weight of harvested roots (kg) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 4 | 8 | 12 | | H1/ | H2/ | H1 | H2 | H1 | H2 | H1 | H2 |
| Untreated | | | | | $123^{b}$ | $31.5^{bc}$ | $59.8^{ef}$ | $12.0^{b}$ | $25.2^{c}$ | $93.5^{b}$ | $84.8^{a}$ | 3.2 | 4.3 |
| Polycote Prime s.d.[@] | | | | | $135^{b}$ | $26.0^{b}$ | $43.3^{d}$ | $10.5^{b}$ | $17.3^{b}$ | $93.5^{b}$ | $89.3^{a}$ | 3.2 | 4.2 |
| Elguard RT s.d.[*] | | | | | $118^{b}$ | $40.3^{c}$ | $49.3^{de}$ | $15.1^{bc}$ | $17.3^{b}$ | $90.8^{b}$ | $95.0^{b}$ | 3.1 | 3.9 |
| Fubol 58WP (12 kg/ha)[*] | + | | | | $133^{b}$ | $5.8^{a}$ | $7.3^{abc}$ | $1.8^{a}$ | $1.9^{a}$ | $99.5^{c}$ | $100.0^{b}$ | 3.1 | 4.2 |
| Favour 600FW (12 l/ha)[*] | + | | | | $117^{b}$ | $0.8^{a}$ | $5.0^{abc}$ | $0.2^{a}$ | $1.2^{a}$ | $99.8^{c}$ | $100.0^{b}$ | 3.6 | 4.9 |
| Favour 600FW (12 l/ha)[*] | | + | | | $121^{b}$ | $3.5^{a}$ | $6.8^{abc}$ | $1.2^{a}$ | $1.4^{a}$ | $99.5^{c}$ | $100.0^{b}$ | 3.0 | 4.2 |
| Favour 600FW (12 l/ha)[*] | | | + | | $121^{b}$ | $2.5^{a}$ | $16.3^{bc}$ | $0.7^{a}$ | $5.7^{a}$ | $99.3^{c}$ | $97.5^{b}$ | 3.0 | 4.2 |
| Favour 600FW (12 l/ha)[*] | | | | + | $134^{b}$ | $42.5^{c}$ | $64.3^{f}$ | $18.7^{c}$ | $25.4^{c}$ | $84.5^{a}$ | $86.0^{a}$ | 3.3 | 4.2 |
| Favour 600FW (12 l/ha) x 2[*] | + | + | | | $132^{b}$ | $2.0^{a}$ | $4.8^{ab}$ | $0.5^{a}$ | $1.5^{a}$ | $100.0^{c}$ | $99.3^{b}$ | 3.1 | 4.4 |
| Favour 600FW (6 l/ha) x 2[*] | + | + | | | $118^{b}$ | $0.5^{a}$ | $5.8^{abc}$ | $0.1^{a}$ | $2.1^{a}$ | $100.0^{c}$ | $98.3^{b}$ | 2.8 | 4.5 |
| Favour 600FW (6 l/ha)[@] | | + | | | $126^{b}$ | $4.0^{a}$ | $7.0^{abc}$ | $0.8^{a}$ | $1.9^{a}$ | $100.0^{c}$ | $100.0^{b}$ | 3.0 | 4.7 |
| Favour 600FW (12 l/ha)[@] | | + | | | $131^{b}$ | $0.8^{a}$ | $6.5^{abc}$ | $0.3^{a}$ | $1.8^{a}$ | $99.8^{c}$ | $99.8^{b}$ | 3.3 | 4.4 |
| $CaCO_3$ (10 t/ha) + Favour (12 l/ha)[@] (1) (2) | +(1) | +(2) | | | $101^{a}$ | $0.3^{a}$ | $3.8^{a}$ | $0.1^{a}$ | $0.9^{a}$ | $100.0^{c}$ | $100.0^{b}$ | 2.9 | 4.8 |
| | | | | | | | | | | | | NSD | NSD |
| CV (%) | | | | | 7.4 | 72.4 | 35.5 | 91.0 | 44.6 | 3.7 | 3.1 | 14.7 | 15.7 |
| SED (42 degrees of freedom) | | | | | 7.46 | 5.55 | 5.09 | 2.68 | 2.32 | 2.52 | 2.15 | 0.32 | 0.48 |

* Elguard RT seed dressing (contains iprodione and thiram)

@ Polycote prime seed dressing (contains iprodione, metalaxyl and thiabendazole)

\# All soil-applied fungicides were made in 500 l water/ha

/ H1 - 24 October 1988. H2 - 22 February 1989.

Figures with the same letter in the suffix within each column do not differ significantly (P = 0.05)

Table 12: Emergence counts and harvest assessments for the overwintered cavity spot trial at ADAS, Arthur Rickwood EHF, 1988

| Treatments# | Timing of application (Weeks post-drilling) | | | | Plants/1m row | % Roots with cavity spot | | Cavity spot index | | % Roots marketable | | Weight of harvested roots (kg) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 4 | 8 | 12 | | H1/ | H2/ | H1 | H2 | H1 | H2 | H1 | H2 |
| Untreated | | | | | 77$^{a}$ | 45.0$^{bc}$ | 61.5$^{b}$ | 20.9$^{cd}$ | 29.2$^{b}$ | 83.0$^{ab}$ | 76.3$^{a}$ | 8.0$^{ef}$ | - |
| Polycote Prime s.d.@ | | | | | 92$^{ab}$ | 49.3$^{c}$ | 61.8$^{b}$ | 20.7$^{cd}$ | 29.4$^{b}$ | 84.8$^{ab}$ | 77.5$^{a}$ | 8.3$^{f}$ | - |
| Elguard RT s.d.* | | | | | 114$^{b}$ | 52.0$^{c}$ | 69.3$^{b}$ | 25.2$^{d}$ | 31.8$^{b}$ | 78.0$^{a}$ | 73.5$^{a}$ | 5.9$^{ab}$ | - |
| Fubol 58WP (12 kg/ha)* | + | | | | 111$^{b}$ | 16.8$^{a}$ | 22.3$^{a}$ | 6.4$^{a}$ | 8.6$^{a}$ | 95.3$^{cd}$ | 94.8$^{b}$ | 7.0$^{cde}$ | - |
| Favour 600FW (12 l/ha)* | + | | | | 105$^{b}$ | 15.5$^{a}$ | 32.8$^{a}$ | 8.1$^{ab}$ | 13.6$^{a}$ | 92.8$^{cd}$ | 91.3$^{b}$ | 6.6$^{bcd}$ | - |
| Favour 600FW (12 l/ha)* | | + | | | 109$^{b}$ | 10.3$^{a}$ | 25.8$^{a}$ | 3.4$^{a}$ | 9.5$^{a}$ | 98.0$^{d}$ | 95.0$^{b}$ | 6.6$^{bcd}$ | - |
| Favour 600FW (12 l/ha)* | | | + | | 97$^{ab}$ | 9.0$^{a}$ | 22.3$^{a}$ | 3.0$^{a}$ | 10.1$^{a}$ | 98.3$^{d}$ | 91.0$^{b}$ | 6.8$^{bcd}$ | - |
| Favour 600FW (12 l/ha)* | | | | + | 110$^{b}$ | 33.0$^{b}$ | 63.0$^{b}$ | 15.6$^{bc}$ | 28.2$^{b}$ | 87.8$^{bc}$ | 77.3$^{a}$ | 5.9$^{ab}$ | - |
| Favour 600FW (12 l/ha) x 2* | + | + | | | 95$^{ab}$ | 9.8$^{a}$ | 22.8$^{a}$ | 4.0$^{a}$ | 9.5$^{a}$ | 97.8$^{d}$ | 93.8$^{b}$ | 6.3$^{abc}$ | - |
| Favour 600FW (12 l/ha) x 2* | + | + | | | 105$^{b}$ | 10.0$^{a}$ | 22.5$^{a}$ | 3.6$^{a}$ | 8.7$^{a}$ | 98.0$^{d}$ | 95.5$^{b}$ | 6.8$^{bcd}$ | - |
| Favour 600FW (6 l/ha)@ | | + | | | 81$^{a}$ | 14.8$^{a}$ | 21.5$^{a}$ | 4.8$^{a}$ | 9.1$^{a}$ | 96.8$^{d}$ | 93.5$^{b}$ | 6.8$^{bcd}$ | - |
| Favour 600FW (12 l/ha)@ | | + | | | 81$^{a}$ | 13.0$^{a}$ | 20.0$^{a}$ | 5.7$^{a}$ | 9.5$^{a}$ | 95.5$^{c}$ | 92.8$^{b}$ | 7.4$^{def}$ | - |
| $CaCO_3$ (10 t/ha) + Favour (12 l/ha)@ (1) (2) | +(1) | +(2) | | | 78$^{a}$ | 8.0$^{a}$ | 21.5$^{a}$ | 3.5$^{a}$ | 8.9$^{a}$ | 97.5$^{d}$ | 93.5$^{b}$ | 6.4$^{abcd}$ | - |
| CV (%) | | | | | 13.8 | 48.8 | 23.7 | 55.6 | 34.7 | 5.4 | 6.7 | 9.9 | - |
| SED (42 degrees of freedom) | | | | | 9.60 | 7.16 | 5.83 | 3.56 | 3.76 | 3.54 | 4.17 | 0.47 | - |

* Elguard RT seed dressing (contains iprodione and thiram)

@ Polycote prime seed dressing (contains iprodione, metalaxyl and thiabendazole)

# All soil-applied fungicides were made in 500 l water/ha

/ H1 - 8 November 1988. H2 - 9 March 1989.

Figures with the same letter in the suffix within each column do not differ significantly (P = 0.05)

Table 13: Emergence counts and harvest assessments for the overwintered cavity spot trial at HRI, Stockbridge House, 1989.

| Treatments# | Timing of application (Weeks post-drilling) | | | | | Plants/1m row | % Roots with cavity spot | | Cavity spot index | | % Roots marketable | | Weight of harvested roots (kg) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | -1 | 0 | 6 | 12 | 20 | | H1/ | H2/ | H1 | H2 | H1 | H2 | H1 | H2 |
| Untreated | | | | | | $184^{abcd}$ | $16.0^{d}$ | $26.5^{d}$ | $5.6^{b}$ | $9.0^{cd}$ | $97.5^{a}$ | 96.0 | 4.8 | 4.1 |
| Polycote Prime s.d.@ | | | | | | $199^{de}$ | $10.5^{bc}$ | $19.5^{bcd}$ | $3.4^{ab}$ | $6.7^{abcd}$ | $99.5^{b}$ | 97.0 | 4.6 | 4.5 |
| Basamid (380 kg/ha)* | | | | | | $194^{cde}$ | $4.0^{ab}$ | $28.5^{d}$ | $1.1^{a}$ | $11.2^{d}$ | $100.0^{b}$ | 94.3 | 4.8 | 4.0 |
| Polycote Prime s.d.@ (x 4) | | | | | | $189^{bcd}$ | $5.5^{ab}$ | $11.3^{abc}$ | $1.1^{a}$ | $3.9^{abc}$ | $100.0^{b}$ | 98.0 | 4.9 | 4.1 |
| Fubol 58WP (6 kg/ha)@ | | + | | | | $220^{e}$ | $1.5^{ab}$ | $6.5^{a}$ | $0.3^{a}$ | $1.8^{a}$ | $100.0^{b}$ | 99.8 | 5.1 | 3.7 |
| Fubol 58WP (12 kg/ha)* | + | | | | | $166^{abc}$ | $2.5^{ab}$ | $7.3^{ab}$ | $0.5^{a}$ | $2.2^{a}$ | $100.0^{b}$ | 98.8 | 4.7 | 4.1 |
| Fubol 58WP (12 kg/ha)* | | + | | | | $170^{abcd}$ | $4.0^{ab}$ | $6.0^{a}$ | $1.0^{a}$ | $2.3^{a}$ | $100.0^{b}$ | 98.5 | 5.1 | 3.9 |
| Fubol 58WP (12 kg/ha)* | | | + | | | $167^{abc}$ | $1.5^{ab}$ | $10.3^{abc}$ | $0.3^{a}$ | $4.1^{abc}$ | $100.0^{b}$ | 97.8 | 4.8 | 3.8 |
| Fubol 58WP (12 kg/ha)* | | | | + | | $155^{a}$ | $16.0^{c}$ | $21.5^{cd}$ | $5.6^{b}$ | $8.1^{bcd}$ | $97.5^{a}$ | 94.8 | 4.8 | 3.9 |
| Fubol 58WP (12 kg/ha) x 2* | | + | | | + | $170^{abcd}$ | $3.5^{ab}$ | $8.0^{ab}$ | $1.5^{a}$ | $3.4^{ab}$ | $99.0^{ab}$ | 97.8 | 4.7 | 3.8 |
| Fubol 58WP (12 kg/ha)* | | +b | | | | $165^{abc}$ | $5.5^{ab}$ | $7.8^{ab}$ | $1.1^{a}$ | $2.8^{ab}$ | $100.0^{b}$ | 98.8 | 4.8 | 3.5 |
| $CaCO_3$ (10 t/ha)* | + | | | | | $168^{abcd}$ | $3.5^{ab}$ | $17.0^{abcd}$ | $1.0^{a}$ | $5.7^{abc}$ | $100.0^{b}$ | 97.5 | 4.8 | 4.2 |
| $CaCO_3$ (10 t/ha) + Fubol (12 kg/ha)* (1) (2) | +(1) +(2) | | | | | $163^{abc}$ | $0.5^{a}$ | $5.7^{a}$ | $0.1^{a}$ | $2.2^{a}$ | $100.0^{b}$ | 98.7 | 4.9 | 4.0 |
| CV (%) | | | | | | 10.7 | 97.6 | 54.9 | 123.2 | 67.1 | 1.1 | NSD 3.0 | NSD 9.7 | NSD 11.6 |
| SED (42 degrees of freedom) | | | | | | 13.22 | 4.02 | 5.24 | 1.51 | 2.31 | 0.78 | 2.06 | 0.33 | 0.32 |

b Band applied treatment

* Elguard RT seed dressing (contains iprodione and thiram)

@ Polycote Prime seed dressing (contains iprodione, metalaxyl and thiabendazole)

# All soil-applied fungicides were made in 500 l water/ha

/ H1 - 22 November 1989. H2 - 13 March 1990.

Figures with the same letter in the suffix within each column do not differ significantly (P = 0.05)

Table 14: Emergence counts and harvest assessments for the overwintered cavity spot trial at Arthur Rickwood EHF, 1989.

| Treatments# | Timing of application (Weeks post-drilling) | | | | | % Roots with cavity spot | | Cavity spot index | | % Roots marketable | | Weight of harvested roots (kg) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | -1 | 0 | 6 | 12 | 20 | H1/ | H2/ | H1 | H2 | H1 | H2 | H1 | H2 |
| Untreated | | | | | | $7.8^{f}$ | 44.3 | $2.9^{d}$ | 17.1 | 98.3 | 89.5 | 4.5 | - |
| Polycote Prime s.d.@ | | | | | | $6.0^{def}$ | 41.8 | $1.8^{abcd}$ | 15.7 | 99.3 | 91.8 | 4.1 | |
| Polycote Prime s.d.@ (x 4) | | | | | | $6.8^{ef}$ | 31.0 | $2.1^{bcd}$ | 10.7 | 99.5 | 95.3 | 4.4 | - |
| Favour 600FW (6 l/ha)@ | | + | | | | $5.5^{cdef}$ | 22.8 | $2.2^{cd}$ | 8.9 | 98.5 | 96.0 | 4.0 | - |
| Fubol 58WP (12 kg/ha)* | + | | | | | $2.5^{abcd}$ | 16.8 | $0.9^{abc}$ | 5.2 | 99.5 | 98.0 | 4.0 | - |
| Fubol 58WP (12 kg/ha)* | | + | | | | $3.8^{abcde}$ | 36.0 | 0.9abc | 13.2 | 99.8 | 93.3 | 4.4 | - |
| Fubol 58WP (12 kg/ha)* | | | + | | | $2.8^{abcd}$ | 22.5 | $1.1^{abc}$ | 7.3 | 99.3 | 97.8 | 4.3 | - |
| Fubol 58WP (12 kg/ha)* | | | | + | | $4.7^{bcdef}$ | 23.0 | 1.7abcd | 7.4 | 99.3 | 97.0 | 4.0 | - |
| Fubol 58WP (12 kg/ha) x 2* | | + | | | + | $1.0^{a}$ | 27.0 | $0.2^{a}$ | 10.3 | 100.0 | 93.0 | 4.4 | - |
| Fubol 58WP (12 kg/ha)* | | +b | | | | $2.3^{abc}$ | 27.8 | $0.5^{ab}$ | 9.4 | 100.0 | 96.8 | 4.6 | - |
| $CaCO_3$ (10 t/ha)* | + | | | | | $3.0^{abcd}$ | 28.3 | $1.3^{abc}$ | 9.3 | 99.0 | 96.3 | 4.0 | - |
| $CaCO_3$ (10 t/ha) + Fubol (12 kg/ha)* (1) (2) | +(1) | | | | +(2) | $3.0^{abcd}$ | 40.5 | $0.8^{abc}$ | 16.2 | 99.8 | 90.0 | 4.3 | - |
| | | | | | | | NSD | | NSD | NSD | NSD | NSD | |
| CV (%) | | | | | | 57.5 | 41.9 | 74.4 | 49.9 | 0.8 | 4.5 | 9.3 | |
| SED (39 degrees of freedom) | | | | | | 1.55 | 8.92 | 0.66 | 3.84 | 0.57 | 3.01 | 0.28 | |

b Band applied treatment

* Elguard RT seed dressing (contains iprodione and thiram)

@ Polycote Prime seed dressing (contains iprodione, metalaxyl and thiabendazole)

# All soil-applied fungicides were made in 500 l water/ha

/ H1 - 2 November 1989. H2 - 1 February 1990.

Figures with the same letter in the suffix within each column do not differ significantly (P = 0.05)

Commercial Sites

The results are presented in Summary in Tables 15-17. Individual plot results are tabulated in the Appendix (Tables 15A-17A)

Of the six trials conducted during the three year period of the investigation only two sites produced symptoms consistent with those of cavity spot at appreciable levels. (Halsall, 1987 and Skelmersdale, 1988).

At the remaining site in 1987 (Burscough) unusual symptoms were apparent on the roots at the first harvest in November (Table 15). These consisted of roughened or russetted areas on the root surface, 1-2 cm across, in the centre of which fine irregular longitudual cracks had developed. Samples forwarded to Dr G White, HRI, Wellesbourne indicated that the most probable incitant of the symptom was Pythium sulcatum as this fungus was recovered consistently from the lesions. These symptoms may be similar to those reported from Japan (Nagai et al., 1986 and Watenabe et al., 1986). None of the treatments in the trial reduced the incidence of the disorder significantly. P. sulcatum exhibits a poor response to metalaxyl treatment in vitro (White, 1988) and this perhaps provides an explanation for the results here.

Following overwintering a second symptom became evident both in the trial and the surrounding commercial crop. Crown rot progressing into the root between the cortical and stele tissues caused almost total crop loss. Again, none of the experimental treatments in the trial were effective and even though an in-depth search for a primary pathogen was made the cause of the disorder remains uncertain. A wider investigation funded by the HDC (Project FV36) is now underway to attempt to elucidate the cause of this disorder.

At the two commercial sites where cavity spot occurred infection levels were moderate-high (Tables 16 and 17). At neither site did cavity spot levels increase overwinter. This result is in complete contrast to results at HRI/ADAS sites.

Early application of metalaxyl as Fubol 58WP or Favour 600FW at 12 kg (l) product/ha was very effective at both sites. Unusually, late applications (12 week post drilling) applied to the trial at Skelmersdale in 1988 were fairly effective and this contrasts with all previous studies on fungicide timing. Reduced rates of Favour 600FW (6 and 3 l product/ha) were less effective, significantly so, at the first harvest in both trials though not by a second assessment in March.

A band applied treatment at Skelmersdale in 1988 was very effective in reducing the incidence of cavity spot, somewhat surprising as this trial was sited on an organic or 'moss' soil and this again contrasts with earlier studies.

In an attempt to improve the level of cavity spot control overwinter a broad spectrum fungicide mixture (Benlate + Basilex) was applied either 4 weeks post-drilling or prior to straw covering overwinter following treatment with Favour 600FW at 12 l product/ha immediately post-drilling to prevent cavity invasion by secondary soil fungi, eg Rhizoctonia, Fusarium. No improvement in the level of cavity spot control was achieved using this approach.

The wetting agent Agral has been shown to give some control of diseases caused by Phycomycete fungi in other studies (unpublished data). Applied at 5 l product/500 l water/ha (ie 1%) at Halsall, 1987 it failed to have any effect on the incidence of cavity spot.

Phosphorous acid ($H_3PO_3$) applied as foliar sprays at the 5-6 true leaf stage has been reported to be effective against cavity spot reducing the incidence of the disease by 78% and increasing root weight in Australia (Walker, 1988). It was included in trials on commercial crops in 1988 as a soil applied treatment immediately post-drilling rather than as foliar sprays as in previously reported work. A slight, but significant, reduction in cavity spot was achieved at the Skelmersdale site but at the first assessment only (Table 17). Both Fubol 58WP at 12 kg/ha and $H_3PO_3$ applied immediately post-drilling increased yield significantly in this trial.

Table 15: Harvest assessments for the overwintered cavity spot trial in a commercial crop at Burscough, Lancashire, 1987.

| Treatments | Timing of application (Weeks post-drilling) | | | % Roots affected | | Disease index | | % Roots marketable | | Weight of harvested roots (kg) | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 4 | 20* | H1[a] | H2[b] | H1 | H2 | H1 | H2 | H1 | H2 |
| Untreated | | | | 44.3 | 89.4 | 15.1 | - | 94.0 | 10.7 | 3.2 | - |
| Favour 600FW (12 l/500 l/ha) | | + | | 33.8 | 94.0 | 11.9 | - | 94.3 | 6.1 | 3.0 | - |
| Favour 600FW (12 l/500 l/ha) | + | | | 39.8 | 94.8 | 10.9 | - | 97.5 | 5.2 | 3.1 | - |
| Favour 600FW (6 l/500l/ha) | + | | | 32.5 | 87.5 | 9.9 | - | 96.8 | 12.5 | 3.2 | - |
| Favour 600FW (3 l/500 l/ha) | + | | | 16.5 | 88.5 | 6.7 | - | 95.3 | 11.5 | 3.1 | - |
| Favour 600FW (12 l/500 l/ha) x 2 | + | | + | 35.5 | 85.9 | 10.1 | - | 98.3 | 14.0 | 2.9 | - |
| Favour 600FW (1) + Benlate & Basilex (2) | +(1) | +(2) | | 32.8 | 87.6 | 9.6 | - | 98.5 | 12.4 | 3.0 | - |
| Favour 600FW (1) + Benlate & Basilex (2) | +(1) | | +(2) | 43.8 | 87.3 | 17.1 | - | 90.8 | 12.8 | 3.0 | - |
| Agral 1% (5l/500l/ha) | + | | | 37.8 | 91.6 | 13.0 | - | 95.5 | 8.5 | 2.8 | - |
| Favour 600FW (12 l/ha) + Agral (1%) | + | | | 30.3 | 87.9 | 9.3 | - | 96.3 | 12.1 | 3.1 | - |
| | | | | NSD | NSD | NSD | | NSD | NSD | NSD | |
| CV (%) | | | | 29.6 | 7.8 | 42.1 | | 5.3 | 68.7 | 14.6 | |
| SED (33 degrees of freedom) | | | | 7.44 | 4.98 | 3.44 | | 3.60 | 4.98 | 0.31 | |

H1 - 6 November 1987; H2 - 4 March 1988

a Symptoms consistent with those of cavity spot were not detected in this trial. At the first harvest fine vertical cracks and associated skin russetting were apparent and this was assessed instead.

b By the second harvest a crown rot had developed to severe levels throughout the trial area, this symptom was assessed on 4 March 1988 also.

* Pre-strawing application.

Table 16: Harvest assessments for the overwintered cavity spot trial in a commercial carrot crop at Halsall, Lancashire, 1987.

| Treatments | Timing of application (Weeks post-drilling)* | | | % Roots with cavity spot | | Cavity spot index | | % Roots marketable | | Weight of harvested roots (kg) | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 4 | 20 | H1 | H2 | H1 | H2 | H1 | H2 | H1 | H2 |
| Untreated | | | | 80.1$^{e}$ | 62.8$^{b}$ | 31.3$^{d}$ | 27.0$^{b}$ | 80.2$^{a}$ | 77.8$^{a}$ | 2.6 | - |
| Favour 600FW (12 l/500 l/ha) | | + | | 16.4$^{ab}$ | 14.5$^{a}$ | 4.6$^{ab}$ | 4.8$^{a}$ | 99.3$^{b}$ | 98.6$^{b}$ | 2.8 | - |
| Favour 600FW (12 l/500 l/ha) | + | | | 14.7$^{a}$ | 5.1$^{a}$ | 3.5$^{ab}$ | 1.5$^{a}$ | 100.0$^{b}$ | 99.4$^{b}$ | 2.8 | - |
| Favour 600FW (6 l/500 l/ha) | + | | | 32.6$^{c}$ | 11.1$^{a}$ | 9.0$^{ab}$ | 3.4$^{a}$ | 98.0$^{b}$ | 99.2$^{b}$ | 2.8 | - |
| Favour 600FW (3 l/500 l/ha) | + | | | 34.8$^{c}$ | 15.3$^{a}$ | 9.5$^{b}$ | 7.1$^{a}$ | 98.3$^{b}$ | 95.2$^{b}$ | 2.6 | - |
| Favour 600FW (12 l/500 l/ha) | + | | + | 12.6$^{a}$ | 11.5$^{a}$ | 2.8$^{a}$ | 3.1$^{a}$ | 100.0$^{b}$ | 100.0$^{b}$ | 2.9 | - |
| Favour 600FW (1) Benlate & Basilex (2) | +(1) | +(2) | | 19.8$^{ab}$ | 10.6$^{a}$ | 5.2$^{ab}$ | 3.0$^{a}$ | 99.7$^{b}$ | 99.2$^{b}$ | 2.9 | - |
| Favour 600FW (1) + Benlate + Basilex (2) | +(1) | | +(2) | 27.9$^{bc}$ | 3.9$^{a}$ | 8.2$^{ab}$ | 1.3$^{a}$ | 97.8$^{b}$ | 99.6$^{b}$ | 3.0 | - |
| Agral 1% (5 l/500 l/ha) | + | | | 84.7$^{e}$ | 61.7$^{b}$ | 32.9$^{d}$ | 29.4$^{b}$ | 80.5$^{a}$ | 75.1$^{a}$ | 2.6 | - |
| CV (%) | | | | 19.1 | 40.9 | 25.8 | 53.9 | 5.3 | NSD 7.4 | NSD 12.2 | |
| SED (30 degrees of freedom) | | | | 5.80 | 7.94 | 2.70 | 4.27 | 3.46 | 4.84 | 0.24 | |

H1 - 6 November 1987; H2 - 4 March 1988

* - pre-strawing treatment

Figures with the same letter in the suffix within each column do not differ significantly (P = 0.05)

Table 17: Harvest assessments for the overwintered cavity spot trial in a commercial carrot crop at Skelmersdale, Lancashire, 1988.

| Treatments | Timing of application (Weeks post-drilling)* 0 4 8 12 20 | % Roots with cavity spot/ H1 | % Roots with cavity spot/ H2 | Cavity spot index H1 | Cavity spot index H2 | % Roots marketable/ H1 | % Roots marketable/ H2 | Weight of harvested roots (kg) H1 | Weight of harvested roots (kg) H2 |
|---|---|---|---|---|---|---|---|---|---|
| Untreated | | $43.3^{c}$ | $37.5^{cde}$ | $22.5^{c}$ | $16.6^{cd}$ | $66.5^{a}$ | $65.2^{ab}$ | $2.5^{a}$ | - |
| Favour 600FW (12 l/500 l/ha) | + | $6.6^{a}$ | $17.5^{ab}$ | $3.6^{ab}$ | $2.6^{a}$ | $90.0^{b}$ | $84.4^{de}$ | $2.9^{abcd}$ | - |
| Favour 600FW (6 l/500 l/ha) | + | $28.1^{bc}$ | $23.3^{abc}$ | $11.2^{ab}$ | $3.9^{a}$ | $74.4^{ab}$ | $81.5^{de}$ | $2.9^{abcd}$ | - |
| Favour 600FW (12 l/500 l/ha) | + | $13.1^{ab}$ | $13.4^{a}$ | $2.8^{a}$ | $2.4^{a}$ | $88.0^{b}$ | $84.9^{e}$ | $2.7^{ab}$ | - |
| Fubol 58WP (12 kg/500 l/ha) | + | $19.1^{ab}$ | $25.3^{abcd}$ | $5.7^{ab}$ | $5.1^{ab}$ | $88.0^{b}$ | $79.2^{de}$ | $3.2^{d}$ | - |
| Favour 600FW (12 l/500 l/ha) | +b | $16.5^{ab}$ | $18.4^{ab}$ | $4.2^{ab}$ | $3.8^{a}$ | $88.0^{b}$ | $77.3^{bcde}$ | $2.6^{ab}$ | - |
| Favour 600FW (12 l/500 l/ha) | + | $15.7^{ab}$ | $26.0^{abcd}$ | $5.4^{ab}$ | $8.2^{abc}$ | $88.0^{b}$ | $72.7^{abcde}$ | $2.7^{abc}$ | - |
| Favour 600FW (12 l/500 l/ha) | + | $20.2^{ab}$ | $26.1^{abcd}$ | $9.2^{ab}$ | $6.2^{ab}$ | $81.5^{ab}$ | $72.4^{abcde}$ | $2.8^{abcd}$ | - |
| Favour 600FW (12 l/500 l/ha) | + + | $13.5^{ab}$ | $21.3^{abc}$ | $2.4^{a}$ | $3.5^{a}$ | $88.0^{b}$ | $79.5^{cde}$ | $2.8^{abcd}$ | - |
| Favour 600FW (6 l/500 l/ha) | + + | $14.0^{ab}$ | $19.2^{ab}$ | $2.6^{a}$ | $3.3^{a}$ | $90.0^{b}$ | $82.9^{de}$ | $2.6^{ab}$ | - |
| $CaCo_3$ (10 tonnes/ha) | + | $30.1^{bc}$ | $41.1^{de}$ | $13.4^{abc}$ | $14.9^{bcd}$ | $80.4^{ab}$ | $67.8^{abc}$ | $2.9^{abcd}$ | - |
| $H_3PO_3$ (10 l/500 l/ha) | + | $30.5^{bc}$ | $43.4^{e}$ | $14.3^{bc}$ | $20.1^{d}$ | $77.8^{ab}$ | $59.9^{a}$ | $3.1^{cd}$ | - |
| Favour 600FW (12 l/ha) + Benlate & Basilex (1) (2) | +(1) +(2) | $16.6^{ab}$ | $32.5^{bcde}$ | $4.6^{ab}$ | $8.5^{abc}$ | $88.0^{b}$ | $71.1^{abcd}$ | $2.9^{abcd}$ | - |
| CV (%) | | 56.8 | 38.2 | 88.5 | 85.5 | 11.2 | 10.8 | 8.8 | |
| SED (36 degrees of freedom) | | 8.27 | 7.17 | 4.69 | 4.44 | 6.63 | 5.76 | 0.18 | |

/ - Data subjected to angular transformation. Actual data is presented in the Appendix. (Table 17A)

b - Band-applied fungicide

* - Pre-straw application

H1 - 14 November 1988; H2 - 22 April 1989

Figures with the same letter in the suffix within each column do not differ significantly (P = 0.05).

Discussion

Since Lyshol et al. 1984 made their initial observations major advances have been made towards improving our understanding of the disease; Groom & Perry, (1985) and White (1986, 1988) have now demonstrated conclusively that the primary incitant of the disease is the soil-borne fungus Pythium violae. Other species, eg Pythium sulcatum, may also be involved in some instances (White, 1988).

The trials series reported here in conjunction with earlier field trials by ADAS (Gladders & McPherson, 1986), have demonstrated that metalaxyl application (Fubol 58WP or Favour 600FW) at 12 kg(1) product/ha applied within 6 weeks of drilling consistently gives effective control of cavity spot. A range of other products tested have generally been less effective (Gladders & Crompton, 1984; Gladders & McPherson, 1986). As a direct result of these early ADAS studies and other collaborative work there is now a label recommendation for the use of Fubol 58WP for cavity spot control and a large proportion of the carrot acreage is treated each year.

However, numerous gaps in our knowledge of the disease remain. The project reported here was undertaken in an attempt to improve our understanding of the disease with the primary aim of determining the optimum rate, timing and method of application for effective control in early protected and late overwintered crops.

The studies reported on early protected crops have shown that:-

- Cavity spot has the potential to cause major losses on early crops grown under protection.

- Effective control on early crops can be achieved with metalaxyl applied as Fubol 58WP or Favour 600FW and there may be potential to reduce the rate to 6 kg(1) product/ha whilst maintaining control.

- There are few opportunities to apply fungicides to covered crops. However, in this trial series timing of fungicide application was not critical. Applications made immediately post-drilling or on removal of the polythene 11-14 weeks later were equally effective. In order to ensure minimum residues in the harvested crop it is recommended that growers should apply the treatment at the earliest opportunity, ie prior to protection.

- Treatment as a band application was effective, albeit in a limited number of trials and this method of application offers a further opportunity to reduce fungicide inputs.

Control of cavity spot with late applications ie at polythene removal when the roots are at the "pencil" stage on these early crops was unexpected. A similar application 11-14 weeks post-drilling on maincrop carrots would almost certainly be ineffective.

February drilled crops, albeit under protection, are likely to be growing more slowly than unprotected crops drilled in April-May. As roots reach a particular physiological age they may become resistant to further invasion of the tap root. However, infection of fine feeder roots may continue; certainly Pythium spp. are well recognised as pathogens of juvenile tissues. This could account for why late applications of metalaxyl on early sown slow-growing crops provides effective control whereas the faster-growing later sown crops reach a stage of host resistance to Pythium more quickly. Against this there is evidence from some trials (HRI/ADAS maincrop sites) that cavity spot incidence increases overwinter and yet the efficacy of late applications of metalaxyl in these situations has not been demonstrated.

Alternatively, the pathogen may only be active in a narrow soil temperature band. In February drilled covered crops soil temperatures are likely to be very low and a temperature rise may be required for the pathogen to become active ie in late April-early May. This is the approximate time at which crop covers are removed and also the time at which optimum control is gained with metalaxyl applications on maincrop carrots.

The persistance of metalaxyl in soil following application is likely to be relatively short (Bailey & Coffey 1985; Sharom & Edgington, 1982) and indeed in situations where there has been a history of metalaxyl use breakdown could occur very rapidly due to enhanced microbial degradation (Bailey & Coffey, 1985). Its activity therefore must be fairly rapid to give the level of control achieved. It is unlikely that post-drilling applications before crop covers are applied would persist until they are removed. Arguably however, it is possible that the metalaxyl resides in the top 1-2 cm of "dry" soil, where microbial activity is low, until the covers are removed. The metalaxyl may then be effective against Pythium as it leaches through the soil profile during rainfall following removal of the crop covers in May.

The studies on the overwintered maincrops have shown that:-

- Cavity spot has the potential to cause severe crop losses in maincrop carrots.

- Cavity spot would appear, in some circumstances at least, to have the potential to continue to develop during the overwintering phase of the crop. Early treatment with metalaxyl appeared to suppress late development of cavity spot in some trials.

- Early treatment remains essential for effective control and this supports earlier studies on fungicide timing. Late applications were ineffective.

- Reduced application rates gave variable control and cannot be relied upon, given our present knowledge, to give acceptable control in all situations.

- Seed treatment with Polycote Prime can reduce the incidence of cavity spot but is not a substitute for soil applied treatment with Fubol 58WP. This commercial seed treatment should not be relied upon to provide cavity spot control, and it does not improve the level of control achieved compared with a single field treatment with Fubol 58WP or Favour 600FW. There may, however, be other advantages in choosing to use this seed treatment.

- Experimental treatment of the seed with Polycote Prime containing a significantly increased dose of metalaxyl would appear to offer considerable promise and early indications suggest germination and subsequent establishment are not affected. This seed treatment has the potential to offer considerable savings both economically and environmentally and should be examined further in future studies.

- Limited studies with ground limestone would indicate that increasing the pH may provide an opportunity to reduce fungicide inputs whilst maintaining control and this aspect also merits further investigation.

Poor or ineffective control should be expected occasionally. In one trial site in this series poor control, albeit a variable symptom, was obtained following metalaxyl application.

The most probably explanations for poor control in commercial crops are:-

1. Misdiagnosis of symptoms
2. Inappropriate timing of application of Fubol 58WP/Favour 600FW
3. Incorrect rates of application
4. Enhanced microbial degradation
5. Fungicide resistance in the pathogen population.

One of the most interesting aspects of this trials series has been that at HRI/ADAS sites in 1988 and 1989 the incidence of cavity spot in untreated plots increased significantly overwinter. In these trials, early treatment with metalaxyl controlled cavity spot effectively and more importantly the control persisted overwinter, even though the persistance of the metalaxyl is reported to be a matter of weeks (Bailey & Coffey, 1985; Sharom & Edgington, 1982). Yet, single late ie pre-straw applications of metalaxyl at the same rate were totally ineffective. Similarly, late applications of broad spectrum tank-mixed fungicides ie Benlate/Basilex were equally ineffective. It appears unlikely therefore that secondary opportunist soil fungi are responsible for the late development.

Clearly further studies are required to resolve this. It may simply be that Autumn applications of metalaxyl fail to persist to provide protection for the period required, or are inactive during low temperature periods. P. violae may have a small temperature range in which it is active in the spring and the development of cavity spot overwinter may actually occur a few weeks before the second harvest in late February-March as the soil temperatures rise.

As the foliage dies down in the Autumn the root essentially becomes a storage organ and it is possible that host defence mechanisms cease. This, may also increase susceptibility to re-invasion by P. violae during the overwintering phase of the crop.

Finally, looking to the future, as environmental concerns increase, further pressure is likely to be brought on excessive pesticide inputs to agricultural and horticultural land. Currently in the region of 80-90% of all UK carrots are treated with Fubol 58WP. In many of the crops treated the potential risk from soil-borne disease, particularly cavity spot, is low but unfortunately due to our lack of knowledge of the disease and the soils in which it occurs we are unable to identify low/high risk sites and Fubol 58WP will continue to be used prophylactically as an insurance treatment.

Effective control with a seed treatment could, in the sort term at least, reduce the environmental concern, and at the same time minimise the risk of enhanced degradation and fungicide resistance (White, el al 1988) occurring in populations of P. violae and P. sulcatum. Moreover, recent evidence has demonstrated the detrimental effect metalaxyl has on beneficial soil micro-organisms including P. oligandrum (White 1991 (In press)) and a reduced application rate of metalaxyl on the seed could minimise these effects.

In the longer term, techniques need to be developed to identify high risk soils ie those containing high populations of P. violae and/or P. sulcatum. This aspect is currently under investigation by Dr G White at HRI Wellesbourne the aim being to develop monoclonal antibodies specific to the fungi in question. Initial results are very encouraging.

Field trials are continuing in 1991/2 and 1992/3 with further funding from the HDC. Trials, conducted at HRI, Stockbridge House and at ADAS, Arthur Rickwood EHF, will examine seed treatments with differential metalaxyl loadings for cavity spot control on the varieties Nandor and Nanco with NIAB resistance ratings for cavity spot of 6 and 2 respectively. Differences in varietial resistance to cavity spot are claimed, (Sweet et al, 1986) though this has been disputed (White et al, 1988). Clearly, if varietal differences in susceptibility to cavity spot do occur, it could provide an additional useful mechanism in an integrated control programme and for this reason this aspect has been included in the extended project. Results from the extended project will be presented in a separate report on completion of the trials.

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Finally, it is with deep regret that I report the death of Mr Duncan Senior, who assisted in the trials at Stockbridge House. Duncan was always on hand to provide enthusiastic support in our investigations and his wide ranging expertise on vegetable R & D will be sadly missed.

Storage of Data

The raw data from this trials series will be retained for a minimum period of 5 years in the Department of Entomology and Plant Pathology at ADAS, Leeds.

**APPENDIX**

Table 7A. Harvest assessments for the early protected carrot trial at Burscough, Lancashire, 1987.

| Treatments | | % Roots with cavity spot | Cavity spot index | % Roots marketable | Weight of harvested roots (kg) |
|---|---|---|---|---|---|
| Untreated | | 62.2 | 32.2 | 70.0 | 3.3 |
| | | 60.0 | 30.0 | 73.1 | 2.8 |
| | | 55.2 | 24.3 | 86.5 | 3.2 |
| | | 53.6 | 25.0 | 84.3 | 2.5 |
| | Mean | 57.8 | 27.9 | 78.5 | 3.0 |
| Favour 600FW (3 l/500 l water/ha) post drilling | | 11.5 | 4.3 | 98.5 | 4.6 |
| | | 11.3 | 3.8 | 100.0 | 3.5 |
| | | 6.5 | 2.2 | 100.0 | 3.6 |
| | | 4.7 | 3.0 | 100.0 | 3.7 |
| | Mean | 8.5 | 3.0 | 99.6 | 3.7 |
| Favour 600FW (6 l/500 l water/ha) post drilling | | 5.0 | 1.7 | 100.0 | 3.1 |
| | | 1.7 | 0.6 | 100.0 | 3.9 |
| | | 1.8 | 0.6 | 100.0 | 3.4 |
| | | 0.0 | 0.0 | 100.0 | 3.0 |
| | Mean | 2.1 | 0.7 | 100.0 | 3.4 |
| Favour 600FW (12 l/500 l water/ha) post drilling | | 2.4 | 0.8 | 100.0 | 3.8 |
| | | 6.4 | 2.1 | 100.0 | 4.0 |
| | | 1.6 | 0.5 | 100.0 | 3.8 |
| | | 2.9 | 1.0 | 100.0 | 3.0 |
| | Mean | 3.3 | 1.1 | 100.0 | 3.7 |
| Favour 600FW (12 l/2000 l water/ha) post drilling | | 3.2 | 1.1 | 100.0 | 3.3 |
| | | 8.6 | 2.9 | 100.0 | 5.4 |
| | | 0.0 | 0.0 | 100.0 | 3.4 |
| | | 0.8 | 0.3 | 100.0 | 3.0 |
| | Mean | 3.2 | 1.1 | 100.0 | 3.8 |
| Favour 600FW (3 l/500 l water/ha) post drilling & cover removal | | 0.0 | 0.0 | 100.0 | 3.7 |
| | | 0.0 | 0.0 | 100.0 | 3.8 |
| | | 0.8 | 0.3 | 100.0 | 3.7 |
| | | 5.5 | 1.8 | 100.0 | 3.5 |
| | Mean | 1.6 | 0.5 | 100.0 | 3.7 |
| Favour 600FW (6 l/500 l water/ha) post drilling & cover removal | | 0.0 | 0.0 | 100.0 | 3.5 |
| | | 1.7 | 0.6 | 100.0 | 3.9 |
| | | 0.0 | 0.0 | 100.0 | 3.6 |
| | | 0.7 | 0.2 | 100.0 | 3.4 |
| | Mean | 0.6 | 0.2 | 100.0 | 3.6 |

Table 7A. (contd) Harvest assessments for the early protected carrot trial at Burscough, Lancashire, 1987.

| Treatments | | % Roots with cavity spot | Cavity spot index | % Roots marketable | Weight of harvested roots (kg) |
|---|---|---|---|---|---|
| Favour 600FW (12 l/500 l water/ha) post drilling & cover removal | | 1.1 | 0.4 | 100.0 | 2.7 |
| | | 3.8 | 1.3 | 100.0 | 4.7 |
| | | 0.0 | 0.0 | 100.0 | 4.0 |
| | | 0.0 | 0.0 | 100.0 | 3.1 |
| | Mean | 1.2 | 0.4 | 100.0 | 3.6 |
| Favour 600FW (12 l/500 l water/ha) cover removal | | 5.5 | 2.2 | 98.9 | 3.3 |
| | | 1.9 | 0.6 | 100.0 | 3.0 |
| | | 0.0 | 0.0 | 100.0 | 3.8 |
| | | 1.7 | 0.6 | 100.0 | 3.4 |
| | Mean | 2.3 | 0.9 | 99.7 | 3.4 |
| Fubol 58WP (12 kg/500 l water/ha) post drilling | | 0.0 | 0.0 | 100.0 | 2.9 |
| | | 0.0 | 0.0 | 100.0 | 3.9 |
| | | 0.0 | 0.0 | 100.0 | 4.4 |
| | | 2.6 | 0.9 | 100.0 | 3.6 |
| | Mean | 0.7 | 0.2 | 100.0 | 3.7 |

Table 8A Harvest assessments for the early protected carrot trial at Holywell, Suffolk, 1987.

| Treatments | | % Roots with cavity spot | Cavity spot index | % Roots marketable | Weight of harvested roots (kg) |
|---|---|---|---|---|---|
| Untreated | | 7.0 | 3.2 | 98.0 | 3.6 |
| | | 12.0 | 6.8 | 93.0 | 3.7 |
| | | 17.0 | 9.2 | 91.0 | 3.1 |
| | | 7.0 | 3.6 | 96.0 | 2.8 |
| | Mean | 10.8 | 5.7 | 94.5 | 3.3 |
| Favour 600FW (3 l/500 l water/ha) post drilling | | 6.0 | 3.4 | 96.0 | 3.8 |
| | | 7.0 | 4.0 | 95.0 | 3.5 |
| | | 3.0 | 1.0 | 99.0 | 3.0 |
| | | 13.0 | 7.0 | 93.0 | 3.4 |
| | Mean | 7.3 | 3.85 | 95.8 | 3.4 |
| Favour 600FW (6 l/500 l water/ha) post drilling | | 2.0 | 0.8 | 100.0 | 3.6 |
| | | 3.0 | 1.2 | 100.0 | 3.9 |
| | | 3.0 | 1.4 | 99.0 | 3.0 |
| | | 9.0 | 4.2 | 95.0 | 3.3 |
| | Mean | 4.3 | 1.9 | 98.5 | 3.5 |
| Favour 600FW (12 l/500 l water/ha) post drilling | | 3.0 | 1.4 | 99.0 | 3.8 |
| | | 2.0 | 1.2 | 99.0 | 2.9 |
| | | 5.0 | 2.4 | 99.0 | 3.8 |
| | | 3.0 | 2.2 | 97.0 | 4.4 |
| | Mean | 3.3 | 1.8 | 98.5 | 3.7 |
| Favour 600FW (12 l/2000 l water/ha) post drilling | | 1.0 | 0.4 | 100.0 | 4.6 |
| | | 4.0 | 1.6 | 98.0 | 3.0 |
| | | 0.0 | 0.0 | 100.0 | 3.7 |
| | | 2.0 | 0.8 | 100.0 | 3.9 |
| | Mean | 1.8 | 0.7 | 99.5 | 3.8 |
| Favour 600FW (3 l/500 l water/ha) post drilling & cover removal | | 0.0 | 0.0 | 100.0 | 3.2 |
| | | 5.0 | 3.6 | 96.0 | 3.9 |
| | | 2.0 | 1.2 | 99.0 | 2.6 |
| | | 0.0 | 0.0 | 100.0 | 3.9 |
| | Mean | 1.8 | 1.2 | 98.8 | 3.4 |
| Favour 600FW (6 l/500 l water/ha) post drilling & cover removal | | 1.0 | 0.6 | 99.0 | 4.4 |
| | | 2.0 | 0.8 | 100.0 | 3.3 |
| | | 0.0 | 0.0 | 10.0 | 2.8 |
| | | 1.0 | 0.4 | 100.0 | 3.6 |
| | Mean | 1.0 | 0.45 | 99.8 | 3.5 |

Table 8A (contd) Harvest assessments for the early protected carrot trial at Holywell, Suffolk, 1987.

| Treatments | | % Roots with cavity spot | Cavity spot index | % Roots marketable | Weight of harvested roots (kg) |
|---|---|---|---|---|---|
| Favour 600FW (12 l/500 l water/ha) post drilling & cover removal | | 0.0 | 0.0 | 100.0 | 4.1 |
| | | 0.0 | 0.0 | 100.0 | 2.8 |
| | | 0.0 | 0.0 | 100.0 | 3.8 |
| | | 0.0 | 0.0 | 100.0 | 3.1 |
| | Mean | 0.0 | 0.0 | 100.0 | 3.5 |
| Favour 600FW (12 l/500 l water/ha) cover removal | | 0.0 | 0.0 | 100.0 | 4.8 |
| | | 1.0 | 0.8 | 99.0 | 3.9 |
| | | 1.0 | 0.8 | 99.0 | 3.2 |
| | | 0.0 | 0.0 | 100.0 | 4.4 |
| | Mean | 0.5 | 0.4 | 99.5 | 4.1 |
| Fubol 58WP (12 kg/500 l water/ha) post drilling | | 0.0 | 0.0 | 100.0 | 4.0 |
| | | 3.0 | 1.4 | 99.0 | 4.3 |
| | | 1.0 | 0.6 | 99.0 | 3.8 |
| | | 2.0 | 1.4 | 98.0 | 3.0 |
| | Mean | 1.5 | 0.9 | 99.0 | 3.8 |

Table 9A. Harvest assessments for the early protected carrot trial at West Stow, Suffolk, 1987.

| Treatments | | % Roots with cavity spot | Cavity spot index | % Roots marketable | Weight of harvested roots (kg) |
|---|---|---|---|---|---|
| Untreated | | 14.0 | 10.0 | 92.0 | 10.0 |
| | | 57.0 | 57.0 | 43.0 | 8.5 |
| | | 77.0 | 77.0 | 23.0 | 10.8 |
| | | 29.0 | 23.7 | 79.0 | 9.0 |
| | Mean | 44.3 | 41.9 | 59.3 | 9.6 |
| Favour 600FW (3 l/500 l water/ha) post drilling | | 29.0 | 21.0 | 83.0 | 9.8 |
| | | 24.0 | 16.7 | 87.0 | 7.0 |
| | | 9.0 | 5.7 | 96.0 | 6.0 |
| | | 40.0 | 35.3 | 67.0 | 9.0 |
| | Mean | 25.5 | 19.7 | 83.3 | 8.0 |
| Favour 600FW (6 l/500 l water/ha) post drilling | | 27.0 | 18.3 | 86.0 | 8.6 |
| | | 69.0 | 68.3 | 32.0 | 7.3 |
| | | 10.0 | 6.0 | 96.0 | 8.5 |
| | | 7.0 | 6.3 | 94.0 | 8.1 |
| | Mean | 28.3 | 24.7 | 77.0 | 8.1 |
| Favour 600FW (12 l/500 l water/ha) post drilling | | 1.0 | 1.0 | 99.0 | 8.5 |
| | | 18.0 | 13.3 | 89.0 | 7.8 |
| | | 18.0 | 8.0 | 97.0 | 8.6 |
| | | 10.0 | 5.3 | 97.0 | 9.2 |
| | Mean | 11.8 | 6.9 | 95.5 | 8.5 |
| Favour 600FW (12 l/2000 l water/ha) post drilling | | 1.0 | 1.0 | 99.0 | 9.4 |
| | | 4.0 | 2.0 | 99.0 | 7.3 |
| | | 12.0 | 4.7 | 99.0 | 10.6 |
| | | 24.0 | 10.7 | 96.0 | 10.0 |
| | Mean | 10.3 | 4.6 | 98.3 | 9.3 |
| Favour 600FW (3 l/500 l water/ha) post drilling & cover removal | | 10.0 | 5.3 | 97.0 | 8.9 |
| | | 1.0 | 1.0 | 99.0 | 6.9 |
| | | 13.0 | 6.3 | 97.0 | 8.2 |
| | | 23.0 | 13.0 | 92.0 | 8.0 |
| | Mean | 11.8 | 6.4 | 96.3 | 8.0 |
| Favour 600FW (6 l/500 l water/ha) post drilling & cover removal | | 10.0 | 4.7 | 98.0 | 10.1 |
| | | 5.0 | 2.3 | 99.0 | 6.2 |
| | | 18.0 | 10.0 | 94.0 | 8.1 |
| | | 19.0 | 10.3 | 94.0 | 9.1 |
| | Mean | 13.0 | 6.8 | 96.3 | 8.4 |
| Favour 600FW (12 l/500 l water/ha) post drilling & cover removal | | 0.0 | 0.0 | 100.0 | 10.2 |
| | | 9.0 | 3.7 | 99.0 | 6.8 |
| | | 5.0 | 3.7 | 97.0 | 10.6 |
| | | 9.0 | 3.7 | 99.0 | 12.3 |
| | Mean | 5.8 | 2.8 | 98.8 | 10.0 |

Table 9A. (contd) Harvest assessments for the early protected carrot trial at West Stow, Suffolk, 1987.

| Treatments | | % Roots with cavity spot | Cavity spot index | % Roots marketable | Weight of harvested roots (kg) |
|---|---|---|---|---|---|
| Favour 600FW (12 l/500 l water/ha) cover removal | | 2.0 | 2.0 | 98.0 | 9.3 |
| | | 2.0 | 2.0 | 98.0 | 7.0 |
| | | 3.0 | 2.3 | 98.0 | 8.2 |
| | | 16.0 | 8.0 | 96.0 | 11.8 |
| | Mean | 5.8 | 3.6 | 97.5 | 9.1 |

Table 10A. Harvest assessment for the early protected carrot trial at Burscough, Lancashire 1988.

| Treatments | | % Roots with cavity spot | Cavity spot index | % Roots marketable | Weight of harvested roots (kg) |
|---|---|---|---|---|---|
| Untreated | | 11.0 | 3.4 | 99.0 | 5.4 |
| | | 34.0 | 35.1 | 97.0 | 8.1 |
| | | 7.0 | 2.9 | 97.0 | 5.9 |
| | | 7.0 | 1.8 | 99.0 | 7.6 |
| | Mean | 14.8 | 10.8 | 98.0 | 6.8 |
| Favour 600FW (3 l/500 l water/ha) post drilling | | 5.0 | 1.5 | 100.0 | 6.4 |
| | | 4.0 | 0.8 | 100.0 | 6.3 |
| | | 4.0 | 0.8 | 100.0 | 7.5 |
| | | 2.0 | 0.4 | 100.0 | 6.4 |
| | Mean | 3.8 | 0.9 | 100.0 | 6.7 |
| Favour 600FW (6 l/500 l water/ha) post drilling | | 0.0 | 0.0 | 100.0 | 5.2 |
| | | 3.0 | 0.6 | 100.0 | 6.3 |
| | | 3.0 | 0.6 | 100.0 | 5.6 |
| | | 4.0 | 1.0 | 100.0 | 6.0 |
| | Mean | 2.5 | 0.6 | 100.0 | 5.8 |
| Favour 600FW (12 l/500 l water/ha) post drilling | | 2.0 | 0.4 | 100.0 | 5.3 |
| | | 0.0 | 0.0 | 100.0 | 8.5 |
| | | 2.0 | 0.4 | 100.0 | 6.2 |
| | | 2.0 | 0.4 | 100.0 | 7.2 |
| | Mean | 1.5 | 0.3 | 100.0 | 6.8 |
| Favour 600FW (12 l/2000 l water/ha) post drilling | | 2.0 | 0.4 | 100.0 | 5.7 |
| | | 3.0 | 0.6 | 100.0 | 6.4 |
| | | 0.0 | 0.0 | 100.0 | 6.8 |
| | | 4.0 | 1.0 | 100.0 | 5.8 |
| | Mean | 2.3 | 0.5 | 100.0 | 6.2 |
| Favour 600FW (3 l/500 l water/ha) post drilling & cover removal | | 0.0 | 0.0 | 100.0 | 6.9 |
| | | 4.0 | 0.8 | 100.0 | 7.0 |
| | | 4.0 | 0.8 | 100.0 | 7.4 |
| | | 0.0 | 0.0 | 100.0 | 5.6 |
| | Mean | 2.0 | 0.4 | 100.0 | 6.7 |
| Favour 600FW (6 l/500 l water/ha) post drilling & cover removal | | 0.0 | 0.0 | 100.0 | 5.5 |
| | | 2.0 | 0.4 | 100.0 | 7.8 |
| | | 0.0 | 0.0 | 100.0 | 5.9 |
| | | 2.0 | 0.4 | 100.0 | 5.7 |
| | Mean | 1.0 | 0.2 | 100.0 | 6.2 |
| Favour 600FW (12 l/500 l water/ha) post drilling & cover removal | | 3.0 | 0.8 | 100.0 | 4.4 |
| | | 3.0 | 0.6 | 100.0 | 6.4 |
| | | 3.0 | 0.8 | 100.0 | 6.5 |
| | | 2.0 | 0.4 | 100.0 | 7.1 |
| | Mean | 2.8 | 0.7 | 100.0 | 6.1 |

Table 10A.(contd) Harvest assessment for the early protected carrot trial at Burscough, Lancashire 1988.

| Treatments | | % Roots with cavity spot | Cavity spot index | % Roots marketable | Weight of harvested roots (kg) |
|---|---|---|---|---|---|
| Favour 600FW (12 l/500 l water/ha) cover removal | | 0.0 | 0.0 | 100.0 | 5.5 |
| | | 4.0 | 1.4 | 99.0 | 6.6 |
| | | 6.0 | 1.1 | 100.0 | 5.8 |
| | | 6.0 | 1.1 | 100.0 | 6.0 |
| | Mean | 4.0 | 0.9 | 99.8 | 5.9 |
| Favour 600FW (12 l/500 l water/ha) post drilling band application | | 0.0 | 0.0 | 100.0 | 7.1 |
| | | 6.0 | 1.2 | 100.0 | 7.8 |
| | | 1.0 | 0.2 | 100.0 | 6.4 |
| | | 4.0 | 1.0 | 100.0 | 5.8 |
| | Mean | 2.8 | 0.6 | 100.0 | 6.8 |
| Fubol 58WP (12 kg/500 l water/ha) post drilling | | 3.0 | 0.6 | 100.0 | 5.6 |
| | | 0.0 | 0.0 | 100.0 | 7.1 |
| | | 0.0 | 0.0 | 100.0 | 6.9 |
| | | 2.0 | 0.4 | 100.0 | 5.3 |
| | Mean | 1.3 | 0.3 | 100.0 | 6.2 |

Table 11A Emergence counts and harvest assessments for the overwintered cavity spot trial at HRI, Stockbridge House, 1988.

| Treatments | | Plants per 1 m row | % Roots with cavity spot | | Cavity spot index | | % Roots marketable | | Weight of harvested roots (kg) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | H1 | H2 | H1 | H2 | H1 | H2 | H1 | H2 |
| Untreated | | 119 | 42.0 | 52.0 | 14.8 | 18.7 | 92.0 | 96.0 | 3.27 | 3.30 |
| | | 128 | 44.0 | 63.0 | 19.8 | 25.7 | 87.0 | 83.0 | 3.30 | 5.05 |
| | | 121 | 32.0 | 58.0 | 10.7 | 26.1 | 96.0 | 81.0 | 3.10 | 4.18 |
| | | - | 8.0 | 66.0 | 2.5 | 30.4 | 99.0 | 79.0 | 2.92 | 4.57 |
| | Mean | 123 | 31.5 | 59.8 | 12.0 | 25.2 | 93.5 | 84.8 | 3.15 | 4.28 |
| Polycote Prime s.d. | | 136 | 26.0 | 44.0 | 12.3 | 15.9 | 90.0 | 95.0 | 2.21 | 3.35 |
| | | 126 | 41.0 | 48.0 | 15.4 | 20.0 | 92.0 | 86.0 | 3.26 | 4.75 |
| | | 142 | 19.0 | 55.0 | 8.2 | 22.6 | 96.0 | 83.0 | 3.39 | 4.58 |
| | | - | 18.0 | 26.0 | 6.0 | 10.5 | 96.0 | 93.0 | 3.87 | 4.10 |
| | Mean | 135 | 26.0 | 43.3 | 10.5 | 17.3 | 93.5 | 89.3 | 3.18 | 4.20 |
| Elguard s.d. | | 116 | 24.0 | 71.0 | 10.4 | 28.2 | 91.0 | 90.0 | 3.30 | 4.50 |
| | | 123 | 39.0 | 44.0 | 14.3 | 14.4 | 91.0 | 99.0 | 3.16 | 2.95 |
| | | 116 | 49.0 | 55.0 | 17.6 | 18.0 | 92.0 | 93.0 | 3.19 | 3.42 |
| | | - | 49.0 | 27.0 | 18.2 | 8.7 | 89.0 | 98.0 | 2.89 | 4.51 |
| | Mean | 118 | 40.3 | 49.3 | 15.1 | 17.3 | 90.8 | 95.0 | 3.14 | 3.85 |
| Fubol 58WP (12 kg/500 l/ha) 0 weeks post drilling | | 130 | 1.0 | 6.0 | 0.2 | 1.1 | 100.0 | 100.0 | 3.38 | 4.50 |
| | | 126 | 14.0 | 8.0 | 4.9 | 2.5 | 98.0 | 100.0 | 2.88 | 3.85 |
| | | 143 | 1.0 | 9.0 | 0.2 | 2.3 | 100.0 | 100.0 | 2.69 | 4.74 |
| | | - | 7.0 | 6.0 | 1.8 | 1.6 | 100.0 | 100.0 | 3.45 | 3.62 |
| | Mean | 133 | 5.8 | 7.3 | 1.8 | 1.9 | 99.5 | 100.0 | 3.10 | 4.18 |
| Favour 600FW (12 l/500 l/ha) 0 weeks post drilling | | 126 | 1.0 | 2.0 | 0.6 | 0.5 | 99.0 | 100.0 | 3.60 | 5.85 |
| | | 105 | 2.0 | 4.0 | 0.3 | 0.9 | 100.0 | 100.0 | 3.58 | 4.20 |
| | | 119 | 0.0 | 7.0 | 0.0 | 1.5 | 100.0 | 100.0 | 2.96 | 5.60 |
| | | - | 0.0 | 7.0 | 0.0 | 1.7 | 100.0 | 100.0 | 4.15 | 4.00 |
| | Mean | 117 | 0.8 | 5.0 | 0.2 | 1.2 | 99.8 | 100.0 | 3.57 | 4.91 |
| Favour 600FW (12 l/500 l/ha) 4 weeks post drilling | | 137 | 2.0 | 12.0 | 0.7 | 2.7 | 100.0 | 100.0 | 3.00 | 4.10 |
| | | 106 | 7.0 | 7.0 | 3.0 | 1.6 | 98.0 | 100.0 | 3.64 | 4.52 |
| | | 121 | 2.0 | 5.0 | 0.4 | 0.9 | 100.0 | 100.0 | 2.78 | 4.55 |
| | | - | 3.0 | 3.0 | 0.7 | 0.5 | 100.0 | 100.0 | 2.72 | 3.57 |
| | Mean | 121 | 3.5 | 6.8 | 1.2 | 1.4 | 99.5 | 100.0 | 3.04 | 4.19 |
| Favour 600FW (12 l/500 l/ha) 8 weeks post drilling | | 121 | 1.0 | 28.0 | 0.2 | 10.2 | 100.0 | 95.0 | 2.81 | 3.90 |
| | | 122 | 4.0 | 17.0 | 0.7 | 5.8 | 100.0 | 98.0 | 3.25 | 4.50 |
| | | 119 | 2.0 | 7.0 | 0.5 | 2.8 | 100.0 | 98.0 | 2.81 | 4.23 |
| | | - | 3.0 | 13.0 | 1.3 | 3.8 | 97.0 | 99.0 | 3.10 | 4.17 |
| | Mean | 121 | 2.5 | 16.3 | 0.7 | 5.7 | 99.3 | 97.5 | 2.99 | 4.20 |
| Favour 600FW (12 l/500 l/ha) 12 weeks post drilling | | 129 | 36.0 | 69.0 | 14.3 | 28.1 | 92.0 | 86.0 | 4.20 | 3.95 |
| | | 133 | 52.0 | 63.0 | 25.2 | 21.8 | 74.0 | 92.0 | 3.91 | 4.30 |
| | | 140 | 64.0 | 68.0 | 31.0 | 28.7 | 74.0 | 82.0 | 2.99 | 4.31 |
| | | - | 18.0 | 57.0 | 4.4 | 23.0 | 98.0 | 84.0 | 2.27 | 4.36 |
| | Mean | 134 | 42.5 | 64.3 | 18.7 | 25.4 | 84.5 | 86.0 | 3.34 | 4.23 |



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Table 11A (contd) Emergence counts and harvest assessments for the overwintered cavity spot trial at HRI, Stockbridge House, 1988.

| Treatments | | Plants per 1 m row | % Roots with cavity spot | | Cavity spot index | | % Roots marketable | | Weight of harvested roots (kg) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | H1 | H2 | H1 | H2 | H1 | H2 | H1 | H2 |
| Favour 600FW (12 l/500 l/ha) | | 142 | 1.0 | 5.0 | 0.2 | 2.2 | 100.0 | 98.0 | 3.40 | 4.10 |
| 0 + 4 weeks post drilling | | 114 | 6.0 | 6.0 | 1.5 | 2.0 | 100.0 | 99.0 | 3.55 | 3.35 |
| | | 139 | 0.0 | 2.0 | 0.0 | 0.4 | 100.0 | 100.0 | 2.75 | 4.89 |
| | | - | 1.0 | 6.0 | 0.2 | 1.5 | 100.0 | 100.0 | 2.68 | 5.40 |
| | Mean | 132 | 2.0 | 4.8 | 0.5 | 1.5 | 100.0 | 99.3 | 3.10 | 4.44 |
| Favour 600FW (6 l/500 l/ha) | | 110 | 0.0 | 5.0 | 0.0 | 1.6 | 100.0 | 99.0 | 3.08 | 3.50 |
| 0 + 4 weeks post drilling | | 116 | 1.0 | 9.0 | 0.2 | 4.0 | 100.0 | 96.0 | 3.65 | 4.00 |
| | | 128 | 1.0 | 4.0 | 0.2 | 0.8 | 100.0 | 100.0 | 2.35 | 4.70 |
| | | - | 0.0 | 5.0 | 0.0 | 2.1 | 100.0 | 98.0 | 2.20 | 5.70 |
| | Mean | 118 | 0.5 | 5.8 | 0.1 | 2.1 | 100.0 | 98.3 | 2.82 | 4.48 |
| Favour 600FW (6 l/500 l/ha) | | 140 | 7.0 | 7.0 | 1.4 | 1.6 | 100.0 | 100.0 | 3.45 | 3.95 |
| 4 weeks post drilling | | 99 | 3.0 | 10.0 | 0.5 | 3.2 | 100.0 | 100.0 | 2.55 | 5.05 |
| | | 138 | 1.0 | 6.0 | 0.2 | 1.3 | 100.0 | 100.0 | 2.86 | 3.94 |
| | | - | 5.0 | 5.0 | 1.0 | 1.3 | 100.0 | 100.0 | 2.98 | 5.97 |
| | Mean | 126 | 4.0 | 7.0 | 0.8 | 1.9 | 100.0 | 100.0 | 2.96 | 4.73 |
| Favour 600FW (12 l/500 l/ha) | | 130 | 0.0 | 3.0 | 0.0 | 0.6 | 100.0 | 100.0 | 3.50 | 4.40 |
| 4 weeks post drilling | | 134 | 3.0 | 14.0 | 1.1 | 4.7 | 99.0 | 99.0 | 3.57 | 4.30 |
| | | 130 | 0.0 | 6.0 | 0.0 | 1.4 | 100.0 | 100.0 | 2.23 | 4.64 |
| | | - | 0.0 | 3.0 | 0.0 | 0.3 | 100.0 | 100.0 | 3.75 | 4.33 |
| | Mean | 131 | 0.8 | 6.5 | 0.3 | 1.8 | 99.8 | 99.8 | 3.26 | 4.42 |
| $CaCO_3$ (10 tonnes/ha) | | 102 | 0.0 | 1.0 | 0.0 | 0.2 | 100.0 | 100.0 | 3.18 | 3.80 |
| 0 weeks post drilling | | 90 | 0.0 | 5.0 | 0.0 | 1.0 | 100.0 | 100.0 | 3.15 | 4.15 |
| Favour 600FW (12 l/500/ha) | | 112 | 1.0 | 3.0 | 0.2 | 0.8 | 100.0 | 100.0 | 2.86 | 5.74 |
| 4 weeks post drilling | | - | 1.0 | 6.0 | 0.0 | 1.5 | 100.0 | 100.0 | 2.50 | 4.57 |
| | Mean | 101 | 0.3 | 3.8 | 0.1 | 0.9 | 100.0 | 100.0 | 2.92 | 4.57 |

Table 12A Emergence counts and harvest assessments for the overwintered cavity spot trial at ADAS, Arthur Rickwood EHF, 1988.

| Treatments | | Plants per 1 m row | % Roots with cavity spot | | Cavity spot index | | % roots marketable | | Weight of harvested roots (kg) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | H1 | H2 | H1 | H2 | H1 | H2 | H1 | H2 |
| Untreated | | 71.0 | 51.0 | 63.0 | 20.6 | 32.8 | 87.0 | 72.0 | 8.75 | - |
| | | 83.0 | 45.0 | 62.0 | 24.6 | 28.0 | 77.0 | 79.0 | 7.37 | - |
| | | 89.0 | 30.0 | 42.0 | 16.2 | 15.0 | 83.0 | 90.0 | 8.67 | - |
| | | 64.0 | 54.0 | 79.0 | 22.0 | 41.0 | 85.0 | 64.0 | 7.14 | - |
| | Mean | 76.8 | 45.0 | 61.5 | 20.9 | 29.2 | 83.3 | 76.3 | 7.98 | - |
| Polycote Prime s.d. | | 94.0 | 45.0 | 66.0 | 18.4 | 31.8 | 86.0 | 75.0 | 9.37 | - |
| | | 114.0 | 48.0 | 71.0 | 22.8 | 35.4 | 81.0 | 74.0 | 8.48 | - |
| | | 75.0 | 59.0 | 45.0 | 24.4 | 21.0 | 83.0 | 86.0 | 8.38 | - |
| | | 86.0 | 45.0 | 65.0 | 17.2 | 29.4 | 89.0 | 75.0 | 7.11 | - |
| | Mean | 92.3 | 49.3 | 61.8 | 20.7 | 29.4 | 84.8 | 77.5 | 8.34 | - |
| Elguard s.d. | | 98.0 | 37.0 | 48.0 | 16.0 | 19.0 | 88.0 | 85.0 | 6.67 | - |
| | | 111.0 | 31.0 | 80.0 | 13.6 | 31.6 | 89.0 | 80.0 | 5.01 | - |
| | | 115.0 | 60.0 | 58.0 | 30.0 | 26.8 | 76.0 | 78.0 | 6.22 | - |
| | | 134.0 | 80.0 | 91.0 | 41.0 | 49.8 | 59.0 | 51.0 | 5.73 | - |
| | Mean | 114.5 | 52.0 | 69.3 | 25.2 | 31.8 | 78.0 | 73.5 | 5.91 | - |
| Fubol 58WP (12 kg/500 l/ha) 0 weeks post drilling | | 83.0 | 16.0 | 19.0 | 5.4 | 6.0 | 98.0 | 98.0 | 7.90 | - |
| | | 115.0 | 17.0 | 36.0 | 6.8 | 15.8 | 93.0 | 88.0 | 6.40 | - |
| | | 110.0 | 15.0 | 15.0 | 5.6 | 4.6 | 95.0 | 99.0 | 6.80 | - |
| | | 136.0 | 19.0 | 19.0 | 7.8 | 8.0 | 95.0 | 94.0 | 7.00 | - |
| | Mean | 111.0 | 16.8 | 22.3 | 6.4 | 8.6 | 95.3 | 94.8 | 7.03 | - |
| Favour 600FW (12 l/500 l/ha) 0 weeks post drilling | | 86.0 | 12.0 | 30.0 | 5.4 | 11.0 | 95.0 | 93.0 | 7.07 | - |
| | | 112.0 | 39.0 | 56.0 | 21.8 | 22.6 | 81.0 | 88.0 | 6.26 | - |
| | | 109.0 | 4.0 | 13.0 | 1.2 | 5.0 | 99.0 | 96.0 | 7.07 | - |
| | | 112.0 | 7.0 | 32.0 | 3.8 | 15.6 | 96.0 | 88.0 | 5.94 | - |
| | Mean | 104.8 | 15.5 | 32.8 | 8.1 | 13.6 | 92.8 | 91.3 | 6.59 | - |
| Favour 600FW (12 l/500 l/ha) 4 weeks post drilling | | 100.0 | 8.0 | 24.0 | 3.2 | 9.0 | 96.0 | 94.0 | 6.06 | - |
| | | 108.0 | 10.0 | 37.0 | 3.2 | 14.6 | 99.0 | 91.0 | 7.55 | - |
| | | 108.0 | 5.0 | 21.0 | 1.4 | 6.4 | 100.0 | 99.0 | 7.09 | - |
| | | 118.0 | 18.0 | 21.0 | 5.8 | 8.0 | 97.0 | 96.0 | 5.75 | - |
| | Mean | 108.5 | 10.3 | 25.8 | 3.4 | 9.5 | 98.0 | 95.0 | 6.61 | - |
| Favour 600FW (12 l/500 l/ha) 8 weeks post drilling | | 53.0 | 8.0 | 15.0 | 3.6 | 5.2 | 98.0 | 96.0 | 7.67 | - |
| | | 111.0 | 13.0 | 35.0 | 4.0 | 16.4 | 97.0 | 84.0 | 7.50 | - |
| | | 95.0 | 6.0 | 10.0 | 1.8 | 5.8 | 99.0 | 94.0 | 6.98 | - |
| | | 130.0 | 9.0 | 29.0 | 2.6 | 13.0 | 99.0 | 90.0 | 4.97 | - |
| | Mean | 97.3 | 9.0 | 22.3 | 3.0 | 10.1 | 98.3 | 91.0 | 6.78 | - |
| Favour 600FW (12 l/500 l/ha) 12 weeks post drilling | | 71.0 | 16.0 | 56.0 | 8.2 | 21.6 | 96.0 | 84.0 | 5.58 | - |
| | | 122.0 | 30.0 | 60.0 | 14.6 | 25.6 | 88.0 | 81.0 | 6.53 | - |
| | | 111.0 | 29.0 | 56.0 | 13.8 | 22.6 | 89.0 | 85.0 | 5.66 | - |
| | | 134.0 | 57.0 | 80.0 | 25.8 | 43.0 | 78.0 | 59.0 | 5.80 | - |
| | Mean | 109.5 | 33.0 | 63.0 | 15.6 | 28.2 | 87.8 | 77.3 | 5.89 | - |

Table 12A (contd) Emergence counts and harvest assessments for the overwintered cavity spot trial at ADAS, Arthur Rickwood, 1988.

| Treatments | | Plants per 1 m row | % Roots with cavity spot | | Cavity spot index | | % Roots marketable | | Weight of harvested roots (kg) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | H1 | H2 | H1 | H2 | H1 | H2 | H1 | H2 |
| Favour 600FW (12 l/500 l/ha) | | 80.0 | 9.0 | 14.0 | 3.6 | 6.4 | 99.0 | 96.0 | 6.26 | - |
| 0 + 4 weeks post drilling | | 87.0 | 19.0 | 42.0 | 8.0 | 18.2 | 95.0 | 87.0 | 6.30 | - |
| | | 95.0 | 8.0 | 18.0 | 3.6 | 7.4 | 97.0 | 95.0 | 6.40 | - |
| | | 117.0 | 3.0 | 17.0 | 0.6 | 5.8 | 100.0 | 97.0 | 6.14 | - |
| | Mean | 94.8 | 9.8 | 22.8 | 4.0 | 9.5 | 97.8 | 93.8 | 6.28 | - |
| Favour 600FW (6 l/500 l/ha) | | 85.0 | 1.0 | 23.0 | 0.6 | 10.8 | 99.0 | 91.0 | 6.45 | - |
| 0 + 4 weeks post drilling | | 96.0 | 28.0 | 39.0 | 10.0 | 14.6 | 95.0 | 95.0 | 8.28 | - |
| | | 109.0 | 7.0 | 15.0 | 2.4 | 5.2 | 99.0 | 98.0 | 6.66 | - |
| | | 130.0 | 4.0 | 13.0 | 1.4 | 4.2 | 99.0 | 98.0 | 5.30 | - |
| | Mean | 105.0 | 10.0 | 22.5 | 3.6 | 8.7 | 98.0 | 95.5 | 6.67 | - |
| Favour 600FW (6 l/500 l/ha) | | 85.0 | 11.0 | 23.0 | 3.4 | 9.0 | 99.0 | 94.0 | 7.15 | - |
| 4 weeks post drilling | | 85.0 | 23.0 | 31.0 | 7.6 | 13.4 | 92.0 | 91.0 | 6.61 | - |
| | | 71.0 | 13.0 | 15.0 | 3.8 | 6.8 | 98.0 | 94.0 | 6.76 | - |
| | | 81.0 | 12.0 | 17.0 | 4.2 | 7.0 | 98.0 | 95.0 | 6.67 | - |
| | Mean | 80.5 | 14.8 | 21.5 | 4.8 | 9.1 | 96.8 | 93.5 | 6.80 | - |
| Favour 600FW (12 l/500 l/ha) | | 68.0 | 19.0 | 18.0 | 8.0 | 8.6 | 93.0 | 94.0 | 8.37 | - |
| 4 weeks post drilling | | 80.0 | 23.0 | 27.0 | 9.0 | 11.4 | 95.0 | 92.0 | 7.83 | - |
| | | 84.0 | 1.0 | 9.0 | 0.2 | 4.4 | 100.0 | 96.0 | 6.90 | - |
| | | 91.0 | 9.0 | 26.0 | 5.4 | 13.4 | 94.0 | 89.0 | 6.45 | - |
| | Mean | 80.8 | 13.0 | 20.0 | 5.7 | 9.5 | 95.5 | 92.8 | 7.39 | - |
| $CaCO_3$ (10 tonnes/ha | | 77.0 | 5.0 | 16.0 | 1.8 | 6.8 | 99.0 | 95.0 | 5.80 | - |
| 0 weeks post drilling + | | 74.0 | 9.0 | 38.0 | 4.8 | 15.8 | 96.0 | 89.0 | 7.76 | - |
| Favour 600FW (12 l/500 l/ha) | | 75.0 | 7.0 | 10.0 | 4.0 | 4.4 | 97.0 | 95.0 | 6.03 | - |
| 4 weeks post drilling | | 86.0 | 11.0 | 22.0 | 3.4 | 8.4 | 98.0 | 95.0 | 5.83 | - |
| | Mean | 78.0 | 8.0 | 21.5 | 3.5 | 8.9 | 97.5 | 93.5 | 6.36 | - |

Table 13A Emergence counts and harvest assessments for the overwintered cavity spot trial at HRI, Stockbridge House, 1989.

| Treatments | | Plants per 1 m row | | % Roots with cavity spot | | Cavity spot index | | % Roots marketable | | Weight of harvested roots (kg) | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | H1 | H2 | H1 | H2 | H1 | H2 | H1 | H2 | H1 | H2 |
| Untreated | | 194.0 | 109.0 | 18.0 | 30.0 | 6.8 | 12.1 | 98.0 | 92.0 | 4.45 | 3.60 |
| | | 176.0 | 149.0 | 6.0 | 10.0 | 1.2 | 3.1 | 100.0 | 100.0 | 5.45 | 4.12 |
| | | 177.0 | 94.0 | 16.0 | 36.0 | 5.6 | 12.6 | 96.0 | 95.0 | 4.10 | 3.28 |
| | | 189.0 | 155.0 | 24.0 | 30.0 | 8.8 | 8.3 | 96.0 | 97.0 | 5.20 | 5.20 |
| | Mean | 184.0 | 126.8 | 16.0 | 26.5 | 5.6 | 9.0 | 97.5 | 96.0 | 4.80 | 4.05 |
| Polycote Prime seed treatment | | 218.0 | 181.0 | 14.0 | 10.0 | 4.4 | 2.9 | 100.0 | 99.0 | 4.90 | 4.64 |
| | | 178.0 | 151.0 | 6.0 | 25.0 | 1.6 | 7.2 | 100.0 | 98.0 | 5.10 | 4.84 |
| | | 189.0 | 162.0 | 2.0 | 15.0 | 0.4 | 8.5 | 100.0 | 100.0 | 3.80 | 3.66 |
| | | 211.0 | 163.0 | 20.0 | 28.0 | 7.2 | 13.1 | 98.0 | 91.0 | 4.60 | 4.80 |
| | Mean | 199.0 | 164.3 | 10.5 | 19.5 | 3.3 | 6.7 | 99.5 | 97.0 | 4.60 | 4.49 |
| Basamid (380 kg/ha) | | 229.0 | 181.0 | 4.0 | 31.0 | 0.8 | 13.4 | 100.0 | 92.0 | 3.70 | 3.60 |
| | | 173.0 | 136.0 | 0.0 | 15.0 | 0.0 | 7.2 | 100.0 | 95.0 | 4.60 | 4.30 |
| | | 178.0 | 136.0 | 12.0 | 49.0 | 3.6 | 17.1 | 100.0 | 93.0 | 5.80 | 3.90 |
| | | 194.0 | 168.0 | 0.0 | 19.0 | 0.0 | 7.0 | 100.0 | 97.0 | 5.00 | 4.30 |
| | Mean | 193.5 | 155.3 | 4.0 | 28.5 | 1.1 | 11.2 | 100.0 | 94.3 | 4.78 | 4.03 |
| Polycote Prime s.d. (x 4) | | 199.0 | 158.0 | 2.0 | 11.0 | 0.4 | 3.5 | 100.0 | 99.0 | 5.00 | 4.30 |
| | | 203.0 | 159.0 | 8.0 | 18.0 | 1.6 | 6.9 | 100.0 | 94.0 | 5.10 | 3.80 |
| | | 194.0 | 211.0 | 10.0 | 6.0 | 2.0 | 1.9 | 100.0 | 100.0 | 4.60 | 4.40 |
| | | 161.0 | 147.0 | 2.0 | 10.0 | 0.4 | 3.1 | 100.0 | 99.0 | 5.00 | 3.86 |
| | Mean | 189.3 | 168.8 | 5.5 | 11.3 | 1.1 | 3.9 | 100.0 | 98.0 | 4.93 | 4.09 |
| Fubol 58WP (6 kg/500 l/ha) 0 weeks post drilling | | 230.0 | 207.0 | 0.0 | 5.0 | 0.0 | 1.1 | 100.0 | 100.0 | 4.90 | 3.44 |
| | | 222.0 | 147.0 | 0.0 | 8.0 | 0.0 | 1.9 | 100.0 | 100.0 | 4.90 | 3.64 |
| | | 210.0 | 186.0 | 6.0 | 8.0 | 1.2 | 2.9 | 100.0 | 99.0 | 5.30 | 3.60 |
| | | 217.0 | 160.0 | 0.0 | 5.0 | 0.0 | 1.3 | 100.0 | 100.0 | 5.40 | 3.68 |
| | Mean | 219.8 | 175.0 | 1.5 | 6.5 | 0.3 | 1.8 | 100.0 | 99.8 | 5.13 | 3.59 |
| Fubol 58WP (12 kg/500 l/ha) 1 wk before drilling | | 175.0 | 122.0 | 4.0 | 5.0 | 0.8 | 1.1 | 100.0 | 100.0 | 4.40 | 3.80 |
| | | 150.0 | 115.0 | 0.0 | 9.0 | 0.0 | 3.3 | 100.0 | 97.0 | 4.60 | 4.10 |
| | | 157.0 | 151.0 | 2.0 | 9.0 | 0.4 | 2.4 | 100.0 | 99.0 | 4.90 | 4.44 |
| | | 180.0 | 130.0 | 4.0 | 6.0 | 0.8 | 2.0 | 100.0 | 99.0 | 5.00 | 4.12 |
| | Mean | 165.5 | 129.5 | 2.5 | 7.3 | 0.5 | 2.2 | 100.0 | 98.8 | 4.73 | 4.12 |
| Fubol 58WP (12 kg/500 l/ha) 0 wks post drilling | | 178.0 | 120.0 | 0.0 | 6.0 | 0.0 | 1.7 | 100.0 | 99.0 | 5.50 | 2.80 |
| | | 179.0 | 123.0 | 8.0 | 6.0 | 2.0 | 2.4 | 100.0 | 98.0 | 5.20 | 4.00 |
| | | 157.0 | 128.0 | 6.0 | 5.0 | 1.2 | 2.0 | 100.0 | 99.0 | 5.00 | 4.56 |
| | | 164.0 | 131.0 | 2.0 | 7.0 | 0.8 | 3.2 | 100.0 | 98.0 | 4.70 | 4.10 |
| | Mean | 169.5 | 125.5 | 4.0 | 6.0 | 1.0 | 2.3 | 100.0 | 98.5 | 5.10 | 3.87 |

Table 13A (contd) Emergence counts and harvest assessments for the overwintered cavity spot trial at HRI, Stockbridge House, 1989.

| Treatments | | Plants per 1 m row | | % Roots with cavity spot | | Cavity spot index | | % Roots marketable | | Weight of harvested roots (kg) | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | H1 | H2 | H1 | H2 | H1 | H2 | H1 | H2 | H1 | H2 |
| Fubol 58WP (12 kg/500 l/ha) | | 182.0 | 136.0 | 2.0 | 4.0 | 0.4 | 0.7 | 100.0 | 100.0 | 5.10 | 3.56 |
| 6 weeks post drilling | | 159.0 | 140.0 | 4.0 | 19.0 | 0.8 | 9.0 | 100.0 | 94.0 | 4.50 | 4.30 |
| | | 158.0 | 132.0 | 0.0 | 11.0 | 0.0 | 4.1 | 100.0 | 98.0 | 4.70 | 4.00 |
| | | 169.0 | 112.0 | 0.0 | 7.0 | 0.0 | 2.5 | 100.0 | 99.0 | 4.70 | 3.50 |
| | Mean | 167.0 | 130.0 | 1.5 | 10.3 | 0.3 | 4.1 | 100.0 | 97.8 | 4.75 | 3.84 |
| Fubol 58WP (12 kg/500 l/ha) | | 137.0 | 105.0 | 18.0 | 29.0 | 4.0 | 14.3 | 100.0 | 86.0 | 4.20 | 3.70 |
| 12 weeks post drilling | | 165.0 | 115.0 | 0.0 | 9.0 | 0.0 | 3.3 | 100.0 | 97.0 | 5.10 | 4.10 |
| | | 184.0 | 131.0 | 16.0 | 29.0 | 5.6 | 9.6 | 96.0 | 97.0 | 5.10 | 3.72 |
| | | 135.0 | 120.0 | 30.0 | 19.0 | 12.8 | 5.2 | 94.0 | 99.0 | 4.60 | 4.00 |
| | Mean | 155.3 | 117.8 | 16.0 | 21.5 | 5.6 | 8.1 | 97.5 | 94.8 | 4.75 | 3.88 |
| Fubol 58WP (12 kg/500 l/ha) | | 184.0 | 117.0 | 0.0 | 15.0 | 0.0 | 5.8 | 100.0 | 97.0 | 4.20 | 3.40 |
| 0 weeks post drilling | | 184.0 | 121.0 | 12.0 | 4.0 | 5.2 | 1.7 | 96.0 | 99.0 | 5.10 | 4.26 |
| & before strawing | | 167.0 | 129.0 | 2.0 | 7.0 | 0.8 | 4.5 | 100.0 | 95.0 | 5.20 | 4.00 |
| down | | 148.0 | 97.0 | 0.0 | 6.0 | 0.0 | 1.4 | 100.0 | 100.0 | 4.20 | 3.36 |
| | Mean | 170.8 | 116.0 | 3.5 | 8.0 | 1.5 | 3.4 | 99.0 | 97.8 | 4.68 | 3.76 |
| Fubol 58WP (12 kg/500 l/ha) | | 203.0 | 108.0 | 14.0 | 11.0 | 2.8 | 3.9 | 100.0 | 98.0 | 4.80 | 2.60 |
| band application | | 153.0 | 106.0 | 4.0 | 13.0 | 0.8 | 4.7 | 100.0 | 98.0 | 5.40 | 3.72 |
| 0 weeks post drilling | | 146.0 | 128.0 | 4.0 | 2.0 | 0.8 | 0.5 | 100.0 | 100.0 | 4.50 | 3.56 |
| | | 158.0 | 144.0 | 0.0 | 5.0 | 0.0 | 2.1 | 100.0 | 99.0 | 4.50 | 4.00 |
| | Mean | 165.0 | 121.5 | 5.5 | 7.8 | 1.1 | 2.8 | 100.0 | 98.8 | 4.80 | 3.47 |
| $CaCO_3$ (10 tonnes/ha) | | 140.0 | 140.0 | 6.0 | 12.0 | 1.6 | 4.0 | 100.0 | 99.0 | 4.90 | 4.04 |
| 1 week prior to | | 210.0 | 169.0 | 2.0 | 12.0 | 1.2 | 2.7 | 100.0 | 100.0 | 5.00 | 5.08 |
| drilling | | 181.0 | 123.0 | 6.0 | 19.0 | 1.2 | 5.2 | 100.0 | 99.0 | 4.00 | 3.42 |
| | | 142.0 | 118.0 | 0.0 | 25.0 | 0.0 | 10.9 | 100.0 | 92.0 | 4.40 | 4.20 |
| | Mean | 168.3 | 137.5 | 3.5 | 17.0 | 1.0 | 5.7 | 100.0 | 97.5 | 4.80 | 4.19 |
| $CaCO_3$ (10 tonnes/ha) | | 154.0 | - | 0.0 | - | 0.0 | - | 100.0 | - | 5.30 | - |
| prior to drilling + | | 140.0 | 131.0 | 2.0 | 5.0 | 0.4 | 2.3 | 100.0 | 98.0 | 4.10 | 4.70 |
| Fubol 58WP (12 kg/500 l/ha) | | 183.0 | 114.0 | 0.0 | 5.0 | 0.0 | 1.9 | 100.0 | 99.0 | 5.10 | 3.44 |
| 0 weeks post drilling | | 176.0 | 146.0 | 0.0 | 7.0 | 0.0 | 2.3 | 100.0 | 99.0 | 5.00 | 3.90 |
| | Mean | 163.3 | 130.9 | 0.5 | 5.7 | 0.1 | 2.2 | 100.0 | 98.7 | 4.88 | 4.01 |

Table 14A Harvest assessments for the overwintered cavity spot trial at ADAS, Arthur Rickwood EHF, 1989.

| Treatments | | % Roots with cavity spot | | Cavity spot index | | % Roots marketable | | Weight of harvested roots (kg) | |
|---|---|---|---|---|---|---|---|---|---|
| | | H1 | H2 | H1 | H2 | H1 | H2 | H1 | H2 |
| Untreated | | 7.0 | 30.0 | 1.8 | 9.0 | 100.0 | 96.0 | 3.93 | - |
| | | 9.0 | 63.0 | 4.0 | 25.2 | 97.0 | 85.0 | 5.46 | - |
| | | 10.0 | 57.0 | 4.0 | 26.4 | 97.0 | 79.0 | 4.58 | - |
| | | 5.0 | 27.0 | 1.8 | 7.8 | 99.0 | 98.0 | 3.94 | - |
| | Mean | 7.8 | 44.3 | 2.9 | 17.1 | 98.3 | 89.5 | 4.47 | - |
| Polycote Prime s.d. | | 6.0 | 40.0 | 1.8 | 13.6 | 99.0 | 96.0 | 4.00 | - |
| | | 7.0 | 27.0 | 1.6 | 9.2 | 100.0 | 96.0 | 4.64 | - |
| | | 7.0 | 68.0 | 2.4 | 29.0 | 99.0 | 79.0 | 3.42 | - |
| | | 4.0 | 32.0 | 1.2 | 10.8 | 99.0 | 96.0 | 4.25 | - |
| | Mean | 6.0 | 41.8 | 1.8 | 15.7 | 99.3 | 91.8 | 4.07 | - |
| Polycote Prime s.d. (x 4) | | 11.0 | 45.0 | 3.8 | 16.6 | 99.0 | 92.0 | 4.48 | - |
| | | 8.0 | 23.0 | 2.0 | 7.8 | 100.0 | 98.0 | 5.04 | - |
| | | 5.0 | 30.0 | 1.8 | 10.4 | 99.0 | 94.0 | 4.41 | - |
| | | 3.0 | 26.0 | 0.6 | 8.0 | 100.0 | 97.0 | 3.65 | - |
| | Mean | 6.8 | 31.0 | 2.1 | 10.7 | 99.5 | 95.3 | 4.39 | - |
| Favour 600FW (6 l/500 l/ha) 0 weeks post drilling | | 4.0 | 19.0 | 2.0 | 7.4 | 98.0 | 95.0 | 3.98 | - |
| | | 9.0 | 25.0 | 3.0 | 10.6 | 98.0 | 95.0 | 4.18 | - |
| | | 2.0 | 22.0 | 1.4 | 7.8 | 99.0 | 98.0 | 3.52 | - |
| | | 7.0 | 25.0 | 2.2 | 9.6 | 99.0 | 98.0 | 3.52 | - |
| | Mean | 5.5 | 22.8 | 2.2 | 8.9 | 98.5 | 96.0 | 3.96 | - |
| Fubol 58WP (12 kg/500 l/ha) 1 week before drilling | | 0.0 | 11.0 | 0.0 | 3.4 | 100.0 | 99.0 | 3.78 | - |
| | | 7.0 | 21.0 | 2.2 | 7.0 | 99.0 | 96.0 | 4.58 | - |
| | | 1.0 | 21.0 | 0.2 | 7.2 | 100.0 | 97.0 | 3.74 | - |
| | | 2.0 | 14.0 | 1.0 | 3.2 | 99.0 | 100.0 | 3.79 | - |
| | Mean | 2.5 | 16.8 | 0.9 | 5.2 | 99.5 | 98.0 | 3.97 | - |
| Fubol 58WP (12 kg/500 l/ha) 0 weeks post drilling | | 2.0 | 16.0 | 0.4 | 5.0 | 100.0 | 98.0 | 4.52 | - |
| | | 7.0 | 25.0 | 1.6 | 8.0 | 100.0 | 96.0 | 5.69 | - |
| | | 4.0 | 64.0 | 1.2 | 24.6 | 99.0 | 85.0 | 4.01 | - |
| | | 2.0 | 39.0 | 0.4 | 15.2 | 100.0 | 94.0 | 3.49 | - |
| | Mean | 3.8 | 36.0 | 0.9 | 13.2 | 99.8 | 93.3 | 4.42 | - |
| Fubol 58WP (12 kg/500 l/ha) 6 weeks post drilling | | 1.0 | 13.0 | 0.2 | 3.6 | 100.0 | 100.0 | 4.09 | - |
| | | 3.0 | 28.0 | 0.6 | 9.2 | 100.0 | 98.0 | 4.79 | - |
| | | 7.0 | 25.0 | 3.4 | 8.6 | 97.0 | 97.0 | 4.55 | - |
| | | 0.0 | 24.0 | 0.0 | 7.6 | 100.0 | 96.0 | 3.76 | - |
| | Mean | 2.8 | 22.5 | 1.1 | 7.3 | 99.3 | 97.8 | 4.29 | - |

Table 14A (contd) Harvest assessments for the overwintered cavity spot trial at ADAS, Arthur Rickwood EHF, 1989.

| Treatments | | % Roots with cavity spot | | Cavity spot index | | % Roots marketable | | Weight of harvested roots (kg) | |
|---|---|---|---|---|---|---|---|---|---|
| | | H1 | H2 | H1 | H2 | H1 | H2 | H1 | H2 |
| Fubol 58WP (12 kg/500 l/ha) 12 weeks post drilling | | 5.0 | 20.0 | 2.2 | 7.0 | 99.0 | 97.0 | 4.55 | - |
| | | 8.0 | 9.0 | 2.8 | 2.2 | 99.0 | 100.0 | 4.73 | - |
| | | 5.0 | 49.0 | 1.6 | 16.6 | 99.0 | 93.0 | 3.45 | - |
| | | 1.0 | 14.0 | 0.2 | 3.8 | 100.0. | 98.0 | 3.15 | - |
| | Mean | 4.8 | 23.0 | 1.7 | 7.4 | 99.3 | 97.0 | 3.97 | - |
| Fubol 58WP (12 kg/500 l/ha) 0 weeks post drilling and before strawing down | | 0.0 | 15.0 | 0.0 | 5.0 | 100.0 | 98.0 | 4.38 | - |
| | | 3.0 | 17.0 | 0.6 | 6.8 | 100.0 | 94.0 | 5.46 | - |
| | | 0.0 | 66.0 | 0.0 | 26.4 | 100.0 | 81.0 | 3.42 | - |
| | | 1.0 | 10.0 | 0.2 | 2.8 | 100.0 | 99.0 | 4.23 | - |
| | Mean | 1.0 | 27.0 | 0.2 | 10.3 | 100.0 | 93.0 | 4.37 | - |
| Fubol 58WP (12 kg/500 l/ha) 0 weeks post drilling band application | | 3.0 | 17.0 | 0.6 | 6.0 | 100.0 | 98.0 | 4.37 | - |
| | | 1.0 | 20.0 | 0.2 | 5.8 | 100.0 | 99.0 | 5.82 | - |
| | | 1.0 | 57.0 | 0.2 | 19.4 | 100.0 | 93.0 | 4.04 | - |
| | | 4.0 | 17.0 | 1.0 | 6.2 | 100.0 | 97.0 | 4.20 | - |
| | Mean | 2.3 | 27.8 | 0.5 | 9.4 | 100.0 | 96.8 | 4.60 | - |
| $CaCO_3$ (10 tonnes/ha) prior to drilling | | 1.0 | 18.0 | 0.2 | 5.8 | 100.0 | 97.0 | 3.59 | - |
| | | 5.0 | 38.0 | 2.2 | 11.8 | 98.0 | 95.0 | 4.73 | - |
| | | 3.0 | 31.0 | 0.6 | 9.8 | 100.0 | 97.0 | 3.46 | - |
| | | 3.0 | 26.0 | 2.0 | 9.8 | 98.0 | 96.0 | 4.06 | - |
| | Mean | 3.0 | 28.3 | 1.3 | 9.3 | 99.0 | 96.3 | 3.96 | - |
| $CaCO_3$ (10 tonnes/ha) prior to drilling + Fubol 58WP (12 kg/500 l/ha) 0 weeks post drilling | | 2.0 | 38.0 | 1.0 | 12.2 | 99.0 | 95.0 | 4.19 | - |
| | | 4.0 | 33.0 | 1.0 | 13.2 | 100.0 | 92.0 | 4.66 | - |
| | | 5.0 | 74.0 | 1.0 | 32.0 | 100.0 | 78.0 | 3.96 | - |
| | | 1.0 | 17.0 | 0.2 | 7.4 | 100.0 | 95.0 | 4.55 | - |
| | Mean | 3.0 | 40.5 | 0.8 | 16.2 | 99.8 | 90.0 | 4.34 | - |

Table 15A Harvest assessments for the overwintered cavity spot trial in a commercial crop at Burscough, Lancashire, 1987.

| Treatments | | % Roots affected | | Disease index | | % Roots marketable | | Weight of harvested roots (kg) | |
|---|---|---|---|---|---|---|---|---|---|
| | | H1 | H2 | H1 | H2 | H1 | H2 | H1 | H2 |
| Untreated | | 41.0 | 10.9 | 12.6 | 2.6 | 100.0 | - | 3.10 | - |
| | | 58.0 | 33.4 | 25.5 | 11.7 | 80.0 | - | 3.08 | - |
| | | 43.0 | - | 14.7 | - | 97.0 | - | 3.30 | - |
| | | 35.0 | - | 7.7 | - | 99.0 | - | 3.35 | - |
| | | 44.3 | 22.2 | 15.1 | 7.2 | 94.0 | - | 3.21 | - |
| Favour 600FW (12 l/500 l/ha) | | 42.0 | 25.5 | 15.0 | 9.4 | 92.0 | - | 2.95 | - |
| 4 weeks post-drilling | | 34.0 | 1.8 | 11.6 | 0.4 | 96.0 | - | 2.40 | - |
| | | 25.0 | - | 8.8 | - | 95.0 | - | 3.35 | - |
| | | 34.0 | 19.6 | 12.0 | 4.7 | 94.0 | - | 3.25 | - |
| | Mean | 33.8 | 15.6 | 11.9 | 4.8 | 94.3 | - | 2.99 | - |
| Favour 600FW (12 l/500 l/ha) | | 24.0 | 14.3 | 6.1 | 5.0 | 100.0 | - | 2.55 | - |
| 0 weeks post-drilling | | 32.0 | 5.8 | 11.1 | 2.7 | 97.0 | - | 3.65 | - |
| | | 63.0 | - | 14.9 | - | 94.0 | - | 3.10 | - |
| | | 40.0 | 39.3 | 11.6 | 10.8 | 99.0 | - | 3.10 | - |
| | Mean | 39.8 | 19.8 | 10.9 | 6.2 | 97.5 | - | 3.10 | - |
| Favour 600FW (6 l/500 l/ha) | | 41.0 | 14.3 | 11.8 | 3.6 | 96.0 | - | 2.15 | - |
| 0 weeks post-drilling | | 41.0 | 30.6 | 13.2 | 9.8 | 97.0 | - | 3.60 | - |
| | | 27.0 | - | 7.5 | - | 97.0 | - | 3.84 | - |
| | | 21.0 | 35.0 | 7.1 | 10.0 | 97.0 | - | 3.20 | - |
| | Mean | 32.5 | 26.6 | 9.9 | 7.8 | 96.8 | - | 3.20 | - |
| Favour 600FW (3 l/500 l/ha) | | 12.0 | 15.4 | 3.1 | 8.8 | 100.0 | - | 2.15 | - |
| 0 weeks post-drilling | | 27.0 | 76.0 | 10.3 | 31.2 | 93.0 | - | 3.10 | - |
| | | 18.0 | - | 10.6 | - | 88.0 | - | 3.40 | - |
| | | 9.0 | 30.8 | 2.6 | 11.1 | 100.0 | - | 3.65 | - |
| | Mean | 16.5 | 40.8 | 6.7 | 17.0 | 95.3 | - | 3.08 | - |
| Favour 600FW (12 l/500 l/ha) | | 45.0 | 19.7 | 14.7 | 7.5 | 97.0 | - | 3.20 | - |
| 0 weeks & strawing down | | 36.0 | 4.3 | 10.1 | 2.1 | 99.0 | - | 3.40 | - |
| | | 31.0 | - | 10.3 | - | 97.0 | - | 3.10 | - |
| | | 30.0 | 32.3 | 5.2 | 6.8 | 100.0 | - | 1.95 | - |
| | Mean | 35.5 | 18.8 | 10.1 | 5.5 | 98.3 | - | 2.91 | - |
| Favour 600FW (12 l/500 l/ha) | | 30.0 | 29.6 | 8.0 | 8.6 | 98.0 | - | 3.01 | - |
| 0 weeks post-drilling + | | 29.0 | 13.5 | 7.6 | 7.6 | 99.0 | - | 2.80 | - |
| Benlate/Basilex | | 44.0 | - | 15.0 | - | 97.0 | - | 3.15 | - |
| 1 kg & 10kg/500 l/ha | | 28.0 | 26.0 | 7.7 | 6.4 | 100.0 | - | 3.15 | - |
| 4 weeks post drilling | Mean | 32.8 | 23.0 | 9.6 | 7.5 | 98.5 | - | 3.03 | - |

Table 15A (contd) Harvest assessments for the overwintered cavity spot trial in a commercial crop at Burscough, Lancashire, 1987.

| Treatment | | % Roots affected | | Disease index | | % Roots marketable | | Weight of harvested roots (kg) | |
|---|---|---|---|---|---|---|---|---|---|
| | | H1 | H2 | H1 | H2 | H1 | H2 | H1 | H2 |
| Favour 600FW (12 l/500 l/ha | | 22.0 | 17.0 | 5.7 | 4.5 | 100.0 | - | 3.10 | - |
| 0 weeks post-drilling + Benlate/Basilex | | 67.0 | 18.6 | 32.6 | 6.3 | 71.0 | - | 3.20 | - |
| 1 kg & 10 kg/500 l/ha | | 45.0 | - | 15.7 | - | 95.0 | - | 3.95 | - |
| prior to strawing down | | 41.0 | 29.5 | 14.2 | 7.1 | 97.0 | - | 2.95 | - |
| | Mean | 43.8 | 21.7 | 17.1 | 6.0 | 90.8 | - | 3.30 | - |
| Agral 1% (5 l Agral/500 l/ha) | | 48.0 | 18.0 | 18.3 | 6.2 | 93.0 | - | 2.40 | - |
| 0 weeks post-drilling | | 41.0 | 85.4 | 12.4 | 28.8 | 96.0 | - | 3.10 | - |
| | | 40.0 | - | 14.3 | - | 96.0 | - | 3.80 | - |
| | | 22.0 | 19.2 | 6.9 | 4.6 | 97.0 | - | 1.75 | - |
| | Mean | 37.8 | 40.9 | 13.0 | 13.2 | 95.5 | - | 2.76 | - |
| Favour 600FW (12 l/500 l/ha) + | | 25.0 | 14.0 | 5.6 | 5.2 | 98.0 | - | 2.45 | - |
| 1% Agral (5 l/ha/500 l/ha) | | 45.0 | 5.7 | 17.9 | 3.0 | 88.0 | - | 3.45 | - |
| 0 weeks post-drilling | | 22.0 | - | 5.0 | - | 100.0 | - | 3.30 | - |
| | | 29.0 | 23.1 | 8.7 | 6.5 | 99.0 | - | 3.30 | - |
| | Mean | 30.3 | 14.3 | 9.3 | 4.9 | 96.3 | - | 3.13 | - |

Table 16A Harvest assessments for the overwintered cavity spot trial in a commercial crop at Halsall, Lancashire, 1987

| Treatments | | % Roots with cavity spot | | Cavity spot index | | % roots marketable | | Weight of harvested roots (kg) | |
|---|---|---|---|---|---|---|---|---|---|
| | | H1 | H2 | H1 | H2 | H1 | H2 | H1 | H2 |
| Untreated | | 73.1 | 38.0 | 27.2 | 13.0 | 83.3 | 93.7 | 2.60 | - |
| | | 79.6 | 67.0 | 30.2 | 30.2 | 81.6 | 74.5 | 2.20 | - |
| | | 88.2 | 74.0 | 33.8 | 31.5 | 82.4 | 70.4 | 2.75 | - |
| | | 79.4 | 72.0 | 33.2 | 33.4 | 73.5 | 72.4 | 2.95 | - |
| | Mean | 80.1 | 62.8 | 31.1 | 27.0 | 80.2 | 77.8 | 2.63 | - |
| Favour 600FW (12 l/500 l/ha) | | 14.9 | 14.0 | 3.6 | 3.2 | 100.0 | 100.0 | 2.45 | - |
| 4 weeks post-drilling | | 12.7 | 30.0 | 3.4 | 8.4 | 100.0 | 100.0 | 2.50 | - |
| | | 17.6 | 4.0 | 5.7 | 1.2 | 97.3 | 100.0 | 3.15 | - |
| | | 20.5 | 10.0 | 5.6 | 6.2 | 100.0 | 94.2 | 3.10 | - |
| | Mean | 16.4 | 14.5 | 4.6 | 4.8 | 99.3 | 98.6 | 2.80 | - |
| Favour 600FW (12 l/500 l/ha) | | - | - | - | - | - | - | - | - |
| 0 weeks post-drilling | | 16.7 | 0.0 | 3.7 | 0.0 | 100.0 | 100.0 | 2.55 | - |
| | | 18.8 | 4.0 | 4.7 | 0.8 | 100.0 | 100.0 | 2.75 | - |
| | | 8.5 | 11.3 | 2.0 | 3.7 | 100.0 | 98.8 | 3.00 | - |
| | Mean | 14.7 | 5.1 | 3.5 | 1.5 | 100.0 | 99.4 | 2.77 | - |
| Favour 600FW (6 l/500 l/ha) | | 32.9 | 12.3 | 9.8 | 2.8 | 96.4 | 100.0 | 3.15 | - |
| 0 weeks post-drilling | | 27.6 | 7.7 | 7.6 | 2.2 | 100.0 | 100.0 | 2.40 | - |
| | | 42.0 | 6.8 | 12.8 | 2.4 | 95.6 | 100.0 | 2.75 | - |
| | | 27.9 | 17.5 | 5.9 | 6.0 | 100.0 | 96.8 | 2.90 | - |
| | Mean | 32.6 | 11.1 | 9.03 | 3.35 | 98.0 | 99.2 | 2.80 | - |
| Favour 600FW (3 l/500 l/ha) | | 37.5 | 15.3 | 13.4 | 11.9 | 94.8 | 86.4 | 2.65 | - |
| 0 weeks post-drilling | | 39.3 | 16.9 | 8.6 | 5.8 | 100.0 | 100.0 | 2.20 | - |
| | | 39.4 | 16.7 | 11.2 | 6.7 | 98.5 | 94.4 | 2.75 | - |
| | | 22.8 | 12.1 | 4.6 | 3.9 | 100.0 | 100.0 | 2.75 | - |
| | Mean | 34.8 | 15.3 | 9.5 | 7.1 | 98.3 | 95.2 | 2.59 | - |
| Favour 600FW (12 l/500 l/ha) | | 16.1 | 11.0 | 3.6 | 2.6 | 100.0 | 100.0 | 2.80 | - |
| 0 weeks post-drilling and | | 14.9 | 15.0 | 3.2 | 4.2 | 100.0 | 100.0 | 3.30 | - |
| prior to strawing down | | 6.8 | 4.7 | 1.4 | 1.3 | 100.0 | 100.0 | 2.70 | - |
| | | 12.5 | 15.3 | 3.1 | 4.1 | 100.0 | 100.0 | 2.75 | - |
| | Mean | 12.6 | 11.6 | 2.8 | 3.1 | 100.0 | 100.0 | 2.89 | - |
| Favour 600FW (12 l/500 l/ha) | | 19.2 | 14.3 | 6.3 | 4.8 | 98.6 | 96.8 | 2.95 | - |
| 0 weeks post-drilling | | 6.3 | 2.0 | 1.5 | 0.4 | 100.0 | 100.0 | 3.10 | - |
| + Benlate/Basilex (1 kg & 10 kg/500 l/ha) | | 20.3 | 3.0 | 4.9 | 1.2 | 100.0 | 100.0 | 3.30 | - |
| 4 weeks post-drilling | | 33.3 | 23.0 | 8.0 | 5.6 | 100.0 | 100.0 | 2.40 | - |
| | Mean | 19.8 | 10.6 | 5.2 | 3.0 | 99.7 | 99.2 | 2.94 | - |

Table 16A (contd) Harvest assessments for the overwintered cavity spot trial in a commercial crop at Halsall, Lancashire, 1987

| Treatments | | % Roots with cavity spot | | Cavity spot index | | % Roots marketable | | Weight of harvested roots (kg) | |
|---|---|---|---|---|---|---|---|---|---|
| | | H1 | H2 | H1 | H2 | H1 | H2 | H1 | H2 |
| Favour 600FW (12 l/500 l/ha) | | 49.1 | 10.6 | 15.6 | 2.8 | 94.5 | 98.7 | 2.80 | - |
| 0 weeks post-drilling | | 11.8 | 3.5 | 2.6 | 1.1 | 100.0 | 100.0 | 2.85 | - |
| + Benlate/Basilex (1 kg & 10 kg/500 l/ha) | | - | - | - | - | - | - | - | - |
| prior to strawing down | | 22.9 | 0.0 | 6.3 | 0.0 | 98.8 | 100.0 | 3.35 | - |
| | Mean | 27.9 | 3.9 | 8.2 | 1.3 | 97.8 | 99.6 | 3.00 | - |
| Agral 1% | | 80.4 | 60.3 | 27.5 | 36.8 | 89.3 | 68.3 | 1.85 | - |
| (5 l Agral/500 l/ha) | | 88.5 | 48.6 | 36.3 | 19.2 | 70.1 | 84.7 | 3.15 | - |
| 0 weeks post-drilling | | 82.6 | 80.7 | 35.4 | 41.0 | 75.4 | 57.9 | 2.75 | - |
| | | 87.2 | 57.1 | 32.6 | 20.4 | 87.2 | 89.3 | 2.50 | - |
| | Mean | 84.7 | 61.7 | 33.0 | 29.4 | 80.5 | 75.0 | 2.56 | - |

Table 17A Harvest Assessments for the overwintered cavity spot trial in a commercial carrot crop at Skelmersdale, Lancashire, 1988.

| Treatments | | % Roots with cavity spot | | Cavity spot index | | % Roots marketable | | Weight of harvested roots (kg) | |
|---|---|---|---|---|---|---|---|---|---|
| | | H1 | H2 | H1 | H2 | H1 | H2 | H1 | H2 |
| Untreated | | 48.0 | 8.0 | 21.6 | 3.2 | 84.0 | 96.0 | 2.7 | 2.9 |
| | | 74.0 | 58.0 | 42.0 | 35.2 | 58.0 | 56.0 | 2.5 | 4.2 |
| | | 12.0 | 28.0 | 4.4 | 6.8 | 98.0 | 94.0 | 2.6 | 3.5 |
| | | 58.0 | 62.0 | 22.0 | 21.2 | 86.0 | 72.0 | 2.2 | 3.6 |
| | Mean | 48.0 | 39.0 | 22.5 | 16.6 | 81.5 | 79.5 | 2.5 | 3.6 |
| Favour 600FW (12 l/500 l/ha) | | 0.0 | 28.0 | 0.0 | 6.8 | 100.0 | 94.0 | 2.6 | 4.2 |
| 4 weeks post-drilling | | 10.0 | 10.0 | 4.0 | 2.4 | 100.0 | 98.0 | 2.9 | 3.8 |
| | | 2.0 | 2.0 | 6.4 | 0.4 | 100.0 | 100.0 | 3.1 | 4.0 |
| | | 0.0 | 4.0 | 4.0 | 0.8 | 100.0 | 100.0 | 2.9 | 2.9 |
| | Mean | 8.0 | 11.0 | 3.6 | 2.6 | 100.0 | 98.0 | 2.9 | 3.7 |
| Favour 600FW (6 l/501/ha) | | 6.0 | 8.0 | 4.8 | 2.8 | 98.0 | 96.0 | 2.9 | 2.6 |
| 0 weeks post-drilling | | 28.0 | 18.0 | 12.0 | 4.0 | 100.0 | 98.0 | 3.1 | 3.8 |
| | | 26.0 | 16.0 | 10.4 | 3.2 | 100.0 | 100.0 | 2.8 | 3.1 |
| | | 34.0 | 22.0 | 17.6 | 5.6 | 34.0 | 94.0 | 2.7 | 3.2 |
| | Mean | 23.5 | 16.0 | 11.2 | 3.9 | 83.0 | 97.0 | 2.9 | 3.2 |
| Favour 600FW (12 l/500 l/ha) | | 14.0 | 4.0 | 7.2 | 0.8 | 98.0 | 100.0 | 2.5 | 2.3 |
| 0 weeks post-drilling | | 2.0 | 0.0 | 0.8 | 0.0 | 100.0 | 100.0 | 2.9 | 2.8 |
| | | 6.0 | 4.0 | 2.4 | 0.8 | 100.0 | 100.0 | 2.6 | 3.2 |
| | | 2.0 | 26.0 | 0.8 | 8.0 | 100.0 | 88.0 | 2.6 | 3.8 |
| | Mean | 6.0 | 8.5 | 2.8 | 2.4 | 99.5 | 97.0 | 2.7 | 3.0 |
| Fubol 58WP (12 kg/500 l/ha) | | 2.0 | 14.0 | 0.8 | 3.6 | 100.0 | 96.0 | 3.5 | 2.8 |
| 0 weeks post-drilling | | 14.0 | 12.0 | 3.6 | 2.4 | 100.0 | 100.0 | 3.6 | 4.2 |
| | | 10.0 | 8.0 | 4.8 | 2.0 | 100.0 | 98.0 | 2.8 | 3.0 |
| | | 22.0 | 46.0 | 13.6 | 12.4 | 98.0 | 84.0 | 2.7 | 2.8 |
| | Mean | 12.0 | 20.0 | 5.7 | 5.1 | 99.5 | 94.5 | 3.2 | 3.2 |
| Favour 600FW (12 l/500 l/ha) | | 16.0 | 18.0 | 8.8 | 6.8 | 98.0 | 94.0 | 2.6 | 3.7 |
| 0 weeks post-drilling | | 6.0 | 14.0 | 3.2 | 4.4 | 100.0 | 94.0 | 2.7 | 2.7 |
| band application | | 6.0 | 2.0 | 2.4 | 0.8 | 100.0 | 98.0 | 2.5 | 3.1 |
| | | 6.0 | 10.0 | 2.4 | 3.2 | 100.0 | 94.0 | 2.4 | 2.5 |
| | Mean | 8.5 | 11.0 | 4.2 | 3.8 | 99.5 | 95.0 | 2.6 | 3.0 |
| Favour 600FW (12 l/500 l/ha) | | 6.0 | 38.0 | 3.2 | 11.2 | 100.0 | 90.0 | 2.9 | 4.0 |
| 8 weeks post-drilling | | 16.0 | 8.0 | 7.2 | 2.0 | 100.0 | 98.0 | 2.8 | 2.5 |
| | | 0.0 | 2.0 | 0.0 | 0.8 | 100.0 | 98.0 | 2.5 | 2.8 |
| | | 18.0 | 44.0 | 11.2 | 18.8 | 98.0 | 68.0 | 2.7 | 2.8 |
| | Mean | 10.0 | 23.0 | 5.4 | 8.2 | 99.5 | 88.5 | 2.7 | 3.0 |



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Table 17A (contd) Harvest Assessments for the overwintered cavity spot trial in a commercial carrot crop at Skelmersdale, Lancashire, 1988.

| Treatments | | % Roots with cavity spot | | Cavity spot index | | % Roots marketable | | Weight of harvested roots (kg) | |
|---|---|---|---|---|---|---|---|---|---|
| | | H1 | H2 | H1 | H2 | H1 | H2 | H1 | H2 |
| Favour 600FW (12 1.500 l/ha) | | 8.0 | 20.0 | 5.6 | 5.6 | 98.0 | 92.0 | 3.0 | 2.7 |
| 12 weeks post-drilling | | 6.0 | 6.0 | 7.2 | 2.0 | 94.0 | 96.0 | 2.6 | 2.2 |
| | | 10.0 | 22.0 | 6.4 | 7.2 | 100.0 | 88.0 | 2.9 | 3.7 |
| | | 28.0 | 34.0 | 17.6 | 10.0 | 96.0 | 86.0 | 2.7 | 2.9 |
| | Mean | 13.0 | 20.5 | 9.2 | 6.2 | 97.0 | 90.5 | 2.8 | 2.9 |
| Favour 600FW (12 1/500 l/ha) | | 6.0 | 20.0 | 2.4 | 5.6 | 100.0 | 94.0 | 2.4 | 3.6 |
| 0 weeks and 4 weeks post-drilling | | 4.0 | 10.0 | 2.4 | 2.4 | 100.0 | 98.0 | 3.4 | 4.2 |
| | | 12.0 | 8.0 | 4.0 | 2.4 | 98.0 | 96.0 | 2.7 | 4.5 |
| | | 2.0 | 16.0 | 0.8 | 3.6 | 100.0 | 98.0 | 2.7 | 2.6 |
| | Mean | 6.0 | 13.5 | 2.4 | 3.5 | 99.5 | 96.5 | 2.8 | 3.7 |
| Favour 600FW (6 1/500 l/ha) | | 14.0 | 28.0 | 5.6 | 6.8 | 100.0 | 94.0 | 2.5 | 4.1 |
| 0 weeks and 4 weeks post-drilling | | 6.0 | 18.0 | 2.4 | 5.2 | 100.0 | 94.0 | 2.7 | 3.6 |
| | | 4.0 | 2.0 | 1.6 | 0.4 | 100.0 | 100.0 | 2.5 | 2.5 |
| | | 2.0 | 4.0 | 0.8 | 0.8 | 100.0 | 100.0 | 2.5 | 3.5 |
| | Mean | 6.5 | 13.0 | 2.6 | 3.3 | 100.0 | 97.0 | 2.6 | 3.4 |
| Ground limestone ($CaCo_3$) | | 18.0 | 48.0 | 10.4 | 15.6 | 98.0 | 80.0 | 2.6 | 3.2 |
| (10 tonnes/ha) | | 36.0 | 24.0 | 17.6 | 6.4 | 86.0 | 92.0 | 3.4 | 3.4 |
| 0 weeks post-drilling | | 28.0 | 50.0 | 16.8 | 15.6 | 98.0 | 84.0 | 3.0 | 3.0 |
| | | 20.0 | 52.0 | 8.8 | 22.0 | 100.0 | 86.0 | 2.5 | 2.5 |
| | Mean | 25.5 | 43.5 | 13.4 | 14.9 | 95.5 | 85.5 | 2.9 | 3.0 |
| Mono-dipotassium phosphite ($H_3Po_3$) | | 28.0 | 44.0 | 19.2 | 14.4 | 94.0 | 78.0 | 2.9 | 4.1 |
| (10 1/500 l/ha) | | 10.0 | 76.0 | 6.4 | 33.2 | 98.0 | 54.0 | 3.6 | 4.1 |
| 0 weeks post-drilling | | 0.0 | 14.0 | 0.0 | 3.6 | 100.0 | 96.0 | 3.0 | 2.5 |
| | | 90.0 | 58.0 | 31.6 | 29.2 | 80.0 | 62.0 | 2.9 | 3.1 |
| | Mean | 32.0 | 48.0 | 14.3 | 20.1 | 93.0 | 72.5 | 3.1 | 3.5 |
| Favour 600FW (12 1/500 l/ha) | | 20.0 | 34.0 | 12.0 | 9.2 | 98.0 | 90.0 | 2.5 | 3.8 |
| 0 weeks post-drilling + | | 2.0 | 20.0 | 0.8 | 4.8 | 100.0 | 96.0 | 3.2 | 4.3 |
| Benlate/Basilex | | 4.0 | 30.0 | 2.4 | 10.0 | 100.0 | 84.0 | 3.1 | 1.9 |
| (2.5 kg & 10 kg/500 l/ha) | | 12.0. | 32.0 | 3.2 | 10.0 | 100.0 | 86.0 | 2.7 | 3.6 |
| prior to strawing down | Mean | 9.5 | 29.0 | 4.6 | 8.5 | 99.5 | 89.0 | 2.9 | 3.4 |

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