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| **Project title:** | Salad Onions: Control of white rot |
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**CONTENTS**

## Practical Section for Growers

- This project compared various seed, in-furrow and foliar applications of tebuconazole as Raxil/Folicur for white rot control in salad onions.

- Treatments were applied alone or in combination.

- Emergence was reduced by higher rates of Raxil seed treating, ie over 0.4g ai per 100,000 seeds, by approximately 5-10% compared with untreated seed.

- Emergence was reduced by higher rates of in-furrow application, ie at 0.5l ai/ha, by about 5% compared with untreated seed.

- Early white rot control proved to be good from Raxil seed treatment at 0.4g ai/100,000 seeds or over, and from in-furrow applications, particularly over 0.25l ai/ha.

- When used alone, two foliar sprays of tebuconazole provided relatively good control.

- When used in combination with one foliar spray, Raxil seed treating at 0.4g/100,000 seeds gave the best white rot control in the trial. However, this control was not significantly greater than an in-furrow and single foliar spray combination

- Growers should use Raxil treated seed for white rot control with confidence, but need to be aware that the treatment will **NOT** give long term protection, ie around 8-10 weeks. A follow up foliar spray to give protection to harvest is considered to be beneficial.

- Growers need to be aware that Raxil treating seed and in-furrow applications of tebuconazole can reduce emergence.

## Experimental Section

### Introduction

White rot (*Sclerotium cepivorum*) remains a major disease affecting bulb onions and other members of the allium genus.

HDC sponsored projects FV4b and 4c in 1995 and 1996 investigated seed treatments of tebuconazole (as Raxil – UK 226) supplemented with stem base or foliar sprays of Folicur (tebuconazole). Excellent control was achieved with these treatments in salad onions in experiments carried out in North Kent whilst less effective control was obtained in experiments in Lincolnshire on bulb onions with similar treatments (Davies et al 1998). This work led to the new off-labels for tebuconazole as a seed treatment and stem-based spray.

In New Zealand, a good degree of control of white rot has been achieved from a procymidone (Sumislex) seed treatment supplemented by in-furrow sprays of tebuconazole with or without foliar sprays of procymidone, tebuconazole or triadimenol (Bayfidan) (Fullerton, Stewart & Slade, 1995). However, procymidone seed treatments are not permitted in the UK and the manufacturer, Sumitomo Chemical Company, has indicated that they do not intend to introduce this produce into the UK because of the limited market size.

In Australia, an in-furrow spray of tebuconazole at sowing was found to be the most effective treatment and was more effective than procymidone (Ryler & Obst, 1995).

In 1997 the use of Folicur as set dips, in-furrow applications and foliar sprays were tested on bulb onions from sets. On a highly infected site 95% of untreated plants developed white rot, all treatments in combination reduced the level to 45% but no treatment gave total control. The set treatment and in-furrow sprays, to a lesser extent, delayed the development of white rot considerably and reduced the final levels by about half.

In 1998 the effects of varying the rates of set dips and in-furrow sprays on white rot control were tested.

The overall level of infection was lower with only 45% of untreated plants infected with white rot at harvest. Field spray, set dip and furrow applications were equally effective individually. Set dipping at 1% was more effective than at 0.5%, and in furrow treatment at 0.5l ai/ha was more effective than at 0.25l ai/ha. Combining a low set dip rate with a low in furrow rate was nearly as effective as a high set dip. In Holland a 0.2% dip is being investigated (pers.comm. de Visser), in this trial, this was less effective than the 1% dip.

In 1999 trials with bulb onions from sets and Folicur examined various treatments including dipping rates, starter solution and the addition of Benlate. The main conclusions drawn from this work was that Folicur dips at 0.5% solution for 20 minutes, proved equally effective as 1.0% dips, but without added problems of phytotoxicity (see year 2000 annual report for HDC project Fv 4e).

As part of the same project, preliminary investigation were made with salad onions and the use of Folicur as a seed dressing (Raxil), an in-furrow application and as foliar sprays were more effective than the seed dressing if used singly.

This project will examine in greater depth, the efficacy of Raxil (tebuconazole and triazoxide) for white rot control.

## Materials and Methods

The trial site was prepared in Spring 2000, by being bedded out to 1.83m wide beds. To ensure uniform white rot infection, albeit the site had relatively high background white rot levels, sclerotia at the rate of 0.4g/m² were spread across the site, and lightly incorporated. Sclerotia were applied on the 15 – 16 May, and the trial drilled on the 5 – 6 June for full cultural details, see appendix.

## Treatments

<u>Salad Onions: efficacy of tebuconazole treatments</u>

| | **Seed Treatment** | **In furrow Treatment** | **Foliar Spray** |
|---|---|---|---|
| | | | |
| A | Untreated | None | None |
| B | Untreated | None | 1x0.25l ai/ha |
| C | Untreated | None | 2x0.25l ai/ha |
| D | Raxil, 0.4g ai | None | None |
| E | Raxil, 0.4g ai | None | 1x0.25l ai/ha |
| F | Raxil, 0.4g ai | None | 2x0.25l ai/ha |
| G | Untreated | 0.125l ai/ha | 1x0.25l ai/ha |
| H | Untreated | 0.25l ai/ha | 1x0.25l ai/ha |
| J | Untreated | 0.5l ai/ha | 1x0.25l ai/ha |
| K | Untreated | 0.125l ai/ha | None |
| L | Untreated | 0.25l ai/ha | None |
| M | Untreated | 0.5l ai/ha | None |
| N | Raxil, 0.5g ai | None | None |
| P | Raxil, 0.3g ai | None | None |
| Q | Raxil, 0.2g ai | None | None |

All salad onion seed treated with Force ST at 2g ai/100,000 seeds.

Raxil treatment rates are based on 100,000 seeds.

The target drilling rate was 100 seeds/m row each plot being 5 rows of 8m, there being 6 replicates of each treatment. Emergence and white rot counts were made on 5 x 1m sections of each plot.

In furrow applications were made using a Stanhay drill with starter fertiliser equipment, placed in a band approximately 15, below the seed, at a rate of 13ml solution/m row. The seed was treated by Elsoms Seeds of Spalding.

**Assessments**

Emergence counts on 5 x 1m rows for each plot, were made on the 16, 20, 23 and 29 June and 14 July. White rot counts were made on the 25 July, 4, 14 and 31 August and the crop was harvested on the 4 September.

White rot counts were destructive, i.e. plants showing foliar symptoms of white rot were carefully pulled out of the ground to confirm the presence of sclerotia/mycelium. At harvest, the healthy (marketable) onions were assessed for length, diameter and weight.

Foliar spray applications were made on the 20 July and 7 August all at 1000l/ha water. The crop was harvested on the 4 September.

<u>Statistical analysis</u>

Data were subjected to analysis of variance following appropriate transformations using Genstat. Statistical differences are noted at the 5% level.

## Results

Emergence

Table 1 Emergence counts on 16 June, 23 June and 14 July (square root transformation)

| Treatments | | | Number Emerged 16 June | 23 June | 14 July |
|---|---|---|---|---|---|
| Seed | In-furrow | Foliar | | | |
| nil | nil | nil | 213.3 (14.6) | 434.8 (20.8) | 436.2(20.9) |
| nil | nil | 1 x 0.25l ai/ha | 209.8 (14.5) | 414.9 (20.4) | 373.2 (19.3) |
| nil | nil | 2 x 0.25l ai/ha | 219.1 (14.8) | 415.2 (20.4) | 402.9 (20.1) |
| Raxil 0.4g | nil | nil | 55.2 (7.4) | 313.5 (17.7) | 322.0 (17.9) |
| Raxil 0.4g | nil | 1 x 0.25l ai/ha | 56.2 (7.5) | 313.2 (17.7) | 303.5 (17.4) |
| Raxil 0.4g | nil | 2 x 0.25l ai/ha | 49.9 (7.1) | 324.5 (18.0) | 315.7 (17.8) |
| nil | 0.125l ai/ha | 1 x 0.25l ai/ha | 157.1 (12.5) | 407.9 (20.2) | 365.9 (19.1) |
| nil | 0.25l ai/ha | 1 x 0.25l ai/ha | 143.3 (12.0) | 392.5 (19.8) | 381.3 (19.5) |
| nil | 0.5l ai/ha | 1 x 0.25l ai/ha | 113.6 (10.7) | 356.4 (18.9) | 332.4 (18.2) |
| nil | 0.125l ai/ha | nil | 143.6 (12.0) | 386.3 (19.7) | 371.8 (19.3) |
| nil | 0.25l ai/ha | nil | 133.5 (11.6) | 384.1 (19.6) | 354.8 (18.8) |
| nil | 0.5l ai/ha | nil | 120.7 (11.0) | 357.9 (18.9) | 313.5 (17.7) |
| Raxil 0.5 | nil | nil | 47.7 (6.9) | 311.2 (17.6) | 297.2 (17.3) |
| Raxil 0.3 | nil | nil | 75.9 (8.7) | 358.5 (18.9) | 355.1 (18.8) |
| Raxil 0.2 | nil | nil | 89.5 (9.5) | 367.0 (19.2) | 363.6 (19.1) |
| | SED | 70(dt) | 0.62 | 0.80 | 0.62 |

Results from Table 1 indicate that early emergence counts were highest in plots having no seed treatment or in-furrow application (NB there were no foliar applications made at this stage).

On the 16 June the highest counts were from treatments with no seed or in-furrow applications. In-furrow application did not reduce emergence as much as seed treating. There was little difference between rate of in-furrow applications used, but trends suggest that higher rates reduced emergence.

Any treatments with Raxil treated seed had very low emergence at the 16 June, 10 days after drilling. Trends suggest that higher rates of treating reduced the number of emerged seeds.

At the third emergence count, 23 June, 13 days after drilling there was little difference between treatments, but Raxil treated seed at the 0.4g and 0.5g ai rates had significantly lower counts than untreated seed with or without no in-furrow applications.

By the fifth emergence count on the 14 July, 18 days after drilling, emergence counts were significantly lower for plots treated with Raxil at 0.4 and 0.5g ai, compared with untreated plots, with a reduction in emergence of around 10%.

Trends also suggest that in-furrow application at 0.5l ai/ha may lower emergence compared with untreated seed.  Apart from these, there were no other differences between treatments.

White Rot Counts

Table 2 Percentage of healthy onions on 25 July, 4, 14 and 31 August (angle transformation)

| Treatments | | | % healthy onions | | | |
|---|---|---|---|---|---|---|
| | | | 25 July | 4 August | 14 August | 31 August |
| Seed | In-furrow | Foliar | | | | |
| nil | nil | nil | 97.6 (81.1) | 76.8 (61.2) | 66.3 (54.5) | 20.4 (26.9) |
| nil | nil | 1 x 0.25l ai/ha | 97.7 (81.3) | 64.9 (53.7) | 57.1 (49.1) | 38.4 (38.3) |
| nil | nil | 2 x 0.25l ai/ha | 95.3 (77.5) | 64.7 (53.6) | 64.3 (53.3) | 64.7 (53.6) |
| Raxil 0.4g | nil | nil | 96.4 (79.1) | 99.3 (85.1) | 92.4 (74.0) | 74.6 (59.7) |
| Raxil 0.4g | nil | 1 x 0.25l ai/ha | 96.8 (79.8) | 99.2 (84.9) | 98.4 (82.7) | 88.1 (69.9) |
| Raxil 0.4g | nil | 2 x 0.25l ai/ha | 96.5 (79.3) | 94.5 (76.4) | 93.2 (74.9) | 79.3 (62.9) |
| nil | 0.125l ai/ha | 1 x 0.25l ai/ha | 97.3 (80.6) | 91.9 (73.4) | 89.7 (71.3) | 78.0 (62.1) |
| nil | 0.25l ai/ha | 1 x 0.25l ai/ha | 95.8 (78.2) | 91.0 (72.5) | 90.3 (71.9) | 82.8 (65.5) |
| nil | 0.5l ai/ha | 1 x 0.25l ai/ha | 96.8 (79.8) | 90.2 (71.8) | 89.4 (71.0) | 84.9 (67.1) |
| nil | 0.125l ai/ha | nil | 92.7 (74.3) | 91.0 (72.5) | 86.1 (68.1) | 69.1 (56.2) |
| nil | 0.25l ai/ha | nil | 90.3 (71.8) | 90.5 (72.0) | 86.6 (68.5) | 76.7 (61.1) |
| nil | 0.5l ai/ha | nil | 96.4 (79.1) | 95.1 (77.1) | 94.0 (75.8) | 85.5 (67.6) |
| Raxil 0.5 | nil | nil | 96.5 (77.1) | 97.3 (80.5) | 95.2 (77.3) | 57.3 (49.2) |
| Raxil 0.3 | nil | nil | 98.7 (83.5) | 97.6 (81.1) | 88.4 (70.1) | 34.5 (36.0) |
| Raxil 0.2 | nil | nil | 93.5 (75.2) | 92.6 (74.3) | 75.9 (60.6) | 27.6 (31.7) |
| | SED | 70 (dt) | 4.49 | 5.54 | 5.68 | 8.57 |

Table 2 indicates the percentage healthy onions at various assessment dates.

On the first assessment date 25 July, approximately 50 days after drilling the percentage of healthy plants (ie plants where no white rot was seen) was similar for most treatments, being lowest for the 0.25l ai/ha in-furrow application.

At the second assessment date, levels of white rot across the trial had increased. The lowest levels of healthy onions were seen in plots with untreated seed and foliar applications. The highest percentages of healthy onions were from the Raxil treated seed plots, with or without a foliar spray (NB the second foliar spray was not applied until 7 August). At the second assessment, the lower rate Raxil seed treatments tended to have lower levels of healthy onions.
At the third assessment date, percentages of healthy plant were lowest for plots having untreated seed and with foliar sprays only. The highest percentages of healthy bulbs was in plots treated with Raxil seed 0.4 (plus a foliar spray) or 0.5g ai. Raxil at 0.2g ai did not significantly increase the level of healthy bulbs compared with untreated seed.

By the fourth assessment date, the percentage of healthy plants was lowest in untreated plots, with untreated seed with only 1 foliar spray, or where Raxil was used at 0.2 or 0.3g ai.

The highest levels of healthy plants were in the following plots:

1. Raxil 0.4g ai plus 1 foliar spray
2. Raxil 0.4g ai plus 2 foliar sprays
3. Untreated seed with 0.125l ai/ha in-furrow plus 1 foliar spray
4. Untreated seed with 0.25l ai/ha in-furrow plus 1 foliar spray
5. Untreated seed with 0.5l ai/ha in-furrow plus 1 foliar spray
6. Untreated seed with 0.25l ai/ha in-furrow only
7. Untreated seed with 0.5l ai/ha in-furrow only

There was no significant difference in the percentage healthy plants between these treatments, but the highest levels were across all assessment dates found in Raxil at 0.4g ai treated plots with 1 foliar spray.

Harvest Results

Table 3 The % healthy onions at harvest and diameter of marketable crop

| Treatments | | | % healthy at harvest | % of marketable crop in size grades(by number) | | |
|---|---|---|---|---|---|---|
| | | | | <8mm | 8-18mm | >18mm |
| Seed | In-furrow | Foliar | Ang Trans | | | |
| nil | nil | nil | 29.6 (33.0) | 20.7 | 59.5 | 15.9 |
| nil | nil | 1 x 0.25l ai/ha | 52.2 (46.2) | 22.6 | 54.0 | 22.7 |
| nil | nil | 2 x 0.25l ai/ha | 54.5 (47.6) | 44.8 | 36.0 | 18.3 |
| Raxil 0.4g | nil | nil | 44.5 (41.9) | 28.8 | 55.3 | 15.2 |
| Raxil 0.4g | nil | 1 x 0.25l ai/ha | 70.2 (56.9) | 29.4 | 54.5 | 15.9 |
| Raxil 0.4g | nil | 2 x 0.25l ai/ha | 57.4 (49.3) | 23.8 | 54.3 | 24.6 |
| nil | 0.125l ai/ha | 1 x 0.25l ai/ha | 42.9 (40.9) | 20.6 | 57.1 | 22.3 |
| nil | 0.25l ai/ha | 1 x 0.25l ai/ha | 54.2 (47.4) | 30.0 | 54.4 | 15.5 |
| nil | 0.5l ai/ha | 1 x 0.25l ai/ha | 58.1 (49.7) | 27.7 | 54.4 | 16.5 |
| nil | 0.125l ai/ha | nil | 34.7 (36.1) | 26.2 | 53.8 | 17.2 |
| nil | 0.25l ai/ha | nil | 34.2 (35.8) | 22.5 | 57.2 | 14.9 |
| nil | 0.5l ai/ha | nil | 54.8 (47.8) | 29.8 | 56.0 | 12.0 |
| Raxil 0.5 | nil | nil | 39.5 (38.9) | 29.0 | 52.6 | 20.3 |
| Raxil 0.3 | nil | nil | 24.0 (29.4) | 18.7 | 66.9 | 7.9 |
| Raxil 0.2 | nil | nil | 21.7 (27.8) | 38.2 | 51.4 | 1.7 |
| | SED | 70 | 8.52 | 7.08 | 6.60 | 6.50 |

Harvest results from Table 3 indicate yield (% in size grades) and percent healthy onions at harvest. The treatments with the lowest percentage of healthy onions were the untreated plots, and Raxil at 0.2 and 0.3g ai.

The treatment within the highest level of healthy onions at harvest was Raxil treated seed at 0.4g ai with 1 foliar application of tebuconazole, but this was not significantly higher than a clutch of other treatments including the in-furrow application at 0.25 and 0.5l combined with foliar sprays.

Trends from the data suggest that low rates of Raxil alone 0.2 and 0.3g ai, do not provide useful white rot control, the use of foliar applications or in-furrow applications at 0.125 or 0.25l ai/ha (alone) would prove just as ineffective.

Yield data (in size grades) at harvest would suggest that there is not much difference between treatments and effect on size, except that the use of two foliar sprays alone increased the number of small onions, and Raxil alone at 0.3g ai, increased the number of 8-18mm onions. It should not be forgotten that there may be a correlation between white rot incidence and onion size.

## Discussion

From the results of this project, it can be seen that taken in isolation, the three methods of application (seed, in-furrow and foliar sprays) all provide varying levels of white rot control in salad onions.

However, it is clear that Raxil at 0.4 and 0.5g ai delayed crop emergence and reduced emergence numbers significantly when compared with untreated seed. Raxil, when applied at lower rates also reduced emergence, but not significantly. High rates of in-furrow application 0.5l ai/ha reduced emergence significantly but appear to be less phytotoxic than the seed dressing.

It is clear that low application rates of Raxil do not provide adequate long term protection against white rot, and may even be relatively ineffectual as a treatment per se.

Although the use of foliar sprays alone provided good control is consistently questioned and it is suggested that it does not move quickly in the soil profile (Allan Walker). It is suggested however that foliar sprays do provide a useful backup to an in-furrow or seed treating, and can reduce any infection close to harvest. Evidence to support this can be seen at the final white rot assessment on 31 August, where the two foliar application treatments had higher levels of white rot than a Raxil used alone at 0.4g ai but at harvest this was reversed.

Though there is no significant difference at harvest, the in-furrow application if used alone at 0.5l ai/ha provides better white rot control than Raxil at 0.4g ai seed treatment. The addition of a simple foliar spray of 0.25l ai/ha proved to be of great benefit to the Raxil seed treated plot.

It is apparent that if growers have the option available, then white rot control is best achieved by combining a seed treatment or in-furrow application with a foliar spray (in this project, Raxil at 0.4g ai combined with a single tebuconazole spray of 0.25l ai/ha gave the best control). It is questioned as to whether seed treatment or in-furrow application used alone is sufficient. From results in this project the author would be content to use treated seed at 0.4g ai plus a single foliar spray, or in-furrow application at 0.25l or 0.5l ai/ha, with a single foliar spray. It is suggested however, that these treatments could reduce plant stand by around 5%.

In order to maintain plant stand it is suggested that the use of low rate Raxil treatments are investigated in combination with foliar sprays. This may prove a double edged sword, by reducing germination losses and maintaining white rot control close to harvest.

## Conclusions

Tebuconazole as an in-furrow or seed treatment has real merit as a method of white rot control in salad onions. Although in this trial foliar sprays provided added protection, some concern is raised over this technique, particularly as tebuconazole is not particularly mobile in soil. Thus growers relying on foliar sprays may find results inconsistent. Seed treating and in-furrow applications always result in the active ingredient being placed closer to the target.

In this project, the best white rot control, albeit with some plant loss, was from a combination of Raxil treated seed at 0.4g ai 100,000 seeds, and a single foliar spray at 0.25l ai/ha. This was not significantly better than an in-furrow application at 0.5l ai/ha, in combination with a single foliar spray.

Acknowledgements

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## Appendix 1

### CROP DIARY

| | | |
|---|---|---|
| Soil Type | Sandy Silt Loam | |
| Previous cropping | 1999 – Brassicas<br>1998 – Various brassicas | |
| Soil analysis | 18/01/2000 – pH 7.6, P = 4, K = 2, Mg = 3 | |
| Fertilisers applied | 04/04/2000 | Sulphate of Potash - 150Kg/ha<br>Triple Super Phosphate - 60 Kg/ha |
| | 06/07/2000 | Nitram - 50 Kg/ha |
| Cultivations | 15/02/2000 | Ploughed |
| | 05/06/2000 | Bedded out |
| | 12/05/2000 | Sclerotia applied |
| | 05-06/06/2000 | Trial drilled |
| Herbicides<br>`` | 16/06/2000 | Sovereign @ 1.65l/ha in 450l/ha water<br>Brasson @ 9l/ha in 450l/ha water |
| Insecticides | 04/08/2000 | Decis @ 300ml/ha in 450l/ha water |
| Fungicides | 20/07/2000 | Clortosip @ 2l/ha in 450l/ha water<br>Folio @ 2l/ha in 200l/ha water |