Investigating and developing fungicide options for onion white rot control in Australia

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Hoong Pung, Susan Cross, Paul Florissen and Ian Macleod
Peracto Pty Ltd, 16 Hillcrest Road, Devonport, 7310, Tasmania

White rot (WR) caused by *Sclerotium cepivorum* is the most important, widespread and destructive fungal disease of onions and spring onions in Australia. Once introduced, the disease can quickly spread within and between paddocks and can cause complete crop loss. The pathogen is particularly difficult to manage, as it can remain dormant in the soil for many years until the next crop is planted. Thus, WR disease is considered to be a major threat to the long-term viability of onion production in Australia.

Management of WR is a priority for the onion industry, and a number of research activities outlined in this paper, are currently being undertaken to investigate suitable management option at both pre-planting and post-planting stages.

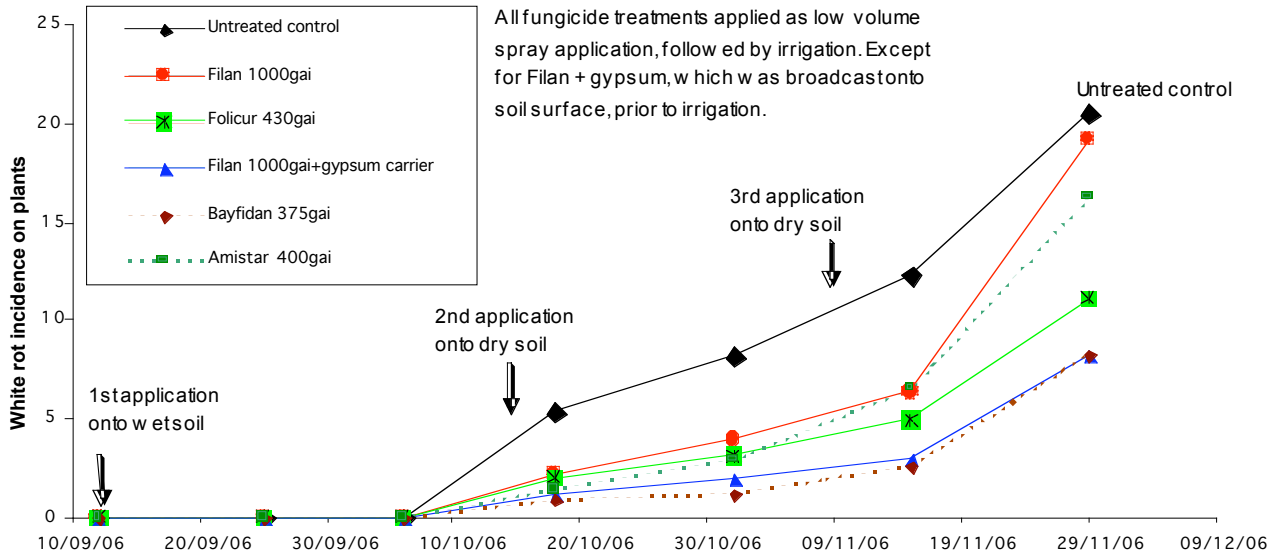
1. Post-plant fungicide applications

Fungicide options for white rot are currently limited and identification of alternative fungicides for commercial use on onions is seen as a priority for the onion industry in Australia. Additionally, application methods for delivering fungicides to the onion bulb and roots are vital, and yet have been very difficult to achieve. As such, research being conducted by Peracto Pty Ltd aims to evaluate and develop effective fungicide treatments and application methods for white rot control.

In 2006 and 2007, five trials were conducted in Queensland and Tasmania to compare the efficacies of fungicides with early and late applications for WR control. Conducted within commercial onion and spring onion crops, the data from these trials was analysed and a detailed report on each trial completed.

Method

Evaluations of the following fungicide products were included: Amistar SC (azoxystrobin), Amistar Xtra (cyproconazole + azoxystrobin), Bayfidan EC (triadimenol), Filan WG (boscalid), Euparen Multi (tolylfluanid), LEM 17, Switch WG (cyprodinil + fludioxonil), Teldor 500 SC (fenhexamid), TADS15620, Folicur SC (tebuconazole) and Sumisclex 500 SC (procymidone).



Results to date

1. Amistar, Bayfidan, Filan, Folicur, LEM 17, Switch and Sumisclex demonstrated activity against *S. cepivorum* and showed potential for WR control.

2. Generally, Bayfidan, followed by Filan, gave the most consistent disease control, and hence, are the most suitable alternatives to current fungicides Folicur and Sumisclex.

3. Fungicide application methods and field conditions were shown to have a major impact on fungicide efficacies. Under dry soil and crop conditions, the low volume fungicide spray application method followed by irrigation was unsatisfactory, particularly for fungicides that bind readily and strongly to plant or soil surfaces.

4. Amistar, Filan and Folicur were shown to be less effective when applied as low volume sprays followed by irrigation under dry field conditions. With improved delivery of the fungicide, such as applying Filan onto a gypsum carrier and then broadcasted onto soil surface, significantly reduced WR and increased onion bulb yield by up to 65 per cent over the untreated control.

5. Bayfidan was the only fungicide that performed well using the low volume spray + irrigation application system under dry conditions. Bayfidan (triadimenol), applied at the high rate of 750 g ai/ha as three spray applications gave the best white rot control, increasing onion bulb yield by up to 86 per cent over the untreated control. Applied at a rate of 375 g ai/ha, Bayfidan also gave excellent control, increasing yield by approximately 55 per cent.

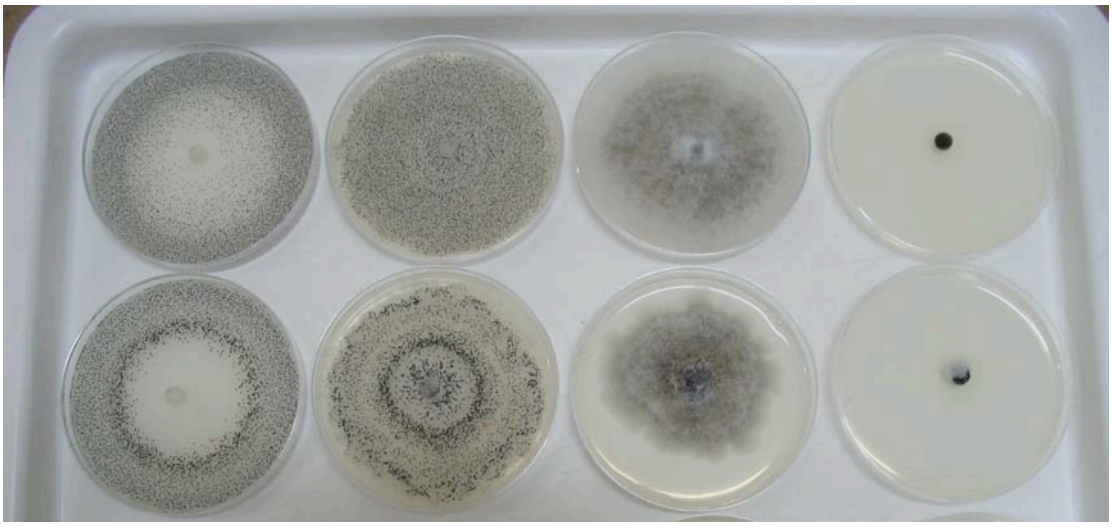
6. Further research into application timing, methods and field conditions is required before conclusive recommendations can be made regarding post-plant treatments. Growers are advised to seek further advice prior to taking action.

2. Inconsistencies associated with fungicide application at sowing

Investigations were conducted into alternative WR treatments to be applied at the sowing stage. In Tasmania, onion growers rely solely on the use of Folicur (tebuconazole) - lime super treatment, whereby Folicur is first mixed with lime super and then applied with triple super fertiliser at sowing with seed. This method, developed in the 1990s (Macleod, 1995a; Macleod & Ryan, 1997) has been shown to provide early control of the disease for up to 200 days. But in recent years, poor control has been noted at less than 100 days. The causes of these inconsistencies in disease control created the basis of the investigation.

Method

Soil samples were collected from 7 paddocks where severe white rot occurred in the 2004/05 and 2005/06 seasons, in order to test for the dissipation rate of tebuconazole in the soils. Two control soil samples were also included – one from a long-term pasture and another from an onion crop at Cranbourne, Victoria, where tebuconazole had never been used on the property.



S. cepivorum growth as affected by increasing concentrations of tebuconazole

Different strains of *S. cepivorum* were also isolated from white rot infected onions from Tasmanian crops in the 2004/05 and 2005/06 seasons. Most of the strains collected were from crops that had been applied with the tebuconazole-lime super treatment at sowing. Fungal strains from an onion crop at Cranbourne, Victoria, where tebuconazole had never been used on the property, were used as control.

Results to date

- Laboratory test indicated that, in absence of vegetation, there was little or no degradation of the fungicide at up to 220 days after treatment. These results indicate that enhanced degradation of tebuconazole is not the cause of poor white rot control in onion crops.

- Tebuconazole was also detected in the soil samples taken before the soil treatment, indicating that the fungicide is relatively stable in soil and has a long residual effect, even after more than one year after the last soil application in the previous onion crop.

- In-vitro tests conducted on 14 strains of *S. cepivorum* from Tasmania showed that all strains were sensitive to tebuconazole and were similar in their sensitivity to the Victorian strains. The fungal isolates were completely inhibited from growth at 1.0 microgram of tebuconazole per ml agar. These results indicate that poor disease control observed in the onion crops is unlikely to be due to the development of fungal strains that are resistant to tebuconazole.

- Chemical analysis of different mixtures of Folicur-lime super + triple super indicated that there was an average of 40% loss of active ingredient compared to the expected application rate. A high proportion of the fungicide in lime super was also found to be concentrated in fine dust particle sizes of less than 425 micron. Treated fertiliser particle size ranged from less than 355 microns to larger than 2000 microns. In the seed drill, the uneven fertiliser particles also caused re-distribution and uneven application. Therefore, poor fungicide application, distribution and loss are believed to be major factors in the poor disease control.

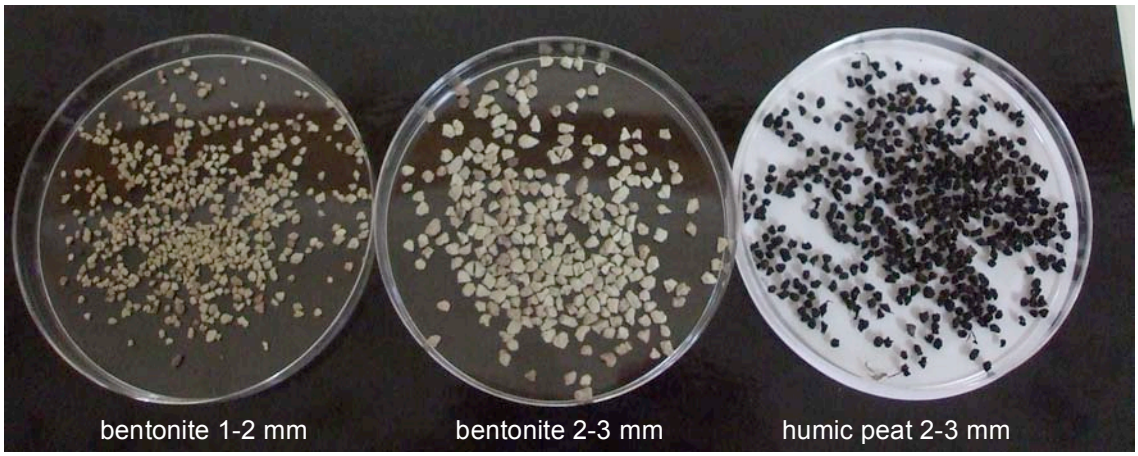
- Bioassay tests on different samples of Folicur-lime super + triple super indicated that the level of active ingredient in the treated fertilisers were at marginal levels for inhibition against *S. cepivorum*. Any drop in the active ingredient rates due to poor fungicide distribution, adsorption and loss of fine dust particles would be likely to result in levels that cause partial or poor inhibition of the pathogen.

3. Alternative carriers for fungicides for use at sowing fungicide application

In 2006, the major fertiliser suppliers in Tasmania indicated that they would cease producing lime super for growers in 2007. This means that the onion growers will have to switch from lime super to single super fertiliser. Previous research (Macleod & Neilsen, 1995b, 1996) had consistently shown that Folicur applied onto other types of fertilisers was less effective than Folicur-lime super treatment. Clearly, improved fungicide coating and distribution methods, and suitable alternative carriers have to be dealt with in order to address the concerns on adequate fungicide levels and disease control.

Method

A number of carrier materials were investigated as alternatives to lime super. More absorbent type of alternative carriers based on inexpensive natural materials such as clay granules, zeolite, diatomaceous earth and organic matter granules were examined for their ability to absorb and retain sufficient liquid fungicide material, as well as to remain intact and free flowing.



Results to dates

- A series of tests showed that one of three sources of bentonite and a humic peat met all the necessary criteria as suitable carriers.

- A total of 15 combinations of product formulation and bentonite or humic peat carriers were produced in small quantities for preliminary in-vitro screening for efficacy against *S. cepivorum* and toxicity to onion seeds. In these screening, small granules of bentonite at 1-2 mm in size were identified as the most suitable for use and larger quantities are being produced for further evaluations in field trials.

- Larger quantities of bentonite carriers coated with tebuconazole and triadimenol had been produced and are currently being evaluated in field studies for WR control in 2007. A synthetic slow release formulation of tebuconazole was also produced for evaluations in trial studies.

Acknowledgements

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Contact Details:

Dr. Hoong Pung, Peracto Pty Ltd, 16 Hillcrest Road, Devonport, 7310 Tasmania.
Ph: (03) 6423 2044 Fax: (03) 6423 4876 Email: hpung@peracto.com.au