Grower Summary

BOF 74a

Evaluating potential new fungicides for the control of Narcissus basal rot in bulb and plant tests

Final report, July 2014

Disclaimer

The results and conclusions in this report may be based on an investigation conducted over one year. Therefore, care must be taken with the interpretation of the results.

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Before using all pesticides check the approval status and conditions of use.
Read the label before use: use pesticides safely.

Further information

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Project title:	Evaluating potential new fungicides for the control of *Narcissus* basal rot in bulb and plant tests
Project number:	BOF 74a
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Report:	Final report, July 2014
Previous report:	None
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Location of project:	Warwick Crop Centre
Industry Representative:	Mark Clark Grampian Growers Ltd
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GROWER SUMMARY

Headline

The fungicides Orius (tebuconazole), Mirage (prochloraz) and Storite (thiabendazole) gave good control of Fusarium basal rot when applied to Narcissus bulbs using standard hot water treatment. Tebuconazole was the most effective and represents an effective alternative active to the currently approved thiabendazole. HDC are currently pursuing an EAMU for tebuconazole, while EU approval for thiabendazole will be lost at the end of 2015. The fungicide HDC F165 was the most effective of three triazoles selected as potential new actives and tested for their effect on Fusarium on agar.

Background

The UK Narcissus industry continues to experience increasing levels of basal rot caused by Fusarium oxysporum f.sp. narcissi (FON), in particular with many of the yellow varieties. Growers rely on only two fungicide active ingredients for the control of this disease; chlorothalonil and thiabendazole, both of which are available for dipping bulbs including by hot-water treatment (HWT) through EAMUs. This situation leaves the industry vulnerable to a loss of disease control options as a result of legislation or commercial considerations.

A previous HDC project (BOF 74) identified new fungicides which could suppress the growth of FON isolates on agar, the most effective of which were prochloraz (an imidazole) and tebuconazole (a triazole). Results for the currently approved fungicides chlorothalonil and thiabendazole showed that the former was relatively ineffective except at the higher concentrations, while the latter failed to adequately reduce growth of two of the eight FON isolates tested, suggesting pathogen tolerance to this active ingredient.

The main aim of this project was to evaluate the protectant efficacy of prochloraz and tebuconazole against FON and compare with the current industry standards thiabendazole and chlorothalonil using small-scale HWT of Narcissus bulbs which were subsequently planted in growing medium artificially inoculated with the pathogen. A biological control agent applied to HW treated bulbs was also tested. The potential for curative activity of the above fungicides was also evaluated by HWT of a Narcissus bulb stock naturally infected with FON in a preliminary experiment. Three triazole fungicides not previously tested on agar in BOF 74 were also tested for their ability to reduce growth of FON isolates on agar.

Summary

Fungicide testing on agar

Three triazole fungicides (HDC F163, F164 and F165) were selected following consultation with growers and manufacturers and tested against eight pathogenic FON isolates representing different morphology groups and locations identified in BOF 74. Agar plugs from cultures of each FON isolate were placed on agar plates amended with each fungicide at rates of 1, 5, 10, 20, 50 and 100 ppm a.i. L-1 (mg L-1) and growth recorded. The minimum fungicide concentration that inhibited mycelial growth by 50 and 95% (MIC50, MIC95) was also calculated for each isolate/fungicide combination.

All three triazole fungicides reduced growth of all FON isolates on agar at all concentrations tested compared to the control cultures (no fungicide, Fig. 1). HDC F165 had greater activity than the other products at all concentrations. MIC50 values were <1ppm for all three fungicides while HDC F165 had the lowest MIC95 value of 3.6 ppm which was comparable with the most effective fungicides tested in BOF 74 (Mirage - prochloraz; Orius - tebuconazole, Agate, prochloraz + tebuconazole).

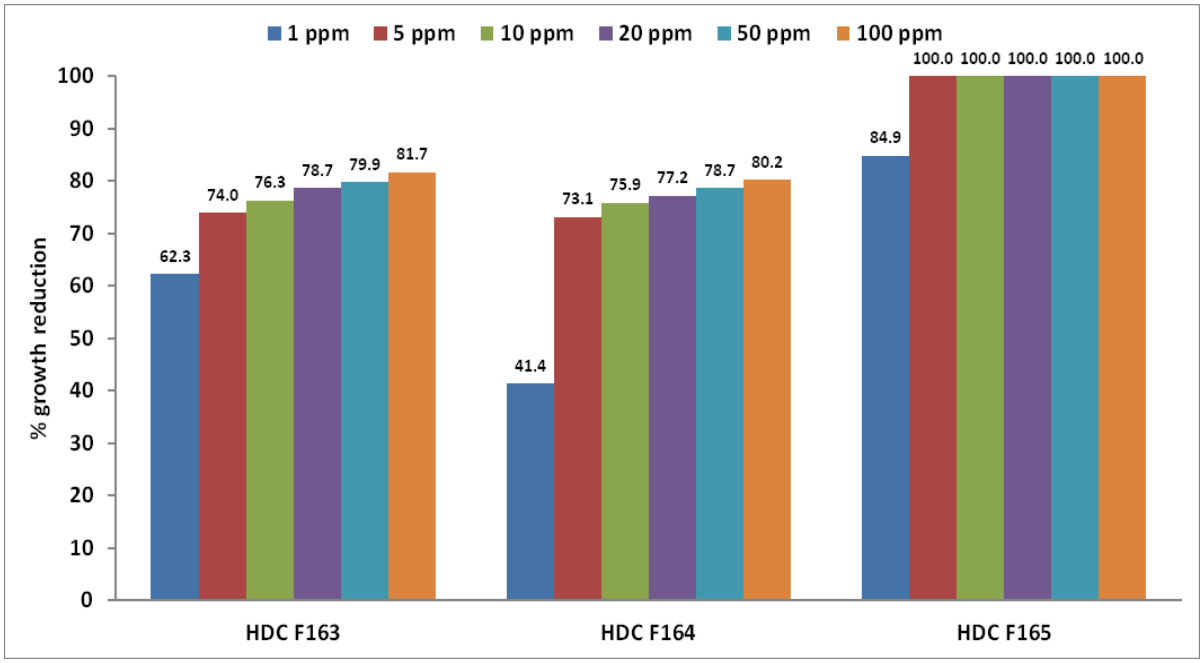

Figure 1. Percentage growth reduction of F. oxysporum f.sp. narcissi (FON) for six concentrations of three triazole fungicides on agar compared to untreated control (no fungicide). Data are means over the eight FON isolates tested.

Fungicide testing on *Narcissus* bulbs/plants

Two stocks of Narcissus bulbs with low (1%) and high incidence (9%) and severity of basal rot were identified for use in a 'protectant' and a preliminary 'curative' experiment respectively. For both experiments, four fungicides comprising the potential two new fungicides Mirage (prochloraz) and Orius (tebuconazole) and the two currently approved products Storite (thiabendazole) and Bravo (chlorothalonil) were used for HWT of Narcissus bulbs in September 2013. Mirage and Orius were both used at concentrations of 500 ppm a.i. while Storite and Bravo were used at currently recommended rates of 500 ppm a.i. and 275 ppm a.i. (ppm = mg L-1) respectively, equivalent to 1.25 L and 1.0 L of product per 1000 L in HWT respectively.

In the curative experiment, following HWT with fungicides, the Narcissus bulbs (9% basal rot initially) were incubated for 60 days at 25°C after which basal rot was assessed on bisected bulbs using a 10-point severity scale. For the protectant experiment, fungicide-treated bulbs were planted in pots in a Narcissus growing medium inoculated with two levels of FON (low / high) and placed in a frost free glasshouse. HWT bulbs (no fungicide) were also treated with the biocontrol agent HDC F184. Plant growth was assessed February-April 2013 and bulbs assessed for basal rot in early June.

Incidence of basal rot in Narcissus bulbs at the end of the curative experiment was 19, 20, 57 and 60% for Bravo, Orius, Mirage and Storite respectively compared to 55% in the HWT no fungicide control. By comparison, incidence of basal rot in 40 spare bulbs (from the same lot) which had not undergone either HW or fungicide treatment was 0%. This latter result was unexpected as initial assessment of incidence was 9% but this may have been due to the relatively small number of bulbs used in the experiment. Mean basal rot severity scores were 0.6, 1.2, 2.0 and 4.1 for Bravo, Orius, Mirage and Storite respectively compared to 4.8 for the HWT no fungicide control and 0.0 for bulbs without HWT or fungicide. By comparison, the percentage of bulbs with low basal rot severity was 87-95% for Bravo, Orius and Mirage but was much lower for Storite at 55% (Fig. 2). The percentage of bulbs with low basal rot severity was 60% for the HWT control bulbs (no fungicide, Fig. 2). Hence, in contrast to Storite, the three fungicides Bravo, Orius and Mirage reduced basal rot development compared to the HWT control indicating that these products have some value in treating bulb stocks known to be contaminated with FON. The results also suggested that for bulbs not treated with fungicide, the HWT process appeared to promote FON infection. Although the experimental approach here attempted to test curative activity, it is unlikely that these fungicides can prevent disease development in bulbs with existing internal FON infection at the time of treatment as evidenced by the general increase in FON incidence from the original value of 9%. The observed activity is probably associated with a preventative mode of action where spores carried on, or just within, the basal plate are killed and any bulb to bulb disease spread is inhibited. Nevertheless these preliminary results suggest that fungicide treatment of bulb

stocks with high initial FON incidence may be worthwhile and requires further investigation in a fully replicated experiment.

Figure 2. Percentage of Narcissus bulbs with low, medium and severe basal rot severity from a bulb stock with high initial disease incidence (9%) after HWT with different fungicides and incubation at 25°C for 60 days. HWT = hot water treatment only (no fungicide), No HWT = no hot water treatment (no fungicide).

In the protectant experiment, FON infection in the inoculated control treatments (bulbs not treated with fungicide and planted in growing medium with FON) was associated with reduced plant height and an increased number of yellowing/chlorotic Narcissus leaves. Some fungicides resulted in increased plant height while all of them significantly reduced the leaf chlorosis symptoms compared to the inoculated controls (low and high inoculum levels). However, the biocontrol treatment HDC F184 had no effect on these FON symptoms. Storite, Mirage and Orius significantly reduced basal rot severity for both FON inoculum levels ranging between 1.9 (Orius, low) and 3.9 (Storite, high) compared to 5.0 and 5.5 in the low and high inoculum untreated control treatments respectively (Fig. 3). Of these three fungicides, Orius was the most effective, resulting in the lowest disease severity score. However, Bravo did not significantly reduce basal rot severity while the biocontrol HDC F184 significantly increased disease severity at both FON levels compared to the inoculated controls. Storite, Mirage and Orius treatments also resulted in a significantly larger proportion of bulbs in the low basal rot severity category ranging from 45% (Storite, low/high) to 77.5% (Orius, low) compared to 22.5% in both the low and high inoculum untreated control treatments respectively (Fig. 4). Of the four fungicides, Orius was the most effective resulting in the highest proportion of bulbs in the low severity category (low, 77.5; high, 60.0; Fig. 3). Bravo only slightly increased the proportion of bulbs in the low disease severity category compared to the inoculated control treatments but this was not statistically significant and the biocontrol HD F184 was ineffective. Overall therefore, the protectant experiment showed that Orius, Mirage and Storite gave good control of basal rot with Orius (tebuconazole) being the most effective. Based on this, the HDC are now pursuing an EAMU

for tebuconazole for use in HWT of Narcissus bulbs. This is timely as EU approval for thiabendazole will be lost at the end of 2015 and there are currently no plans from manufacturers to apply for re-registration of this product. Finally, although the biocontrol agent HDC F184 showed no activity against basal rot here, new biological products which are coming onto the market as well as other appropriate fungicide products should be evaluated in order to continue to develop a range of future options for basal rot control. A full review of the current status of chemical and biological options for basal rot control is given in the Science Section.

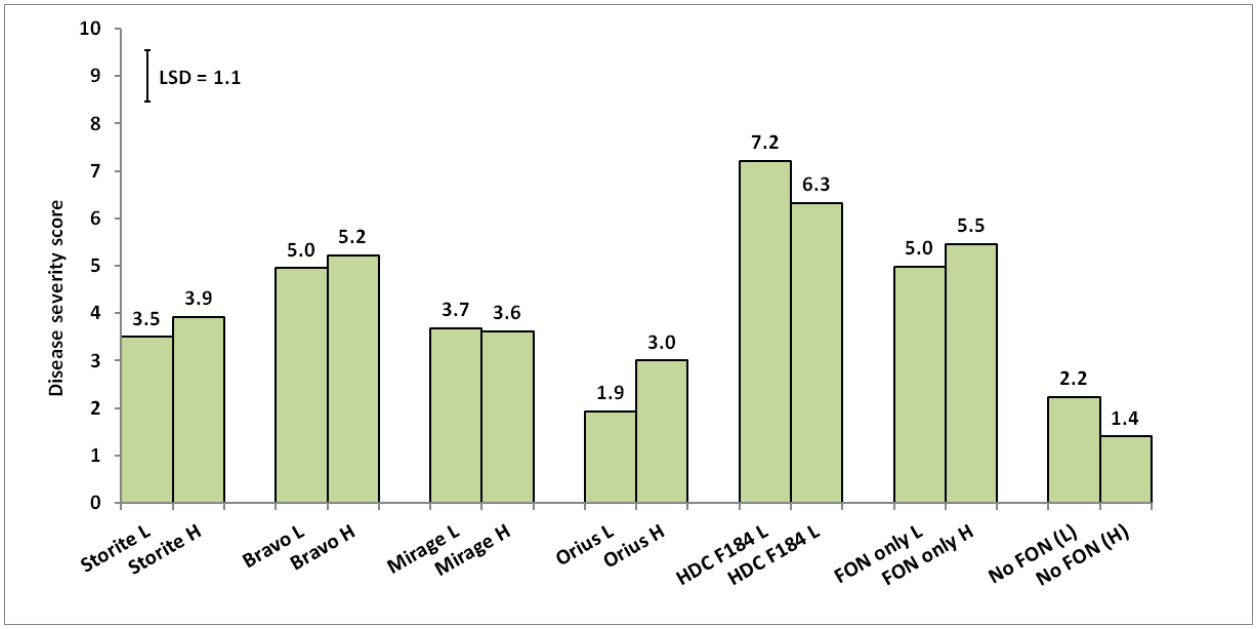

Figure 3. Effect of fungicides and the biocontrol agent HDC F184 on basal rot severity score for HWT Narcissus bulbs after planting in compost inoculated with F. oxysporum f.sp. narcissi (FON) at low (L) and high (H) inoculum levels. Data are means for 40 plants per treatment. Bar = Least Significant Difference (LSD, 5% level).

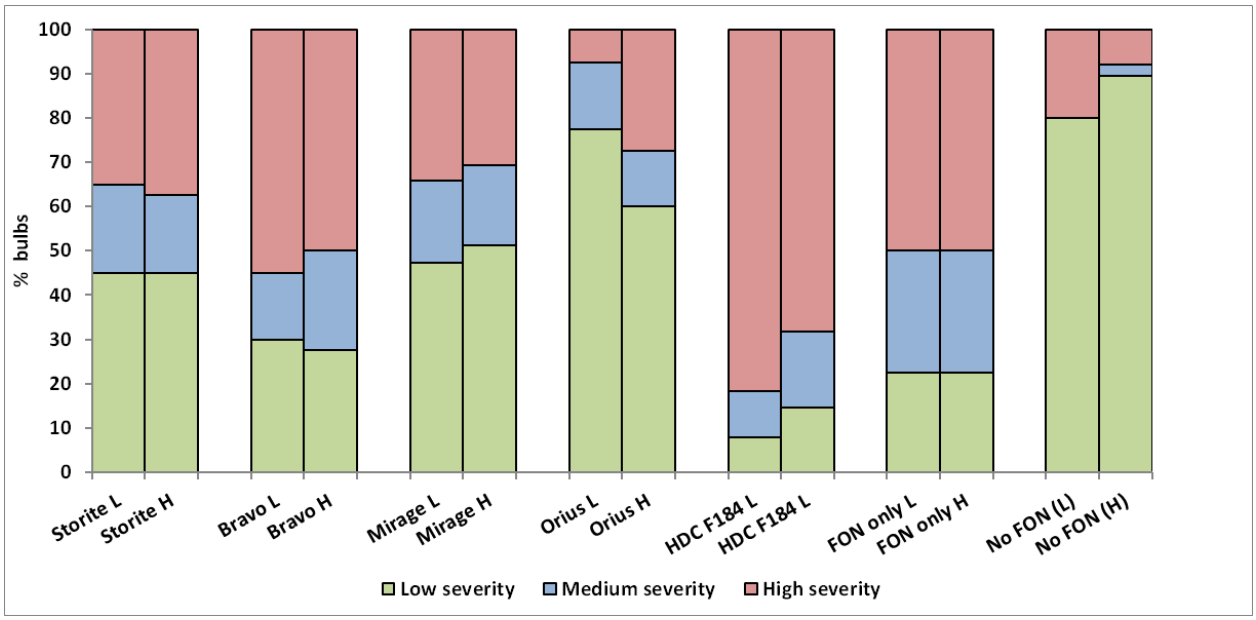

Figure 4. Effect of fungicides and the biocontrol agent HDC F184 on percentage of HWT Narcissus bulbs in different disease severity categories after planting in compost inoculated

with F. oxysporum f.sp. narcissi (FON) at low (L) and high (H) inoculum levels. Data are means of for 40 plants per treatment.

Conclusions

- The fungicide HDC F165 was the most effective of three triazoles tested in reducing the growth of FON on agar and represents a potential alternative to the currently approved fungicides (Storite, Bravo) pending evaluation on bulbs in HWT.
- In a preliminary experiment, Bravo (chlorothalonil), Orius (tebuconazole) and Mirage (prochloraz) reduced basal rot development in a *Narcissus* bulb stock with initial high basal rot incidence (9%) but Storite (thiabendazole) had no effect. Results also suggested that HWT of bulbs promoted FON infection development.
- Orius (tebuconazole), Mirage (prochloraz) and Storite (thiabendazole) gave good control of basal rot for HWT bulbs planted in growing medium inoculated with FON with Orius (tebuconazole) being the most effective.
- HDC are currently pursuing an EAMU for tebuconazole for use in HWT of *Narcissus* bulbs.
- Approval for thiabendazole will be lost at the end of 2015 and there are currently no plans from manufacturers to apply for re-registration of this product except for possibly a co-formulation of thiabendazole and imazalil
- The biocontrol agent HDC F184 showed no activity against basal rot. However, new biological products which are coming onto the market should be evaluated in order to develop a range of options for basal rot control.

Financial Benefits

None at this time.

Action Points

- Continue to use approved thiabendazole and chlorothalonil based products for basal rot control alternated at full-rate in HWT every time a stock of bulbs is lifted and re-planted until new fungicides become available (Note that thiabendazole fungicides may not be applied more than once in any one year).
- Support the HDC in seeking EAMUs for products containing tebuconazole / prochloraz or both, identified as having good activity against Fusarium basal rot in this project.

- Support further work to identify and evaluate other fungicides with newer chemistry as well as biological and disinfectant approaches for basal rot control to insure against future legislation banning or restricting use of any of the above products.
- Support further work to examine alternative application methods if HWT with fungicides becomes unacceptable or restricts the range of products that can be used.
- Support further work to develop an integrated control programme for Fusarium basal rot incorporating chemical and biological treatments as well as development of resistant Narcissus varieties.