**Contract report for the Horticultural Development Council**

# Narcissus: Effects of fungicide foliar sprays on the incidence of bulb rots

**December 2000**
**BOF 41a**

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| Project title: | Narcissus: Effects of fungicide foliar sprays on the incidence of bulb rots |
| Project number: | BOF 41a |
| Project leaders: | Dr Tim M O'Neill, ADAS Arthur Rickwood<br>Mr Gordon R. Hanks, Crop & Weed Science Department, HRI, Kirton |
| Report: | Year 1 Annual Report, December 2000 |
| Key worker: | Dr Kim R.Green, ADAS Arthur Rickwood |
| Location of project: | ADAS Arthur Rickwood<br>Mepal, Ely<br>Cambs, CB6 2BA<br><br>Horticulture Research International,<br>Kirton, Boston<br>Lincs, PE20 1NN |
| Project co-ordinators: | Mr Brian Taylor and Dr Gordon Flint |
| Date commenced: | July 2000 |
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Key words: Bulb rot, fungicide treatments, narcissus, neck rot, basal rot, foliar diseases of narcissus, *Fusarium oxysporum* f.sp. *narcissi*

The results and conclusions in this report are based on an investigation conducted over one year. The conditions under which the experiment was carried out and the results obtained have been reported with detail and accuracy. However because of the biological nature of the work it must be borne in mind that different circumstances and conditions could produce different results. Therefore, care must be taken with interpretation of the results especially if they are used as the basis for commercial product recommendations.

**AUTHENTICATION**

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

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# PRACTICAL SECTION FOR GROWERS

## COMMERCIAL BENEFITS OF THE PROJECT

The project has shown that in field trials the application of regular fungicides, effective in delaying foliar senescence and controlling narcissus smoulder, did not result in an increase in neck rot during storage as had been suggested in other research involving inoculation of the crop with *Fusarium oxysporum* (the fungal pathogen most commonly associated with neck rot).

## BACKGROUND AND OBJECTIVES

Neck rot has been noted as a major cause of narcissus bulbs being rejected for export. Recent work on neck rot (HDC Project BOF 31b) has suggested that, when leaf senescence had been delayed due to fungicide applications, inoculation with *Fusarium oxysporum* may subsequently increase the incidence of neck rot compared with plants that had not received fungicides. Fungicides and fungicide timings are being tested for their control of narcissus smoulder and white mould in field trials, but any fungicide treatment that encourages neck rot, although combating leaf disease, is likely to be unacceptable to the industry. The current project aims to evaluate the effects of fungicide treatments on the development of neck and other bulb rots in storage, utilising existing field trials at ADAS Arthur Rickwood (Mepal, Cambridgeshire) and HRI, Kirton, Lincolnshire.

## SUMMARY OF RESULTS AND CONCLUSIONS (2000)

The incidence of neck rot was low (<4%) for individual fungicide treatments, despite the use of storage conditions that promote disease development. The total incidence of rots (neck rot, basal rot, whole rot, other minor rots and damage due to narcissus fly larvae) was also low, with less than 5% of bulbs affected in individual treatments. Despite significantly longer green leaf area retention in the fungicide-treated plots, there was no effect of fungicide treatment at either site on the development of neck rot. Similarly, there was no effect of fungicides on other individual types of bulb damage or total rotting.

While the percentage of total rots was similar at both sites, it was apparent that for Mepal bulbs the greatest proportion of rotting was due to neck rot compared with basal rot for Kirton bulbs. It was also interesting to note that the incidence of damage due to narcissus fly larvae was slightly higher at Kirton with 2.5% in the untreated control compared with 0.1% at Mepal.

Isolation from bulbs with neck rot yielded *Fusarium* spp., *Penicillium* sp. and *Botrytis narcissicola*. These results support previous reports indicating that neck rot is caused by a complex of pathogens rather than an individual species.

## ACTION POINTS FOR GROWERS

Although the project is incomplete, it appears to show that the foliar fungicides used in this work can be used to achieve good control of smoulder without concomitantly increasing neck rot. This work is due to be repeated in 2001, after which it may be possible to draw conclusions more firmly.

## ANTICIPATED PRACTICAL AND FINANCIAL BENEFITS

The project will alert growers to any implications for the incidence of neck rot as a result of spray programmes designed to control foliar fungal diseases.

## SCIENCE SECTION

### INTRODUCTION

Recent HDC-funded research on narcissus neck rot (BOF 31b)[1] has suggested an association between application of a fungicide spray programme and increased incidence of neck rot. In this project, the relationship between various husbandry factors and the occurrence of neck rot was examined. There was found to be a higher incidence of neck rot on plants that were inoculated with neck rot pathogens, when fungicide applications that delayed foliar senescence had been applied. It was suggested that the persistence of green leaf tissue allowed infection of the bulbs through the leaves.

As part of Horticulture LINK project 188 (BOF 41), fungicides and fungicide timings are being evaluated for the control of smoulder and white mould. However, any fungicide treatment that, whilst combating foliar diseases, encourages neck rot, is likely to be unacceptable. The current project was initiated to evaluate the development of neck and other bulb rots in storage, utilising existing field experiments from the LINK project in which a range of fungicide spray treatments had been applied.

### MATERIALS AND METHODS

#### Site and crop details

Bulbs were obtained from field trials conducted in 1998-2000 with narcissus cv Carlton under Project BOF 41, one at ADAS Arthur Rickwood, Mepal, Cambridgeshire and one at HRI, Kirton, Lincolnshire. Detailed site and crop information are provided in the reports for the original project[2], and the crop diary is summarised in Appendix 1 of this report. Briefly, trials were planted in September 1998 and grown for two years using typical husbandry techniques for the region, except that no routine fungicide applications were made. Experimental fungicide spray programmes were applied in spring 2000 (see below). The bulbs were harvested in July 2000.

Further trials in the series are being conducted over the period 1999-2001 at the same sites, and will be reported in 2001.

#### Treatments

The fungicide spray treatments were:
1. Untreated
2. Benlate (0.5 g/litre) + Dithane (1.5 g/litre)
3. Ronilan (1.0 ml/litre)
4. Bravo 500 (3.0 ml/litre)
5. Scala (2.0 ml/litre)
6. Amistar (1.0 ml/litre)

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[1] Narcissus neck rot: Control of infection by *Penicillium*, *Fusarium* and *Botrytis*. Final Report on HDC Project BOF 31b, Horticultural Development Council, East Malling.
[2] Narcissus leaf diseases: Forecasting and control of white mould and smoulder. First Annual Report (April 1999) and Second Annual Report (May 2000) on HDC Project BOF 41, Horticultural Development Council, East Malling.

7. Folicur (1.0 ml/litre)
8. Unix (0.6 g/litre)

Treatments were applied six times at about fortnightly intervals using an Oxford precision sprayer fitted with flat fan nozzles, applying 1000 litre water /ha at 2-bar pressure. Sprays were applied across the plots (two ridges wide at Mepal, three ridges wide at Kirton) and extending to cover half of each flanking guard row. The spray dates were 17 February, 13 March, 31 March, 19 April, 9 May and 20 May 2000 at Mepal, and 17 February, 10 March, 20 March, 31 March, 19 April and 22 May 2000 at Kirton.

**Harvest and storage**

Because of the effects of different fungicide treatments on the rate of foliar senescence, the amount of foliage remaining at bulb lifting (mid-July 2000) varied between plots. At harvest, any remaining foliage was flailed off mechanically and the bulbs were immediately lifted to the soil surface using a one-row bulb lifter. The bulbs from each plot were placed in net bags (about 25 kg each) and dried by fans in a shed at ambient temperatures. After 2 weeks, the dried bulbs were cleaned on a cleaning-grading line. Two hundred medium-sized bulbs were selected at random from each plot, placed in net bags and stored on wooden trays in a controlled environment store (25ºC and 80% RH). These storage conditions were used to provide an environment conducive to the development of bulb rots (G.R. Hanks, personal communication).

**Assessments**

After storage for 5 weeks, all bulbs were bisected lengthwise and the incidence of each of the following types of bulb damage was recorded:
Neck rot
Basal rot
Complete bulb rot (not possible to distinguish base or neck origin)
Other minor rots
Damage due to narcissus fly larvae

Tissue from bulbs with damage typical of each rot type were plated onto potato dextrose agar, amended with streptomycin sulphate, to determine the cause of rotting.

**Experiment design and analysis**

At each site the trial comprised four replicate blocks of eight treatments arranged in a randomised block design with a double replication of the untreated control. At Mepal each plot was two ridges wide x 9 m long, and at Kirton three ridges wide x 8 m long, every plot having a guard ridge on either side.

Due to the very low incidence of bulb rots in these trials, the data were unsuitable for analysis by analysis of variance. Instead, the data from each site were analysed using Friedman’s test.

## RESULTS AND DISCUSSION

The incidence of neck rot did not exceed 4% for any individual treatment, despite the use of storage conditions that were considered conducive for disease development. The total incidence of rots (neck rot, basal rot, whole rot, other minor rots and damage due to narcissus fly larvae) was also low, with less than 5% of bulbs affected in individual treatments (Table 1). Despite longer green leaf area retention in the fungicide-treated plots, there was no significant effect of fungicide treatment at either site on the development of neck rot. Similarly, there was no effect of fungicide treatment on other individual types of bulb damage or total rotting.

**Table 1. Percentage narcissus bulbs from two sites with different rot types after storage**

| Treatment | ADAS Arthur Rickwood | | | | HRI Kirton | | | |
|---|---|---|---|---|---|---|---|---|
| | Basal rot | Neck rot | Whole rot | Total rots | Basal rot | Neck rot | Whole rot | Total rots[a] |
| Control | 0.9 | 1.8 | 0.1 | 2.8 | 1.8 | 0.3 | 0.1 | 2.3 |
| Benlate | 0.6 | 0.8 | 0.0 | 1.4 | 2.8 | 0.3 | 0.5 | 3.6 |
| Ronilan | 0.1 | 3.6 | 0.3 | 4.0 | 1.8 | 0.0 | 0.3 | 2.0 |
| Bravo 500 | 0.6 | 1.5 | 0.0 | 2.1 | 3.3 | 0.0 | 0.6 | 4.0 |
| Scala | 0.5 | 1.8 | 0.1 | 2.4 | 0.9 | 0.0 | 0.3 | 1.3 |
| Amistar | 0.0 | 1.8 | 0.4 | 2.1 | 2.0 | 0.3 | 0.0 | 2.3 |
| Folicur | 0.4 | 2.6 | 0.0 | 3.1 | 2.5 | 0.4 | 0.0 | 2.9 |
| Unix | 0.6 | 2.9 | 0.1 | 3.6 | 3.3 | 0.0 | 0.3 | 3.5 |
| Significance[b] (7 d.f.) | NS | NS | NS | NS | NS | NS | NS | NS |
| Mean | 0.48 | 2.08 | 0.13 | 2.70 | 2.27 | 0.14 | 0.24 | 2.72 |
| Fungicide mean | 0.41 | 2.13 | 0.13 | 2.68 | 2.05 | 0.11 | 0.23 | 2.44 |

[a]Includes bulbs affected by narcissus fly larvae and other minor rots in addition to basal rot, neck rot and whole rot.
[b]According to Friedman's Test; NS = not significant

While the percentage of total rots was similar at both sites, it was apparent that the greatest proportion of rotting was due to neck rot at the Mepal site, and to basal rot at the Kirton site. It was also interesting to note that the incidence of damage due to narcissus fly larvae was slightly higher at Kirton, with 2.5% of bulb affected in the untreated control, compared with 0.1% at Mepal (data not shown).

*Fusarium* spp. were the only fungi isolated from bulbs with typical symptoms of basal rot at both sites. In contrast, a range of fungi was isolated from bulbs with symptoms of neck rot. *Fusarium* sp. and *Penicillium* sp. were isolated from Kirton bulbs, while *Botrytis narcissicola* was isolated in addition to these species from Mepal bulbs. These results support previous reports indicating that neck rot is caused by a complex of pathogens rather than an individual species. The finding additionally of *B. narcissicola* in bulbs from Mepal site may be related to the greater incidence of neck rot at this site.

The finding in these trials that the increased retention of green leaf area by the use of fungicide sprays did not lead to an increase in the incidence of bulb rots is in apparent contrast to the findings of Project BOF 31b. However, the latter project involved the deliberate inoculation of narcissus plants with *Fusarium oxysporum* in the period before bulb lifting, whereas in the current project only natural infection with neck rot pathogens was being considered. This suggests that fungicide sprays and green leaf retention are unlikely to enhance levels of neck rot under ‘normal’ conditions, although it is possible that under conditions of heavy pressure from pathogens this might, exceptionally, occur. As these treatments and records will be repeated in 2001, there will be another opportunity to test this conclusion. In Project BOF 31b it was also found that leaving flowers non-picked also enhanced levels of neck rot, in combination with other pre-disposing factors; in the current trials the flowers were cropped, as this was a pre-requirement for the LINK project protocol.

## CONCLUSIONS

The incidence of bulb rots that developed during storage was low (<5 %) for all treatments. There was no effect of fungicide treatments applied during the growing season on the development of neck or other bulb rots during storage. The results from this trial will not affect the selection of fungicides to be evaluated in LINK Project field trials in 2001, nor the usual recommendation to apply a regular fungicide spray programme to narcissus crops in the field.

## APPENDIX 1

## Crop diary

| | Date | |
|---|---|---|
| **Operation** | **ADAS Arthur Rickwood** | **HRI Kirton** |
| Trial planted | 1998 | 1998 |
| Fungicide application | 17/02/00<br>13/03/00<br>31/03/00<br>19/04/00<br>09/05/00<br>20/05/00 | 17/02/00<br>10/03/00<br>20/03/00<br>31/03/00<br>19/04/00<br>22/05/00 |
| Inoculation with *Botrytis narcissicola* | 13/05/99 | 26/05/99 |
| Assessments | 08/02/00<br>07/03/00<br>13/04/00<br>19/05/00<br>02/06/00 | 09/02/00<br>15/04/00<br>16/05/00<br>06/06/00<br>19/06/00<br>05/07/00 |
| Bulbs lifted, put to dry | 24/07/00 | 17/07/00 |
| Bulbs cleaned and weighed | 08-10/08/00 | 28/07 - 01/08/00 |
| Bulbs put in high % RH store | 11/08/00 | 02/08/00 |
| Bulbs assessed for storage rots | 14/09/00 | 06/09/00 |