

## Grower Summary

### **BOF 076a**

Understanding  
physiological disorders in  
narcissus project  
extension to study the  
three-year down crop

Annual 2015

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<b>Project Title:</b>	Understanding physiological disorders in narcissus project extension to study the three-year down crop
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## **GROWER SUMMARY**

### **Headline**

A survey of commercial daffodil bunches showed that low levels of daffodil rust are widespread in the rust-prone 'Golden Ducat' but are also surprisingly common in other cultivars. In this survey and in the field trial, while rust was only very rarely found at a level sufficient to cause rejection of the product, these findings will emphasise to growers the importance of thorough pre-picking field inspections.

### **Background**

The physiological disorder known as 'daffodil rust' (or 'stem rust', or simply 'rust') degrades daffodil stem quality and can make affected cut-flowers unmarketable. In mild cases rust may result in a few small, inconspicuous, rusty lesions on the flower stem, but in more severe cases the lesions are more obvious, with groups of larger lesions along the stem which can lead to the product being down-graded or rendered unsuitable for sale. In the most extreme instances rust leads to brittleness, cracking or bending of the stem. Commercial daffodil production in the UK is largely dependent on the sales of cut-flowers, so it is important to avoid anything that might harm the customer's perception of product quality.

To gauge the extent and economic cost of rust, the HDC (now AHDB Horticulture) organised surveys of daffodil growers in 2002, 2003 and 2011–2013. The findings confirmed that rust was causing ongoing, commercially significant losses, justifying an investigation into its cause and potential management. At those times no pathological or nutritional cause for rust was found, though neither should be ruled out entirely because more structured sampling might have yielded a more robust conclusion. Some physiological disorders of other crops are characterised by the appearance of brown or black spotting and have been linked with some adverse environmental conditions, also suggested as a possible cause of daffodil rust. Project BOF 076 was set up in 2012 to test the hypothesis that the soil-water environment may be involved in the development of rust. In 2012, plots of the rust-susceptible cultivar 'Golden Ducat' were planted in ten commercial daffodil fields at varied locations through west Cornwall, where daffodils appeared to be prone to the disorder. It was hoped that this would maximise the likelihood that rust, despite its unpredictability, would occur

naturally in at least some of the test locations, potentially enabling predisposing factors to be identified. Project BOF 76 was also used to supply a structured set of plant samples, with and without rust symptoms, that was used to examine possible pathological or nutritional causes of rust. The project extended from 2012 to 2014.

**The main findings from BOF 076 were:**

In spring 2013 very few rust lesions appeared in the period before picking/flowering, and at only one of the ten sites. The incidence of rust lesions then increased slightly at most sites to give between 0 and 144 affected stems per plot of about 1,000 stems in the post-picking stage. In spring 2014 rust lesions appeared at a higher incidence but still a low severity. By the post-picking stage all sites had mild rust symptoms, most or all stems being affected at seven of the ten sites, one of these exhibiting occasionally more severe symptoms of stem-cracking. None of the assessments found commercially-significant levels of rust (with the possible exception of the stem-cracking mentioned), and it was evident that trace levels of rust, were common, particularly after flowering. Hence, in a susceptible cultivar, rust may commonly persist at a low and insidious level.

Rust incidence varied substantially between sites and between years, and weather patterns (particularly for winter rain) were also markedly different between years. Data on soil water content (SWC) and other meteorological factors, logged at the ten sites, were examined for any associations with rust incidence and severity. The most striking result was an apparent relationship between rust incidence and SWC in the months before flowering. For the first crop-year, three of the four sites with the highest incidence of rust were associated with the highest SWC (the exception was a steeply sloping site). Further analysis showed that high SWC in November and December was closely related to the high levels of rust. For the second crop-year also there was a strong tendency for higher rust incidence where SWC was high, and lower incidence where SWC was low. Again, the apparent relationship was stronger for SWC over the preceding months than for SWC around flowering, suggesting the incidence of rust was related to conditions over a longer period.

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Rust incidence did not appear to be associated with:

- Soil and air temperature and relative humidity, which were relatively uniform across all sites in both years;
- Some geographical factors – longitude, latitude, altitude and distance from the sea in the prevailing wind direction (which would affect the amount of salt-laden air);
- Soil structural factors – ‘Visual Soil Structure Quality Assessment’, ADAS soil texture assessment, soil depth and the proportions of clay, silt, sand and stone particles;
- The type of fertiliser applied before planting, or previous cropping;
- The date the bulbs were planted (which had varied substantially between sites);
- The concentrations of N, P, K or Mg or soil pH or (probably) trace elements;
- The current concentrations of major nutrients or trace elements in the leaves.

Laboratory examination showed that a *Stemphylium* species was the fungus most consistently isolated from rust-affected leaves. *Ramularia* and *Botrytis* spp. were also isolated from some samples, though these are common daffodil pathogens and were probably coincidentally present. There was no evidence of bacterial infection in rust-affected leaves.

## Summary

The present work comprised principally a one-year extension to project BOF 076 to cover 2014–2015, allowing a further year of observations. At the time of this report (June 2015) much of the data collection has been completed – crop and rust assessments, logging of SWC and weather data, collection of soil and leaf samples for mineral analysis, and sampling of leaves for diagnostic examination – and analytical, biometrical and diagnostic work is now under way and will be reported in the final project report (January 2016).

In the third crop-year, the overall incidence and severity of rust on the ten plots were broadly similar to those in 2014. At the pre-picking stage (14–16 February) a low level of rust was found, though the sites where rust first appeared were not the same as the previous years, and rust incidence was notably higher at Penventon than at the other sites.

At the picking stage (9–12 March) rust levels had again increased markedly since the pre-picking assessment, and were greater than in 2014. Rust levels varied between sites more than before, with incidence scores (on a 0–5 scale) between 1 and 4, between 3 and 200 affected stems per plot. The severity score, however, was 1 at all ten sites (on a 0–5 scale). Plants at St Buryan and Goonhavern had the lowest incidence of rust, and levels were highest at Roseworthy and Penventon. These low- and high-rust sites did not correspond to the low and high-rust sites of the previous years.

At the post-picking stage (10–12 April), and despite a confounding effect of white mould infestations at some sites, it was clear that the incidence of rust had increased substantially at all sites, with overall levels similar to those of 2014. Rust incidence score varied from 2 (Tregiffian) to 5 (Kelynack, St Buryan, Roseworthy, Bodilly, Mawla, Penventon and Fourburrow), with corresponding extremes of stems with rust per plot of <100 (Tregiffian and Goonhavern) and all (Roseworthy and Bodilly) or most (>900) stems affected (St Buryan and Fourburrow). The severity score remained at 1, except at Roseworthy and Bodilly where it had risen to 2.

The lack of consistency in rust levels over the three years and ten sites, and the substantial differences in weather patterns over the three years, notably a much drier winter in 2014–2015, will be of benefit in seeking associations between rust, SWC and other factors, as the data-set will cover a wide range of conditions – a challenging task but one that should provide a resilient model if indeed the link between SWC and rust is confirmed in this third year.

**Other work carried out in 2014–2015 is summarised below:**

The diagnostic work on fungal pathogens at PHS is concentrating on the role of *Stemphylium*, which has again been isolated from stems with rust.

At WCC, work to extract and sequence viral RNA from ‘rusty’ and clean leaves is underway. The presence of some virus families, such as potyviruses, has been confirmed, while others have not been found.

Little is known about the course of development of rust lesions. Putative 'early-stage' lesions - small patches or larger tracts of 'pitting' and depressed, paler areas on the stems as well as 'blistering' - were often seen during regular assessments. The lesions can be seen soon after shoot emergence, and it might help our understanding of rust if the time of first appearance of (putative) rust lesions were known. Bulbs of 'Golden Ducat' were recovered from one of the fields at intervals from 12 November through 10 March and entire stems dissected out and examined for lesions. Few 'early-stage lesions' were found, and only on the samples taken 26 January (on 2 out of 10 plants, on the yellowish part of the stem passing through the soil) and 10 March (on 1/10 stems, on the white part of the stem within the bulb). More extensive observations would be needed to study fully the significance of these putative lesions.

The results of the project suggest that rust-prone cultivars like 'Golden Ducat' may always carry a low level of rust but the situation is less clear for 'non-rust-prone' cultivars. To assess the incidence and severity of rust on daffodil bunches being traded, random five-bunch samples of 'Golden Ducat', and of 'non-rust-prone' cultivars flowering at about the same time, were obtained from growers/traders and the stems assessed. The survey yielded 103 samples, comprising 42 'Golden Ducat' and 61 other cultivars, 31 being from Cornwall, 47 from Lincolnshire and Norfolk and 25 from Scotland. The 'Golden Ducat' samples gave an average rust severity score of 1.2 (on a scale of 0–6, where 1 is 'almost unnoticeable' and 3 and 4 represent the borderline between acceptability and rejection). The other cultivars had a notably lower average, 0.3. For rust incidence, 'Golden Ducat' averaged just over 50% of stems with rust (at any level) and the other cultivars a much lower 21%. However, despite these generally mild rust symptoms, both groups included some bunches with all stems affected by rust at some level, and some with none. This confirmed the susceptibility of 'Golden Ducat' to rust, but the other cultivars displayed more rust, perhaps much more, than expected. Most 'Golden Ducat' samples had values in the highest incidence class (more than 40%). Continued vigilance is needed in carrying out pre-picking crop inspections.



## **Financial Benefits**

On the basis of information provided by growers, rust can result in a 3% average annual loss of revenue from cut-flowers (spread across all years), or losses of 10% in one year in three (with negligible losses in the intervening years). A 3% annual loss is estimated to amount to about £0.7m annually to UK growers, or just over £2m every third year. These are direct monetary losses resulting from reduced flower yields and downgraded or unmarketable product, and there would probably be additional costs associated with finding alternative customers and safeguarding against future unpredictable yields and poor quality. Such losses might be largely eliminated if this project and its extension lead to the provision of solutions for rust and the development of strategies for rust avoidance or risk management. These financial and other benefits should be set against the total project cost of £118k over 3½ years.

Much more importantly, solving the rust problem would remove the likelihood of a gross loss of markets through lowered customer perception of the product – especially important at a time when many other issues are impinging on the profitability of daffodil growing.

## **Action Point**

The project needs to be completed before recommendations are made. However, the high rate of rust incidence (and sometimes of rust severity) in ‘Golden Ducat’, coupled with the finding that other cultivars can also display not inconsiderable rust symptoms, suggest that continued vigilance is needed by growers in carrying out pre-picking crop inspections.