



Agriculture & Horticulture
DEVELOPMENT BOARD



New Project

BOF 076

Understanding physiological
disorders in Narcissus

Project Number:	BOF 076
Project Title:	Understanding physiological disorders in Narcissus
Project Leader:	Gordon Hanks
Industry Representative:	Mr Adrian Jansen Lingarden Bulbs Ltd
Start Date:	31 st June 2012
End Date:	31st January 2015
Project Cost (Total project Cost):	£62,459 (£72,459)

Project Summary:

As well as being affected by a number of serious and well-researched pests and diseases, daffodil production is sporadically compromised by a number of physiological disorders (or 'abiotic diseases') of which the causes and 'epidemiology' are virtually unknown. One of these disorders, called daffodil physiological rust, was apparently unknown until the early 1990s, but since then has affected crops on many farms across the UK. Although the symptoms are often mild, the disorder is now increasingly presenting as severe, rust-like marks along much of the flower stem (and leaves), which may be sufficiently disfiguring to cause customer-rejection of large batches of cut-flowers; affected stems can also become brittle. This was particularly so in the 2010 and 2011 cropping seasons.

A difficulty of studying physiological rust is that, until a definite cause is identified or hypothesised, more specific investigations aimed at managing the disorder – say pathological, nutritional or environmental in nature – cannot be suggested. Hence, it is likely that this project will provide a better understanding of daffodil physiological rust as a basis for further studies, but will not provide answers directly.

Because of the often sporadic appearance of the disorder, attempts to identify the cause of daffodil physiological rust so far have usually been ad hoc responses to finding a serious outbreak of rust symptoms, and have therefore been opportunistic and non-

systematic in nature. Based on wide-ranging discussions with the industry, these usually appear to have consisted of:

- Sending samples to a plant clinic for diagnosis of disease, always apparently without a causal organism being implicated;
- Carrying out soil and plant nutrient analysis, again, invariably without finding any associations between nutrient levels and the presence or absence of rust symptoms.

Because of this, the pathogen and nutrient theories of daffodil physiological rust have largely been rejected, albeit without very robust evidence. Such a conclusion is backed-up by findings about daffodil chocolate spot,¹ another but less serious disorder, which has many similarities with daffodil physiological rust, including a failure to identify pathogen- or nutrition-related causes through similar ad hoc testing.

A third theory suggests a vague link between these disorders and soil factors, temperature and water availability. This will be investigated in the proposed project using a systematic approach, in which a stock of daffodil 'Golden Ducat', the most rust-susceptible cultivar known and therefore a good test plant, will be grown at multiple sites, monitoring soil, water and nutritional conditions and physiological rust symptoms to determine cause and effect. The project would run for at least two years, but, amongst other reasons, since many daffodil crops are now grown for three or more years, there will be an option to extend the project to three years, if it is assessed that useful results are still being obtained at that point.

The possibility that there are still pathological or nutritional causes of the disorder will not, however, be ignored. To gain further information on a possible pathological cause, the project would include testing rust lesions that occur for the presence of fungal pathogens, and would generate tissue samples in liquid nitrogen that would be available to subsequent studies into a viral cause of rust. Nutritional factors will be investigated as part of the overall work on soil effects.

The sporadic occurrence of physiological rust means that any project that relies on the condition appearing at the sampling sites must maximise the chance of this happening. This can most obviously be achieved through using a sufficiently large number of sites (a minimum of ten) in the most rust-prone area (west Cornwall) and growing an obviously rust-prone cultivar ('Golden Ducat') and stock.

¹ this 'chocolate spot' is distinct from the disease of beans having the same name but caused by *Botrytis fabae*

Aims & Objectives:

(i) Project aim(s):

To identify the cause(s) of 'physiological rust' disorder of field-grown daffodil crops

(ii) Project objective(s):

- 1 To review the HDC grower surveys on daffodil physiological rust carried out in 2002 and 2011-2012
- 2 To investigate the role of the soil/water environment, including soil structure, water availability, temperature and nutritional status, on the occurrence, incidence and severity of physiological rust in a stock of daffodil 'Golden Ducat', a highly rust-susceptible cultivar, grown over a three-year period at a range of sites
- 3 To provide rust-affected daffodil samples for diagnostic testing to identify any fungal pathogen(s) associated with rust lesions
- 4 To provide rust-affected daffodil tissues for low-temperature storage against the need to test for viruses at a later stage if required
- 5 To inform industry of the likely cause(s) of daffodil physiological rust (i.e. soil-related, nutritional, pathological or other cause) indicated by objectives 1 to 4, and, as appropriate, to formulate a protocol for the management or avoidance of physiological rust and (or) facilitate discussions with science specialists and growers to formulate new research approaches to the understanding of daffodil physiological rust

Objectives 1 to 4 are not interdependent, but the full development of objective 5 depends on achieving all of objectives 2 to 4 (and preferably 1). It should be noted that the project would be based on work carried out over a limited number of years, so it is possible that the findings may not be truly representative due to weather or other year-to-year variations. As well, there is always a possibility that conditions beyond the contractor's control, such as unusual weather, serious pest or disease problems, or material changes within the industry, might affect the results or even prevent results being obtained. In this project the sporadic nature of daffodil physiological rust may mean that in some years few plots may be affected

Benefits to industry

In many cases daffodil physiological rust results in rust-like lesions along the flower stems (and leaves) that are mild, non-disfiguring or even un-noticeable to the casual observer, but the lesions may become more disfiguring and may spread along the length of the stem, with the stem becoming brittle. In some instances in the past few years substantial volumes of cut-flowers have been rejected by high-end customers. In spring 2011, severe symptoms of physiological rust were relatively commonplace, and, while growers and packers can often match stem quality to customer specifications and thereby avoid losing sales entirely, their returns will inevitably be reduced. Sales will be lost, especially among the multiple-retailers and export customers on whom many growers depend (e.g. it is estimated that 60% of UK daffodil cut-flower production is exported). Ultimately, the reputation of UK producers for supplying high-quality daffodil flowers in volume could be eroded. It is unknown whether physiological rust affects bulb growth, and hence future flower production, though it is likely that the loss of any significant amount photosynthetic area would reduce overall growth to some extent.

In a survey of growers conducted by the HDC in 2002:

- ▶ 75% of respondents had observed physiological rust symptoms in the previous four or five years, and of these 50% had seen flowers down-graded and 33% had experienced totally unmarketable flowers
- ▶ Of the growers seeing physiological rust, 8% of their area had been affected, 4% of the area was down-graded, and 1% of the area was unmarketable; turnover had been reduced by between 0 and 15%, with an average of 2%.

Today, the losses would be much higher. In discussion with industry representatives in 2011, an example was cited where the failure to sell flowers from an affected crop of 'Golden Ducat' resulted in a loss of £7,500/ha, so, for some individual growers, the consequences of rust could be very high. However, in the majority of cases, losses would be expected to be more modest, say a 5 to 10% reduction in the price returned to the grower, in the range of 1 to 3p per bunch, equivalent to £375 to £750/ha. Taking the lower of these estimates, and assuming conservatively that flowers would be cropped from about half of the daffodil area each year (i.e. from about 2,000ha, leaving first-year and longer-term crops un-picked), this would equate to a loss of farm-gate value of some £750,000 annually, though this ignores any loss of bulb yield (and therefore of flower yield) in subsequent years.

Although the project would not be expected in itself to lead to the elimination of

physiological rust, it is likely that significant rust-avoidance would be possible as a result of a better understanding of the factors causing it. The project would therefore be expected to have a significant benefit in comparison to its costs.

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