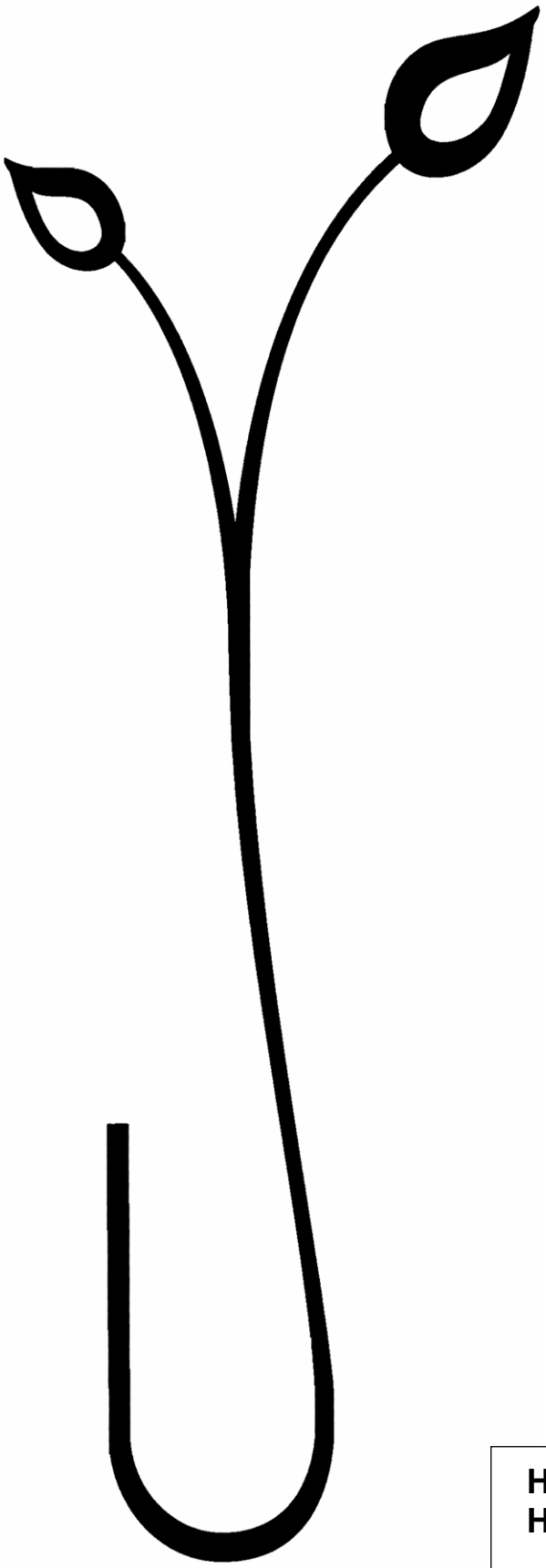
Grower Summary

BOF 63 & BOF 63a

Integrated control of bulb-scale mite in narcissus

Final report 2011

Horticultural
Development
Company



Research
Report

HortLINK project HL0178
HDC Project BOF 63 & CP 36

Integrated control of bulb-scale mite in narcissus

Final Report 2011

Project title:	Integrated control of bulb-scale mite in narcissus
Project number:	BOF 63, BOF 63a, HL0178 (incl. CP 36)
Project leader:	Rosemary Collier Warwick Crop Centre, School of Life Sciences, Wellesbourne Campus, University of Warwick, Wellesbourne, Warwick CV35 9EF
Report:	Final report, August 2011
Previous report:	Annual reports 2007, 2008, 2009
Key staff:	Gordon Hanks, Leanne Cozens, Malcolm Millar, Lorraine Fensome, Tom Newton, Andrew Jukes
Location of project:	Warwick Crop Centre, School of Life Sciences, Wellesbourne Campus, University of Warwick, Wellesbourne, Warwick CV35 9EF
Project co-ordinators:	Adrian Jansen
Date project commenced:	1 October 2006
Date project completed:	31 July 2011
Key words:	Bulb-scale mite, narcissus, acaricide, hot-water treatment, warm storage, epidemiology, biological control, integrated pest management, bulb mite

The results and conclusions in this report are based on a series of experiments conducted over a one-year period. The conditions under which the experiments were carried out and the results have been reported in detail and with 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.

Dr R Collier
Director, Warwick Crop Centre
School of Life Sciences, University of Warwick

Signature ..... Date .....

Report authorised by:

Professor B Thomas
Deputy Head
School of Life Sciences, University of Warwick

Signature ..... Date .....

Grower Summary

Headline

The project showed that hot-water treatment (HWT) and good hygiene remain key elements in the integrated control of the bulb-scale mite in daffodils. Some methods suggested as techniques for mite control – such as heat-treatment or frosting – appeared to be ineffective, but there were promising results from a trial in which the predatory mite *Amblyseius barkeri* appeared to be effective in killing bulb-scale mites. None of the acaricides tested produced a statistically-significant level of mite control.

Background and expected deliverables

The UK is the world-leader in production of narcissus. Some 4,300 ha of narcissus are field-grown, producing an annual saleable output of about 30,000 tonnes of bulbs and 600 million cut-flowers, of which perhaps 30% of bulbs and 40% of flowers are exported. To be cost-effective, narcissus production has become very intensive, which has increased problems with pest and disease. Of the three major narcissus pests, large narcissus fly, stem nematode and bulb-scale mite, bulb-scale mite has received least attention.

Bulb-scale mite was once regarded as a sporadic pest, but for the last 10 years growers have called for more effective control measures. While bulb-scale mite symptoms rarely cause concern in field-grown bulbs or in storage, the higher temperatures in glasshouses, where bulbs are forced for cut-flowers and grown as pot-plants favour rapid multiplication of the pest, resulting in seriously damaged, distorted leaves and stems, with rejections and serious losses to producers. With the loss of endosulfan there is no approved acaricide to control bulb-scale mite in glasshouse narcissus. Other than HWT, there is no non-chemical means of control. Despite the rigorous use of HWT on bulb stocks before planting, bulb-scale mite problems continue to increase. No acaricide suitable for field application has yet been identified. Standard HWT cannot be used to treat bulbs intended for sale or forcing, since it causes leaf and flower distortion in the year after treatment. The aim of this project was to develop an integrated control strategy for bulb-scale mite based on an understanding of its biology and ecology.

Summary of the project and main conclusions

Objective 1: Define the relationship between temperature and bulb-scale mite development

The original focus of this objective was to monitor development of individuals or populations of bulb-scale mite under different environmental conditions *in vitro.* However, the work was re-aligned at the end of 2008 because the cycling of populations under natural conditions was not fully understood. Some effort had already been devoted to monitoring populations in potted bulbs maintained outdoors, and this effort was transferred to monitoring a stock of Dutch Master, infested with bulb-scale mite, which was planted at Wellesbourne in summer 2008. Samples of bulbs were taken at monthly intervals over a period of two years. The infestation was very high initially, and then declined through winter/spring 2009 before increasing to a small peak in June. This was followed by a decline until March 2010, when numbers increased again, peaking in early July. Adult and immature mites and mite eggs were found inside the bulb, and on the foliage when it was present. However, the neck of the bulb was the favoured location in the summer period. Mites were distributed very unevenly throughout the crop and, for example, in one sample of bulbs taken in November 2008, mite numbers ranged from 5-850 and egg numbers from 0-600 per bulb. The uneven distribution of mites, together with the considerable amount of time required to dissect a single bulb to count them, were two of the major challenges when undertaking the experimental work.

Objective 2: Discover when, where and how bulb-scale mite originates and spreads in field crops and in bulb storage

The use of planting troughs to examine the spread of bulb-scale mites between foliage over distance has indicated that mites may move between bulbs where their leaves touch or where the plant to plant separation distance is 0.5m or less. A field trial to follow this up indicated that movement between bulbs does not occur rapidly.

All of the commercial narcissus fields sampled in south-western and eastern England in 2007 and 2008 and in the south-west in 2009 showed damage due to the presence of bulb-scale mites, although some were at low levels of infestation. In general, infestations were greater in crops from the south-west. There was no evidence that damage was greater or less at the edges of the fields than towards the centre, but there were patches of infestation

in the field. At all sites, *along* rows, high numbers in one sample were correlated with high numbers in adjacent samples (1 m apart) and vice versa. For >1m separations, results were more variable. Results were less clear *between* rows, although there was some evidence of correlation between adjacent rows. This may be a reflection of the way that the bulbs are stored and then planted, or it may indicate the distance over which mites normally disperse from an infested bulb. As described above, leaf 'bridges' may be effective mite routes, but the mites may also move between adjacent bulbs. There is no evidence to date that weeds are a source of bulb-scale mites, but naturalised narcissus (e.g. in field margins or dumps) are a potential source of bulb-scale mite and bulb mite.

The distribution of mite-infested bulbs within crops suggested that infestations might be arising because growers were inadvertently planting infested bulbs, rather than crops being invaded from other sources. This might either be because some mites were surviving HWT, or because hot-water treated bulbs became re-infested with mites prior to planting. To determine whether mite infestations can arise from the exposure of dry bulbs to dust and debris during handling and storage, dust/debris samples were collected from the premises of bulb growers and merchants. Un-infested bulbs were stored in paper bags with this material, which was then tipped into the pots in which the bulbs were subsequently planted. Although some of the symptoms identified in the first year of sampling suggested that mites might have been transferred in this way, more detailed examinations in the second year failed to reveal any mites.

To investigate further whether mites were surviving HWT and (or) bulbs were being re-infested after HWT, growers were asked to provide samples of bulbs taken, first, immediately after HWT, and, secondly, from the same stocks on the date they were planted following intervening storage. These bulbs were dissected to record the numbers of mites and eggs. Some of the samples, both immediately after HWT and at planting, contained dead bulb-scale mites, sometimes in large numbers, but a few also contained live bulb-scale mites. Some bulbs also contained mite eggs, although it was impossible to determine whether these were alive or dead. These findings suggest that either the recommended treatment time and temperature are insufficient to kill all mites or that the temperature varies within treatment tanks. This has lead to some further HDC-funded work (BOF 63b) to determine more precisely the temperatures to which bulbs are exposed during typical commercial HWT.

Objective 3: Design optimal high or low temperature and/or chemical treatments to control bulb-scale mite in bulbs for replanting and for forcing, and ensure all stages in its life-history are killed and that crop quality is unaffected

Current and potential methods of mite control were investigated. These included the storage of dry bulbs at temperatures of 42, 44 and 46°C for periods of 1, 2 or 3 hours (warm storage), exposure of bulbs to low temperatures (-2°C) for up to 72 hours ('frosting'), novel HWT additives and a range of acaricides applied as foliar sprays. Neither warm storage nor 'frosting' were effective ways of controlling bulb-scale mite and a few mites also survived HWT, including HWT with the new additives (FAM 30 with or without Bravo 500). None of the acaricides tested produced a statistically-significant level of mite control.

Objective 4 Design novel biological control strategies and test these as part of an integrated management strategy in commercial crops.

Very small scale tests with biological control agents (predators) suggested that the predatory mite *Amblyseius barkeri* had killed a large proportion of the bulb-scale mites in the infested bulbs with which they were confined. This supports the findings of an earlier Dutch study which indicated that this species might control bulb-scale mite on *Hippeastrum.* This species of predator appeared to be more effective than the three other species that were tried.

Objective 5 Examine the link between bulb-scale mite and smoulder disease.

Experiments in which the inoculation of mite-infested and un-infested bulbs with leaves with active smoulder (*Botrytis narcissicola*) lesions, failed to result in infection with the fungal pathogen, and hence no links between bulb-scale mites and smoulder infection could be demonstrated. However, from the extent of feeding damage caused by bulb-scale mites, and seen on the young growing bulb-scales, it seems very likely that internal fungal infections could be spread to the shoots as they grow out of the neck of the bulb.

Objective 6 Deliver a prototype, improved programme for bulb-scale mite control.

Best practice has been examined and the following are important practices in managing bulb-scale mite in daffodils:

- ► HWT, carried out according to current advice regarding the duration and temperature of the dip (though this does not seem to be fully effective, any surviving mites are generally small in number).
- ► Hygiene, especially the removal of possible sources of re-contamination via dust and debris.

Objective 7 Communicate with the industry

The project and its findings have been presented at a number of grower meetings and in *HDC News*.

Financial benefits

Effective control of bulb-scale mite in forced narcissus would reduce losses by an estimated 15 to 20%. It is expected that the recommendations would be taken up by the bulk of the industry, with a farm-gate value of £2.9m to £3.9m annually. Bulb-scale mite is a prohibited pest for bulbs exported to the USA, with a zero tolerance. Effective control should increase the volume of bulbs eligible for the US market by 7.5 to 10% as the findings are taken up by all growers exporting to the US (these represent about 30% of the UK acreage) – a potential increase of sales by up to £0.5m. However, increasing awareness of bulb-scale mite may lead to stricter tolerances for exports to other countries.

Action points for growers

- Growers should be aware that the debris accumulating in bulb handling and storage facilities may provide a source of mite infestation and that they should implement appropriate hygiene measures, by keeping these areas as free of dust and debris as possible.
- The recommended HWT procedures should be carefully followed.
- Any mite-controlling effects of dry heat or frosting treatments are unreliable.
- Growers should remove volunteer narcissus growing in field margins or close to newly planted crops.