

<b>Project Title</b>	Epidemiology of the bulb-scale mite (Steneotarsonemus laticeps) in Narcissus (HDC Studentship)
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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.

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## Epidemiology of the bulb-scale mite, *Steneotarsonemus laticeps*, in *Narcissus*

There are three major pests of *Narcissus*, the large *Narcissus* fly (*Merodon equestris*), the stem nematode (*Ditylenchus dipsaci*) and, forming the subject of this study, the bulb-scale mite, *Steneotarsonemus laticeps* (Halbert) (Acari: Tarsonemidae). There have been relatively few studies on bulb scale mite and until recently it was considered to be only a sporadic pest. However, it has become increasingly common, but there is little understanding of the reasons. It is found in several areas of Europe, including the UK, Netherlands and Sweden, as well as North America (Alford, 1991; Jeppson *et al.*, 1975).

### *Morphology and life cycle of bulb scale mite*

Bulb scale mite is a member of the phytophagous genus *Steneotarsonemus*, a genus which primarily feeds on monocotyledonous plants, many of which are of economic importance. Bulb scale mite is a pest of many bulb species, but *Narcissus* will form the focus of this study. Adult bulb scale mite are extremely small (0.2mm) and pale brown in colour with a conspicuous white stripe on the dorsal surface. The body is ovoid and elongate and dorsoventrally flattened, as an adaptation to a parasitic lifestyle within a bulb. The sexes are distinguished by size, females being substantially larger and more elongate than males, and by their differently adapted fourth pair of legs; in the males they are thicker and stronger to carry a pupal stage, pre-adult-female prior to mating. Bulb scale mite is negatively phototropic, living between the scales within bulbs, feeding on the epidermal surface with piercing mouthparts (Lynch, 1993; Winfield, 1967; Doucette, 1940). The majority of its lifecycle takes place within the bulb, although increased turgidity of the bulbs during growth forces the mites out to the neck of the bulb and onto the foliage. It is suspected that this stage is instrumental in dispersion of the mites, particularly at the end of the growing season when a mat of dead foliage enables dispersion (Hodson, 1934). The duration of the life cycle varies according to factors such as temperature and season. Preliminary studies have shown the minimum time from egg to adult to be 15 days at 20 °C, increasing to 51 days at 10 °C. These studies concluded that the optimal temperature for population growth was 10 – 20 °C, with negative responses to temperatures above 25 °C, such as slow development and extremely low egg production (Lynch and Bedi, 1994).

Little is known about the biology of bulb scale mite, since *in vitro* cultures have proven difficult (Hodson, 1934). In this study, the initial focus will be to determine the range over which bulb scale mite survives and breeds and thus provide indications of temperature ranges which could be exploited for control. For example, if low temperatures were shown to suppress population growth, adaptations to cold storage could facilitate control. Additionally, the practice of storing bulbs post-harvest in July for 2-3 months outdoors, could be a contributing factor to increased bulb scale mite numbers, since ambient temperatures are in the range for their development and reproduction (Lynch and Bedi, 1994).

### *Pathology*

Infested bulbs produce distorted saw-edge leaves with yellow flecking and severe infestations can result in complete loss of the foliage and imperfect flowers or no flowers at all (Hodson, 1934; Doucette, 1929). Additionally, feeding damage promotes secondary infections, such as attack by the fungal pathogen smoulder (*Botrytis narcissicola* Kleb.), leading to further crop loss (Gray and Sheil, 1987).

Whilst bulb scale mite populations and consequent damage for bulbs grown in the open are generally low, infestations can have severe effects in glasshouse-forced bulbs. The abnormally high temperatures and humidities experienced in forcing favour considerable population growth (Winfield, 1964; Doucette, 1936). Since forcing has become an increasingly common practice in order to maximise production and thus profits, this has led to bulb scale mite becoming a more prevalent pest compared to field production.

### *Current control measures*

Conventional chemical pesticides often prove unsuccessful in bulb crops since they rarely penetrate down to the mites within the scales. The fumigation of stored bulbs with methyl bromide or pirimiphos-methyl has been a successful control method. However, high doses can be damaging to both bulbs and flowers and the above mentioned fumigants are being phased out (Murdoch, 1975; Gurney and Gandy, 1974). Drenches of the acaricide endosulfan have provided partial control when applied to boxes of bulbs pre-forcing, however, it has severe toxic implications to humans and the environment (Anon, 2000; Winfield, 1964). The main control option available currently is hot water treatment (HWT) of lifted bulbs, soaking bulbs in hot water, formaldehyde and selected insecticides. Treatment for 1 ½ hrs at 43.4 °C has been considered sufficient to eradicate bulb scale mite (Wilson and Becker, 1960; Doucette, 1936). However, HWT is used in *Narcissus* to target stem nematode for which the standard treatment is 3

hrs at 44.4 °C (Winfield, 1971). The treatment has consequences on the following season's flower growth, and there is a fine line between eradicating the pest and damaging the bulbs (Lane, 1984; Winfield, 1967). It is therefore unsuitable for bulbs destined for forcing or sale. Additionally, it is thought that only the outer scales of the bulb reach the required kill temperature, possibly leaving mite infestations within the bulb unharmed. This could explain the resultant recurrence in numbers even post HWT. Clearly, therefore, there is the need for more appropriate and effective control measures, in particular for the forced bulb industry and for bulbs intended for sale.

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