Potential for biological control of the bulb scale mite (Acari: Tarsonemidae) by predatory mites in amaryllis

G.J. Messelink & R. van Holstein-Saj
Applied Plant Research, Division Glasshouse Horticulture, PO Box 8, 2670 AA Naaldwijk, The Netherlands, E-mail: gerben.messelink@wur.nl

The bulb scale mite Steneotarsonemus laticeps is a serious pest in the culture of amaryllis. A survey of predatory mites with a potential to control S. laticeps naturally occurring was conducted on 15 commercial greenhouses with amaryllis. The most abundant species was Neoseiulus barkeri, which was found on almost half of the nurseries sampled and was observed frequently in colonies of S. laticeps. Laboratory predation tests were set up with this predator as well as commercially available predatory mites to evaluate their ability to feed on S. laticeps. Results indicate N. barkeri to be a promising candidate for biological control of the bulb scale mite in amaryllis.

Keywords: biological control, Steneotarsonemus laticeps, Neoseiulus barkeri, amaryllis

The bulb scale mite Steneotarsonemus laticeps (Halbert) (Acari: Tarsonemidae) is a serious pest in greenhouse cultures of amaryllis (Hippeastrum). These tiny mites (ca. 200 μm) can cause dramatic growth inhibition and flower deformation. About 95 percent of the nurseries are contaminated with this pest. Control of the bulb scale mite relies heavily on chemicals since effective biological control agents are lacking.

First efforts to develop integrated pest management (IPM) strategies in amaryllis were started in 2004 with a project funded by the Dutch Product Board for Horticulture. High densities of the predatory mite Neoseiulus cucumeris Oudemans (Acari: Phytoseiidae) were introduced on two amaryllis nurseries. In spite of repeated introductions of high rates (up to 1000 mites/m²), this predator never established. Amaryllis is believed to be not suitable for leaf-dwelling phytoseiids like N. cucumeris. Leaves are smooth without any sheltered places and completely hairless, while these mites prefer to deposit eggs on plant hairs. During the long vegetative stage of this crop, pollen that may serve as alternative food is lacking.

The objective of this study was to search for new biological control agents.
that are able to colonize an amaryllis crop and to control S. laticeps. A survey of naturally occurring predatory mite species was conducted among amaryllis growers. Tests were conducted with species that were abundant, easy to rear and/or commercially available. Their ability to feed on S. laticeps was evaluated in the laboratory. The phytoseiid species Amblyseius andersoni Chant, Neoseiulus barkeri Hughes and N. cucumeris were compared with two commercially available Hypoaspis spp. (Laelapidae). N. barkeri and N. cucumeris are known to be effective predators of another tarsonemid mite, Polyphagotarsonemus latus (Banks), in sweet pepper (Fan & Pettit 1994, Mizobe & Tamura 2004). A. andersoni was found to feed on the tarsonemid Phytonemus pallidus (Banks) in strawberry (Croft et al. 1998). Some authors propose soil-dwelling predatory mites like Hypoaspis spp. (Acari: Laelapidae) for controlling the bulb scale mite (Helyer et al. 2004), but efficacy has never been proven. In this study the suitability of the bulb scale mite as a prey for Laelapidae was therefore tested as well.

MATERIAL AND METHODS

Greenhouse survey

Fifteen amaryllis growers were visited in May 2005. Samples were taken during the vegetative stage of the crop. Each nursery was sampled by taking two bulbs. Leaves, bulbs and roots with attached soil were separately packed in plastic bags and transported to the laboratory. Leaves and bulbs were examined directly with a binocular. Micro-arthropods were extracted from the remaining bulb parts and soil-root samples by heat and collected in ethanol, using Tullgren funnels. Predatory mites were mounted on glass slides for microscopic determination.

Laboratory predation experiments

Laboratory predation tests were set up with the following predatory mites to evaluate each for their ability to feed on the bulb scale mite: Amblyseius andersoni Chant, Neoseiulus cucumeris Oudemans, Neoseiulus barkeri Hughes, Hypoaspis miles Berlese and Hypoaspis aculeifer Canestrini. The Phytoseiids (N. cucumeris, N. barkeri and A. andersoni) were all reared on Acarus farris and wheat bran according to Ramakers & van Lieburg (1982). The soil-dwelling predatory mites H. miles and H. aculeifer were supplied by Koppert BV and were delivered in vermiculite with the mite Tyrophagus putrescentiae as a prey. The bulb scale mite S. laticeps was reared on amaryllis bulbs cultivar ‘Mont Blanc’ at 20°C, which is optimal according to Lynch & Bedi (1994), and 70% RH.

Predators were tested after a starvation period of 48 hours. Ability to feed on S. laticeps was evaluated by recording feeding attempts and successful predation on a single adult of S. laticeps offered to a predator colony of about 50 individuals (a mixture of adults and immatures) of one predator species. Phytoseiids were kept on sweet pepper leaf discs (ø 2.5 cm) surrounded by water soaked cotton to prevent them from escaping. Soil-dwelling predatory mites (Hypoaspis
spp.) were kept in small units (ø 3.2 cm) of six-well multi-well plates with small amounts of vermiculite. Feeding behavior was observed under a binocular at magnification 40x with a minimum of cold light.

An observation was ended after successful predation or after 5 minutes. Predation was considered successful when fluid uptake from the bulb scale mite by the predator had been observed or when the mite did not respond anymore to being touched with a fine brush. One test consisted of 12 bulb scale mites being offered successively to a predator species. The total experiment was designed in 4 replicates.

Species responses were logit transformed and analyses of variance (ANOVA) and Fisher least significant differences (LSD) tests were applied using GenStat Release 8.11.

**RESULTS**

**Greenhouse survey**

A total number of 15 species of predatory mites was found. The most abundant species was *Neoseiulus barkeri*, which was found on almost half of the nurseries sampled (Table 1). This was also the only species present in soil as well as on bulbs and leaves. It was often observed in colonies of the bulb scale mite. Other abundant species were *Hypoaspis aculeifer*, *Hypoaspis angusta* and a large

---

**Table 1.** Observed predatory mite species, sorted by size (mean length of female’s idiosoma (μm), according to Karg 1971), and observed location in an amaryllis plant, during a survey at 15 amaryllis growing sites.

<table>
<thead>
<tr>
<th>Predatory mite species</th>
<th>Size</th>
<th>Number of nurseries</th>
<th>Location in plant</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Proctolaelaps ventrianalis</em></td>
<td>260–285</td>
<td>1</td>
<td>x</td>
</tr>
<tr>
<td><em>Rhodacarus</em> sp. (small)</td>
<td>300</td>
<td>3</td>
<td>x</td>
</tr>
<tr>
<td><em>Arctoseius cetratus</em></td>
<td>310–360</td>
<td>1</td>
<td>x</td>
</tr>
<tr>
<td><em>Proctolaelaps pygmaeus</em></td>
<td>345–410</td>
<td>2</td>
<td>x</td>
</tr>
<tr>
<td><em>Neoseiulus barkeri</em></td>
<td>350–380</td>
<td>7</td>
<td>x</td>
</tr>
<tr>
<td><em>Hypoaspis aculeifer</em></td>
<td>310–360</td>
<td>1</td>
<td>x</td>
</tr>
<tr>
<td><em>Parasitus</em> sp.</td>
<td>450</td>
<td>1</td>
<td>x</td>
</tr>
<tr>
<td><em>Lasioseius</em> sp.</td>
<td>450</td>
<td>1</td>
<td>x</td>
</tr>
<tr>
<td><em>Hypoaspis miles</em></td>
<td>520–650</td>
<td>2</td>
<td>x</td>
</tr>
<tr>
<td><em>Hypoaspis angusta</em></td>
<td>545</td>
<td>5</td>
<td>x</td>
</tr>
<tr>
<td><em>Hypoaspis aculeifer</em></td>
<td>550–685</td>
<td>6</td>
<td>x</td>
</tr>
<tr>
<td><em>Parasitus</em> sp.</td>
<td>600</td>
<td>1</td>
<td>x</td>
</tr>
<tr>
<td><em>Rhodacarus</em> sp. (large)</td>
<td>600</td>
<td>5</td>
<td>x</td>
</tr>
<tr>
<td><em>Parasitus islandicus</em></td>
<td>650–730</td>
<td>2</td>
<td>x</td>
</tr>
<tr>
<td><em>Macrochelus robustulus</em></td>
<td>660–770</td>
<td>1</td>
<td>x</td>
</tr>
<tr>
<td><em>Parasitus luminarissimilis</em></td>
<td>675–720</td>
<td>1</td>
<td>x</td>
</tr>
</tbody>
</table>
Rhodacarus sp., which were found on 30-40% of the nurseries (Table 1). By far highest numbers of these predators were located in the soil-root environment (Table 1).

**Laboratory predation experiments**

Among the phytoseiids tested, the number of predation attempts was not significantly different between the species *N. cucumeris*, *N. barkeri* and *A. andersoni*.
(Table 2). However the number of feeding successes was significantly higher for
N. barkeri than for N. cucumeris. In 85 percent of the cases adults of S. laticeps
were successfully attacked by N. barkeri within the 5 minutes observation time
(Fig. 1). A. andersoni was the second best predator. The two Hypoaspis spp. were
not very successful in feeding on the bulb scale mite. S. laticeps was never preyed
upon by H. aculeifer and only occasionally by H. miles (Table 2).

**DISCUSSION**

In the laboratory, the three phytoseiids tested (N. cucumeris, N. barkeri and A.
andersoni) attempted to prey on the bulb scale mite with similar frequency. The
smallest predator, N. barkeri, was found to be the most effective one. Predation
efficacy seems to be correlated with body size of the predatory mites (Fig. 2).
The much larger soil-dwelling Laelapidae seemed to ‘overlook’ the prey. Larger
prey, like larvae of the palm seed borer Coccotrypes carpophagus (Coleoptera:
Scotylidae) or even phytoseiids (N. barkeri), were attacked and killed immedi-
ately by them. The small body size and short hairs of N. barkeri might enable it
to follow S. laticeps in hidden places deep within the amaryllis bulbs.

We conclude that N. barkeri is the most promising candidate available for
controlling the bulb scale mite in amaryllis. This species was the most effective
predator in the laboratory, is able to establish in an amaryllis crop and can colo-
nize both leaves and bulbs and to some extend the surrounding soil. The typically
leaf-dwelling phytoseiids N. cucumeris and A. andersoni were effective preda-

---

**Figure 2.** Correlation between predatory mite size (Karg 1971, Miedema 1987) and preda-
tion efficacy with the bulb scale mite as prey.
tors in the laboratory, but were never observed during the survey on amaryllis nurseries. The predatory mite Proctolaelaps pygmaeus was observed during the survey on two nurseries in the bulb and in soil. The size of this predator is similar to that of N. barkeri, suggesting that it might likewise be a suitable control agent for the bulb scale mite. However, this species was recorded to cause skin irritation to man (Andrews & Ramsay 1982), which may create problems in mass rearing.

Neoseiulus barkeri (= Amblyseius mckenziei) was the first phytoseiid species being massreared for biological control of thrips in greenhouses (Ramakers & van Lieburg 1982), but is currently replaced by N. cucumeris. However, it is among the most suitable phytoseiids for massrearing. The results of this study suggest that it is worthwhile to consider restarting massproduction for controlling both bulb scale mites and thrips in amaryllis in greenhouses.

Acknowledgement This study was supported by the Dutch Product Board for Horticulture. Pierre Ramakers and Barbara Eveleens are acknowledged for their comments.

REFERENCES