ABSTRACT  Abilities of phytoseiid mites to attack, reproduce, and control cyclamen mite, *Phytoseius pallidus* (Banks), on strawberry were assessed. In laboratory feeding tests, *Typhlodromus pyri* (Scheuten), *Neoseiulus fallacis* (Garman), and *N. californicus* (Chant) attacked *P. pallidus* most often; *Amblyseius andersoni* Chant fed on the cyclamen mite most successfully, and *Galendromus occidentalis* (Nesbitt) had difficulty piercing the hardened body of adults. Net predation was *T. pyri* > *N. fallacis* > *N. californicus* > *A. andersoni* > *G. occidentalis*. Although several species fed on cyclamen mites, some are more common on strawberry or are more proven as effective predators of *P. pallidus* and thus later reproduction and pest control tests were conducted with only 2 species. When held with excess cyclamen mites, survival and immature production of *N. fallacis* were ≈50% of when feeding on a more preferred prey, *Tetranychus urticae* Koch and like levels for *N. cucumeris* (Oudemans), a proven effective predator of *P. pallidus*. When releases of *N. fallacis* or *N. cucumeris* were made to plants with moderate densities of cyclamen mites and *T. urticae*, pests were controlled sooner and damage to plants was less with *N. fallacis* than *N. cucumeris*. Releases of both phytoseiids to plants infested with high densities of only cyclamen mites produced fewer of either *N. fallacis* or *N. cucumeris* than when both pests were present, but there was better pest control (less plant damage) and again, *N. fallacis* gave slightly better control than *N. cucumeris*. Although *N. fallacis* gave more rapid control of both pests, *N. cucumeris* may give longer-term regulation at lower densities. Differences in life histories may dictate that unique methods of release are needed for *N. fallacis* versus *N. cucumeris* and mixed releases of both may be effective.

KEY WORDS  *Neoseiulus fallacis, Neoseiulus cucumeris*, biological control, inoculative release

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because of limited coverage of pesticides in buds and evolved resistance to pesticides (Kaufman et al. 1995). There are incentives to develop alternative controls for both pest mites, and some phytoseiids (Neoseiulus fallacis, Amblyseius rhenanus (Oudemans), and Amblyseius reductus (Wainstein)) are known to control both mites in other regions (Huffaker and Kennett 1956, Malov and Tokunova 1990, Tuovinen 1995). Except for N. cucumeris, neither of the Amblyseius species or close relatives occur in western Oregon, but N. fallacis is common on strawberry and many other crops in the region and several other phytoseiids are found on this fruit crop at lower densities than N. fallacis (Hadam et al. 1986). The degree to which any native phytoseiid in western Oregon can control both of these mite pests was the focus of this research.

Materials and Methods

Predation on Cyclamen Mites. Several phytoseiids that occur on strawberry (Hadam et al. 1986, Cooley et al. 1993) were reared on standard 12-cm² pan units with waterproofed paper substrates (Strong and Croft 1995): Amblyseius andersoni Chant, Calendromus occidentalis (Nesbitt), Neoseiulus californicus (Chant), Neoseiulus fallacis (Garman), and Typhlodromus pyri Scheuten. To evaluate each for their abilities to feed on cyclamen mites, observations of direct predator-prey encounters were evaluated with single adult P. pallidus. Densities of phytoseiids per unit were 400–600 adult females and associated males and immatures (similar proportions among species). Holding predators with no food for 48 h standardized hunger, after which time cyclamen mites were placed on rearing units. As predators approached a cyclamen mite, contacts by predator appendages with cyclamen mite bodies, feeding attempts, feeding successes, and the predator life stage that exhibited the behavior were scored in 4 replicated, 10-min observation times per species. The efficiency of predation based on comparisons between the actual number of contacts or predation attempts that resulted in death of the cyclamen mite and food uptake by the predator adult female were also calculated. Death was determined by the absence of movement when cyclamen mite was prodded with a brush. Food uptake by the predator was estimated by watching fluids of the pest pass through the body of the predaceous mite. Tests were run at 25 ± 1°C and 80 ± 5% RH. Species responses were compared by analysis of variance (ANOVA) and Fisher least significant difference (LSD) tests (Petersen 1985).

Survival and Reproduction on Cyclamen Mites and Other Foods. Although several phytoseiid species can feed on cyclamen mites, certain ones are more common in the field, whereas others have proven to be more effective predators of this pest in the past. Because N. fallacis showed such high levels of predation (above), in later tests, only this mite and the proven effective N. cucumeris were studied further. Adult female N. fallacis (and N. cucumeris with cyclamen mites) of variable age were provisioned with all stages of cyclamen mites, T. urticae, pollen, or no food. Before adding foods, predators were held 24 h singly without food on 2.5-cm² arenas ringed by adhesive (Tanglefoot, Grand Rapids, MI). Treatments were tested simultaneously at 25 ± 1°C and 80% ± 5% RH. Cyclamen mites were added by transferring excised buds to test arenas. For N. fallacis, mixed stages of T. urticae, corn pollen, or no foods were evaluated separately. Amounts of food added daily were in excess of maximum consumption rates for either predator species: P. pallidus = 50-100 mixed life stages; T. urticae = 25-50 mixed life stages; pollen = 200-500 grains. Three adult female predators were placed on each arena (8 replicates per species per food type). Adult female survival (%), level of mite activity (walking during 1 min), cumulative eggs per female adult, and cumulative motile stages of immatures per female adult were counted daily for 8 d, which time precluded new adults developing on arenas. A survival index for predators was calculated by dividing the cumulative number of eggs per female by the cumulative number of motile immature life stages present per female, 2 d after eggs were counted. Survival of immature life stages for each egg that was laid also was calculated from the 2 previous data types. Responses of each species, behavior, and food were compared by single-factor ANOVA and Fisher LSD test.

Single Plant Tests of Predation and Biological Control. Strawberry plants (Totem cultivar) were placed individually in 0.5-liter containers. Three or 4 treatments, each with 5 single plant replicates, were evaluated in 2 sets of experiments. Plants were inoculated either with cyclamen at 10–20 per bud + T. urticae at 5–10 adult females per leaf or cyclamen mites only at 100–150 per bud. In both tests, 5 adult female predators were added per plant 1 wk after prey mites were added. Predator treatments were N. fallacis releases, N. cucumeris releases, and 3 controls, 1 with prey + no predators, and 1 with prey + no predators. Every 2 wk, for 4–8 wk, all life stages of T. urticae and phytoseiids were counted on 3 leaflets (1 leaf) of 3 stalks per plant. Cyclamen mites were counted by dissection of buds at peak densities of predators occurred (1–2 wk after peak densities of T. urticae). Before destructive sampling of buds, plant stalks with live or dead leaves, vegetative runners, and live or damaged (wrinkled) buds were counted. All life stages of cyclamen mites, predaceous mites, and plant counts (see above) were analyzed by single-factor (1 date) or repeated-measures (all dates) ANOVAs (von Ende 1993) and Fisher LSD tests (Petersen 1985).

Results

Predation on Cyclamen Mites. When adult P. pallidus were introduced into colonies of mixed stages of predators, predation attempts and actual predation values varied among the 5 species (Table 1). Predation attempts were highest for T. pyri, N. fallacis, and N. californicus and were least for A. andersoni and G. occidentalis. Actual feeding was T. pyri > N. fallacis > N. californicus = A. andersoni > G. occidentalis. The
degree of successful predation per attempt (effective predation) was highest for the largest phytoseiid, A. andersoni, near equal for T. pyri and either Neoseiulus spp. and least for G. occidentalis (statistics not calculated for these derived measures, see statistical comparisons for values used in calculations). Net predation or percent of contacts that resulted in death of prey was T. pyri > N. fallacis > N. californicus > A. andersoni > G. occidentalis. Predation by stages other than adult females was highest for N. californicus and T. pyri. For all species but G. occidentalis, active immature stages were able to feed on adult cyclamen mites. Although T. pyri showed high levels of predation on cyclamen mites, this predator does not widely occur on strawberry in the region (Hadam et al. 1986), so further testing was not done with this mite.

Survival and Reproduction on Cyclamen Mites and Other Prey. When held with excess P. pallidus, activity was less and survival more for N. fallacis than N. cucumeris (Table 2). Cyclamen mites seemed to be suitable prey for either phytoseiid. However, knowledge of their life history traits caused us to qualify our conclusions: N. fallacis is a more specialized predator of spider mites that aggregates more in response to T. urticae than does N. cucumeris (Croft et al. 1998a). Thus, greater activity (or less aggregation) may have caused N. cucumeris to get into sticky borders more and be lost from tests more often. Studies with other confinement techniques are needed to see if either phytoseiid survives better on cyclamen mites. N. fallacis had fewer cumulative eggs per female per day than N. cucumeris but cumulative immatures per day per female were similar (Table 2). Again, greater movement of immature N. cucumeris could have influenced results.

In comparing foods for N. fallacis, it is important to establish the relative value of different food types to which P. pallidus can be compared. In this regard, activity was least and survival most when held with T. urticae (Table 2). Less activity or arrestment usually indicates a favorable food source (Croft et al. 1998a). For pollen and no food, N. fallacis activity was higher than with either of the prey mites. Less movement in the last few days just before death lowered the mean activity value for the no food treatment and made it similar to pollen. Maize pollen probably is not a preferred food in that N. fallacis continues to search for other foods even when pollen is abundant. When with P. pallidus as food, activity for N. fallacis was lower than with all other foods, except T. urticae. Activity data may indicate that cyclamen mite is a more preferred food than pollen for N. fallacis. Survival either on cyclamen mite, T. urticae, or corn pollen was high (>90%). Egg and immature production for N. fallacis when with cyclamen mites were as high as with pollen, but lower than with T. urticae (Table 2). With cyclamen mite or pollen, immature survival was near 60% for N. fallacis (versus 100% with T. urticae) and much higher than with no food. When compared with N. cucumeris when held with P. pallidus, N. fallacis had lower activity, higher survival, lower egg production, similar immature production, and similar immature.

Table 1. Predation attempts and successful feeding on cyclamen mites (P. pallidus) by adult females and other life stages of phytoseiid mites of 5 species

<table>
<thead>
<tr>
<th>Phytoseiid species</th>
<th>Attempt predationa</th>
<th>Actual predationb</th>
<th>Effective predationc</th>
<th>Net predationd</th>
<th>Predation by non-adult female stagesa</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amblyseius andersoni</td>
<td>0.318a</td>
<td>0.273b</td>
<td>55.7</td>
<td>27.3</td>
<td>36.4 (M,D,P)</td>
</tr>
<tr>
<td>Galendromus occidentalis</td>
<td>0.318a</td>
<td>0.143</td>
<td>34.1</td>
<td>14.3</td>
<td>45.5 (M,D,P)</td>
</tr>
<tr>
<td>Neoseiulus californicus</td>
<td>0.318a</td>
<td>0.075</td>
<td>69.0</td>
<td>27.3</td>
<td>36.4 (M,D,P)</td>
</tr>
<tr>
<td>Neoseiulus fallacis</td>
<td>0.659bc</td>
<td>0.318b</td>
<td>54.5</td>
<td>27.3</td>
<td>36.4 (M,D,P)</td>
</tr>
<tr>
<td>Tiphia/dromus pyri</td>
<td>0.727c</td>
<td>0.523b</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Means in columns followed by the same letter are not statistically different (P = 0.05).

* Frequency per contact. Mean of 4 replicates/spp. (n = 44); F = 18.9, df = 4, 15, P = 0.0001.

** Predation attempts/actual predation (percentage); no statistical comparison made.

* Contacts (n)/actual predation (percentage); no statistical comparison made.

Table 2. Activity, survival and reproduction of 2 Neoseiulus species of phytoseiid mites when provisioned with excess P. pallidus or other foods on small arenas

<table>
<thead>
<tr>
<th>Phytoseiid</th>
<th>Food/prey</th>
<th>Females tested</th>
<th>Activity frequency</th>
<th>Survival (8 d)</th>
<th>Cumulative immatures/female/d</th>
<th>Immatures/egg</th>
</tr>
</thead>
<tbody>
<tr>
<td>N. fallacis</td>
<td>T. urticae</td>
<td>24</td>
<td>0.17a</td>
<td>1.00d</td>
<td>2.85d</td>
<td>1.04c</td>
</tr>
<tr>
<td></td>
<td>Maize pollen</td>
<td>24</td>
<td>0.69e</td>
<td>0.90ed</td>
<td>1.63bc</td>
<td>1.32b</td>
</tr>
<tr>
<td></td>
<td>no food</td>
<td>24</td>
<td>0.57d</td>
<td>0.39a</td>
<td>0.70a</td>
<td>0.00a</td>
</tr>
<tr>
<td></td>
<td>P. pallidus</td>
<td>24</td>
<td>0.32b</td>
<td>0.91c</td>
<td>1.63b</td>
<td>1.15b</td>
</tr>
<tr>
<td>N. cucumeris</td>
<td>P. pallidus</td>
<td>24</td>
<td>0.45c</td>
<td>0.77b</td>
<td>2.19c</td>
<td>1.10b</td>
</tr>
<tr>
<td>ANOVA F value*</td>
<td></td>
<td></td>
<td>37.54</td>
<td>97.50</td>
<td>46.10</td>
<td>59.43</td>
</tr>
<tr>
<td>Significance of P =</td>
<td></td>
<td></td>
<td>&lt;0.0001</td>
<td>&lt;0.0001</td>
<td>&lt;0.0001</td>
<td>&lt;0.0001</td>
</tr>
</tbody>
</table>

Means in columns followed by the same letter are not significantly different at P > 0.05.

* df = 4, 35 for each ANOVA test.
survival per egg laid. The difference in egg production was considered a minor difference in light of immature production being so similar. A difference in activity with pollen versus mite prey is less likely for a generalist like N. cucumeris that feeds readily on pollen (McMurtry and Croft 1997). Overall, from these data we concluded that cyclamen mite is a moderately suitable prey for N. fallacis, but wondered if N. fallacis would remain in a bud when only cyclamen mites were present?

Single Plant Tests with T. urticae (Moderate Density) Plus Cyclamen Mites. When N. fallacis or N. cucumeris were added to plants infested with T. urticae and S. pallidus, predator densities and plant damage differed (Fig. 1). N. fallacis increased rapidly by feeding on T. urticae. By 8 June when spider mites densities peaked, T. urticae was less on plants with N. fallacis versus N. cucumeris and even more in controls than plants inoculated with either predator by ~2- to 4-fold, respectively (Fig. 1, upper left). N. fallacis was 14 times more common than N. cucumeris by 8 June and almost no predators were in controls (Fig. 1, lower right). Cyclamen mites could only be counted near test end because of destructive bud sampling, but by 24 June some reduction of this pest in buds was seen even though T. urticae were still appreciable (Fig. 1, upper right). By 8 July, impact on cyclamen mite in buds was more by N. fallacis than by N. cucumeris, but in buds, N. cucumeris was more common (Fig. 1, lower right). Because the number of buds per plant were much less than the number of leaves per plant, the actual densities of N. fallacis were much greater than those for N. cucumeris on a whole plant basis. The occurrence of more N. cucumeris in buds versus leaves may indicate it is adapted to feed on cyclamen mites or prefers the humid habitat of the bud.

The impact of N. cucumeris on cyclamen mites (Hufnaker and Kennett 1956) and its limited response to T. urticae have been noted before (Croft et al. 1998b). Evidence for its greater adaptation to P. pallidus was seen in egg production (Table 2); N. cucumeris had a value 130% of the value for N. fallacis. But in buds, cyclamen mites levels differed with N. fallacis giving ~75% reduction on 24 June and 98% by 8 July (Table 3) compared with 53 and 32% by N. cucumeris. Considering the short time span of these tests, the results were attributed more to differences in rates of increase between the 2 predators rather than their adaptations to the pest. If studies had been carried out longer, then regulation of cyclamen mites might have been better by N. cucumeris than N. fallacis. This is often the case, when one looks at the relative efficiency of control versus regulation by a specialist versus a generalist predator of mites (McMurtry and Croft 1997).

Differences among treatments in pest damage were less discriminating than mite levels, partly because of smaller sample sizes for leaflets versus buds (15 versus 5 per plant) and partly because of difficulty in estimating when symptoms were maximally expressed. On 24 June (when cumulative pest effects might be most), damaged bud levels were statistically different, and dead leaves were nearly different (P = 0.086; Table 3). Although data for other damages did not differ on the last date, some did over all dates: Total stems per plant did differ and they were most common in plots with N. fallacis (repeated measures ANOVA F = 5.94; df = 2, 12; P = 0.016). Runners did not differ
fallacis release plots (Table 3). This was because re-
budlets were variable and low (Fig. 2, lower left), but
intermediate (> 17 per budlet) in controls without
again (Fig. 1), N. cucumeris. Predator densities in
added cyclamen mites, and low (<1 per budlet) in
the crown of the plant (and the pest might later re-
predator densities were assessed 4 wk after predators
left). Levels were highest (> 68 mites per budlet) in
infest buds), stalk bases were dissected and pest and
predators were introduced, cyclamen mites in budlets
wpe released after pest mites had been present for
some time.

Plots with Cyclamen Mites Only. Once it was clear
that N. fallacis could suppress cyclamen mites when
spider mites were present, tests with cyclamen mite
alone were attempted. Although some T. urticae
appeared in plots, densities were similar and never >2
per leaf in plots for all life stages. Four weeks after
predators were introduced, cyclamen mites in budlets
showed differences among treatments (Fig. 2, upper
left). Levels were highest (> 68 mites per budlet) in
controls with cyclamen mites added but no predators,
intermediate (>17 per budlet) in controls without
added cyclamen mites, and low (<1 per budlet) in
either predator release plot. Predator densities in
budlets were variable and low (Fig. 2, lower left), but
again (Fig. 1), N. cucumeris was more than N. fallacis.

To see if cyclamen had escaped predation deep in
the crown of the plant (and the pest might later re-
infest buds), stalk bases were dissected and pest and
predator densities were assessed 4 wk after predators
were released (Fig. 2). Bases of 3 stems per plant
where stems entered crowns and crevices within
sheath areas were examined for cyclamen mites and
predators. As in bud counts, P. pallidus densities dif-fered among treatments (Fig. 2, upper right); they
were most (172; < 243 per stem base) in controls
with added cyclamen mite and no N. fallacis or N. cucumeris
were found (Fig. 2). There were fewer P. pallidus (21
per leaf base) in plots without releases of this pest.

There were a few cyclamen mites with N. cucumeris
but none with N. fallacis. Both of the predator treat-
ments (Fig. 2, lower right) had adult female phyto-
seids deep within crown bases and there were more
N. cucumeris than N. fallacis. N. cucumeris eggs were in
crowns, indicating that it was still responding repro-
ductively to low densities of cyclamen mite or other
foods. Single adult N. fallacis were in 4 of 5 crowns but
no immatures were found, indicating that it had almost
eliminated foods. Adult female N. fallacis did not ap-
pear robust or gravid but all had gut color, indicating
that some food was still present.

Again, interpretation of plant damages were limited
by smaller sample sizes than mite samples, but some
ANOVA.s were significant (Table 4). For stems, runners,
and dead leaves, no differences were seen but
trends were similar to tests with both mite pests (Table
3): Highest densities of plant stems occurred in N.
fallacis plots, lowest ones in controls with cyclamen
mite releases (Tables 3 and 4). Only 1 runner was
produced in any plot and no differences in dead leaves
occurred because these were caused mostly by spider
mite feeding (Table 3). Live buds, damaged buds, and
dead buds were different or nearly so among treat-
ments (Table 4). Plots with N. fallacis + cyclamen
mites and controls without cyclamen mite releases had
the most live buds but the least damaged and dead
buds. Controls with releases of cyclamen mites had
the fewest buds but the most damaged and dead buds. N.
cucumeris plots were intermediate for new, damaged,
and dead buds.

Discussion

Reasons why phytoseiids probe (attempt predation)
cyclamen mites but do not feed (actual predation)
may be the result of unfavorable tactile stimul
Fig. 2. Population trends of *N. fallacis*, *N. cucumeris*, and pest mites *P. pallidus* and *T. urticae* in strawberry plots after inoculations with both pests and predator mites.

(e.g., lack of appropriate odors); another explanation may be difficulty in piercing the body. For *G. ocidentalis*, piercing the adult integument was difficult but this mite could feed on the softer immature life stages (unpublished data). *N. fallacis* would hold the adult and probe the hardened exterior until it found softer tissues near the leg or mouthpart bases and then it would pierce the body. *A. andersoni*, the largest phytoseiid studied, had little difficulty piercing adult tissues, suggesting that its mouthparts may be more adapted to hardened exocuticles. In other studies, *A. andersoni* readily fed on adult phytoseiids and insects with hardened cuticles (Croft 1994, Croft and Croft 1996). All 5 phytoseiid species had less difficulty feeding on the immature life stages of cyclamen than on the adult mites (unpublished data).

We assessed whether *N. fallacis* would reproduce on exposed cyclamen mites that left the strawberry buds. Predation data indicated that this tarsonemid was a suitable prey for reproduction of *N. fallacis* and

**Table 4.** Plant parts and pest damage caused by high densities of *P. pallidus* and low densities of *T. urticae* after release of *N. fallacis* or *N. cucumeris* on strawberry plants

<table>
<thead>
<tr>
<th>Dates: 4 Aug Treatment*</th>
<th>n</th>
<th>Plant parts per plant</th>
<th>Plant damage units per plant</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Stems</td>
<td>Runners</td>
</tr>
<tr>
<td>Means Attributes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>N. f.</em> release</td>
<td>5</td>
<td>5.2</td>
<td>0.0</td>
</tr>
<tr>
<td><em>N. c.</em> release</td>
<td>5</td>
<td>4.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Control™ cm</td>
<td>5</td>
<td>4.6</td>
<td>0.0</td>
</tr>
<tr>
<td>Control™+ cm</td>
<td>5</td>
<td>3.2</td>
<td>0.2</td>
</tr>
<tr>
<td>ANOVA F*</td>
<td></td>
<td>1.15</td>
<td>1.00</td>
</tr>
<tr>
<td>Significance of F =</td>
<td></td>
<td>0.359</td>
<td>0.415</td>
</tr>
</tbody>
</table>

Means in column followed by the same letter are not significantly different at $P > 0.05$.
*See treatment densities of spider mite, cyclamen mite and predator mites in Fig. 2.

*Number of plants sampled

³ df = 3, 16 for ANOVA test.
implied that some predation probably occurs at high densities when cyclamen mites are exposed more on curled leaves (versus only in buds). Activity data indicated that _P. pallidus_ elicited arrestment of _N. fallacis_ when compared with the _T. urticae_ and no food treatments. These results suggest that if _N. fallacis_ would enter leaf buds, they might remain there with cyclamen mites even if other alternate prey or foods were not present. In other studies of cyclamen mite control, the effectiveness of 2 phytoseiids, either _A. rhenanus_ or _A. reductus_, was attributed to their persistence in the confined habitat of buds and in folded leaves with cyclamen mites (Tuovinen 1995).

Finally, individual plant studies indicated that biological control of _P. pallidus_ was achieved as readily by _N. fallacis_ as by _N. cucumeris_, the latter is thought to be a highly effective biological control agent of cyclamen mite (Huffaker and Kennett 1996). However, pest control was only sampled over a short period. _N. fallacis_ is a more specialized predator of tetranychid mites than _N. cucumeris_; the latter feeds on a wider range of arthropods and pollens (McMurtry and Croft 1997). It is well-known generally, that generalist phytoseiids are better regulators of pest mites, whereas specialist are better at numerically responding and controlling high density populations of phytophagous mites (McMurtry and Croft 1997). Thus, _N. fallacis_ might show a faster numerical response to pest mites than _N. cucumeris_, as was observed in these experiments. With cyclamen mites alone (Table 4), the difference in plant damage that occurred between predator treatments was thought to be because of slower pest control by _N. cucumeris_, even though by the end of the test, pest levels were similar between predator treatments. However, over longer periods, _N. cucumeris_ may persist and regulate cyclamen mites better than _N. fallacis_ because it feeds on other foods more. _N. fallacis_ may stay in plant crowns less when cyclamen mites become scarce. This was indicated when _N. cucumeris_ was more common than _N. fallacis_ after cyclamen mites had been suppressed at the end of tests.

Relative to both mite pests that occur on many cultivars of strawberry, we expected that cyclamen mite control by _N. fallacis_ might be affected more by the overall population dynamics of _T. urticae_. However, suppression of cyclamen mites occurred even when _T. urticae_ was dense and _N. fallacis_ was present. Furthermore, based on plant damage estimates, we concluded that some suppression of cyclamen mites occurred even before _T. urticae_ was fully suppressed to very low densities. Just what preference _N. fallacis_ has for _T. urticae_ versus _P. pallidus_ is not known precisely, but it likely differs from that of _N. cucumeris_. _N. cucumeris_ does not prefer _T. urticae_ to cyclamen mite, but _N. fallacis_ probably does (Croft et al. 1998b).

Overall, life history differences between these predators would dictate different release tactics for each. If rapid suppression of both pests were needed, then _N. fallacis_ would be best because of its tendencies to feed on both mites and numerically respond to either pest rapidly. If long-term regulation of both pests was the goal, then releases of _N. cucumeris_ at low pest densities might be appropriate. As noted, generalist predators of spider mites are usually better regulators of mite pests than specialists. A mixed release of both may be a useful strategy: _N. fallacis_ could reduce dense populations of either pest and _N. cucumeris_ could keep them at low levels if selective pesticides were used for control of other pests. Study of key interactions among _N. fallacis_, _N. cucumeris_, and both mite pests are needed to more fully develop a mixed release strategy of both phytoseiids.

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