# Neoseiulus fallacis

## Spider Mite Predator

Adapted from the Applied Bio-Nomics Manual

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**Neoseiulus (=Amblyseius) fallacis Spider Mite predator (Acarina: Phytoseiidae)**
**Common Name: Fallacis**

**Target pests**
Two-spotted spider mite (*Tetranychus urticae*), European red mite (*Panonychus ulmi*), spruce spider mite (*Oligonychus ununguis*), southern red mite (*Oligonychus ilicis*), and Bank's Grass mite.

**Description**
Fallacis is a native predatory mite that feeds on spider mites, rust mites and small insects. It is one of the most important biological control agents in North American berry and orchard crops.

- Adults have pear-shaped bodies, 0.5 mm long; they are tan to light orange in color, shiny, with long legs.
- Immature predators are cream colored and semi-transparent.
- Eggs are oval and 0.3 mm long.
- Fallacis is reddish in color when feeding on the European red mite, gold when feeding on the two-spotted spider mite in strawberries, and blotchy green when feeding on the two-spotted spider mite in cane berries.

**Use in Biological Control**

- Fallacis is used to control two-spotted spider mites and other mites on greenhouse peppers, field strawberries, raspberries, currants and mint. In British Columbia, Washington and Oregon, IPM programs for field berry crops are based on using Fallacis as the primary control for spider mites.
- Fallacis is also used on container and field-grown nursery stock. Research in Oregon found that Fallacis can control the spider mites *O. ilicis, O. ununguis,* and *T. urticae* on woody ornamentals (*Thuja, Skimmia, Weigela, Potentilla, Euonymus,* and *Buddleia)*.
- Fallacis feeds on apple rust mite (*Aculus schlectendali*), cyclamen mite (*Steneotarsonemus pallidus*) and tomato russet mite (*Aculops lycopersici*); however, whether or not it controls these species is not known.
- Fallacis is more resistant to pesticides than most biological controls and a strain highly resistant to pesticides is available commercially (see text box, below).
- Unlike other predatory mites, such as the Persimilis predatory mite, Fallacis can remain in areas with low levels of spider mites; they survive in the absence of mite prey by feeding on other small arthropods and pollen.
- Fallacis feeds and reproduces over a wide range of temperatures from 48-85° F (9-32° C). They do best where there is a dense plant canopy and when relative humidity is over 50%.
- Fallacis can reproduce at lower temperatures than other predatory mites (*Phytoseiulus persimilis, Neoseiulus californicus*) and displaces them in the cooler growing areas in Canada and northern USA.

**Monitoring Tips**

- Use a headband magnifier or 10-15X hand lens. The predators are usually easy to tell from their prey, which are slow moving.

- Adult mites often hide under leaf hairs and along the edge of leaf veins. They are most easily seen on parts of the leaf where spider mite numbers are low or around the edges of the main spider mite infestation.
- Eggs are usually found singly or in pairs in crevices along, or partly under, the leaf midrib or where prey is abundant.

**Life Cycle**

Development from egg to adult takes from 7-9 days at 70° F (21° C) to 3 days at 85° F (32° C). At 78° F (26° C) a fourfold increase in numbers can occur within 4 days; in the field, under optimum conditions, populations can increase from 10 predators/100 leaves to 200-500 predators/100 leaves, in just 2 weeks.

- Adult females lay 1-5 eggs per day, for a total of 26-60 eggs over their 14-62 day life time. The eggs hatch in 2-3 days. Eggs are oval and twice the size of two-spotted mite eggs.
- Newly hatched predators do not eat, but later stages and adults feed on all stages of prey. Female Fallacis eat 2-16 spider mites per day.
- Adult females enter diapause in response to the short days (daylight of 14 hours or less in Canada) in fall. They stop reproducing and move into sheltered areas, such as under bark or ground cover.

**Product Information**

Fallacis is available commercially either on bean leaves or in a granular carrier (usually vermiculite or corn grits). Both formulations should be applied as soon as possible. Fallacis packages can be held at 50-60° F (10-15° C), out of direct sunlight, for 1-2 days--but quality and egg laying will be lower. Release when temperatures are between 55 and 80° F, preferably not in the middle of the day. Release predators in areas with highest pest densities.

<u>Using the bean leaf product</u>

- Place leaf pieces from the container onto infested leaves of crop plants. The bean leaves eventually dry out and become inconspicuous.
- Check the product by examining the underside of some of the leaves using a 10-15X hand lens or magnifier. Active predators should be visible.
- Advantages of this product are that all life stages are present, which introduces all ages of predators into a crop. It also provides ideal humidity and a food supply for the predators in transit.

Note that although the bean leaves may contain a few two-spotted mites, this does not add to the pest problem because the predators quickly eliminate them. The presence of this food enables Fallacis to become established and start reproducing immediately, which improves biological control.

<u>Using the vermiculite product</u>

- Lay the container on its side at room temperature, out of direct sunlight, for 1/2 hour.
- Check the product by sprinkling some of the vermiculite onto a sheet of white paper and using a 10-15X hand lens or magnifier. Active mites should be visible.
- Wet the canopy foliage at release points after release, because the predators prefer humid conditions. If relative humidity drops below 40% at canopy level, such as during a winter cold front, a reinoculation is advised.
- Gently rotate the bottle to mix the mites with the carrier and distribute the contents over the infested plants.

**Introduction Rates**

Fallacis is most effective when applied at the first sign of a mite infestation. Fallacis will usually become established in the crop after one introduction, where they remain if mites or pollen are available for food. When prey become scarce, Fallacis moves to the top of the plant and usually disperses throughout the crop on very slow air movement.

When predators are found on each infested leaf it usually means that the biological control program will be successful. It may take another 2-6 weeks for new plant growth to show improvement, depending on growth rates.

General Introduction Rates

- 1-5 Fallacis/10 $ft^2$ ($m^2$)

For greenhouse crops, apply predators to all infested plants. Use the lower rate for preventative introductions onto mite susceptible plants; use the higher rates if there are established mite populations.

Greenhouse peppers:

- As soon as flowers have pollen, or spider mites are present, apply 1 predator/5 plants. Also, apply Persimilis to all outbreak areas when using Fallacis because spider mite can reach high densities on this crop during hot weather. Research in BC has shown that better control of spider mite can be achieved when both Fallacis and Persimilis are used together on greenhouse pepper.

Woody ornamentals, container plants:

- Apply 1-5 predators/10 $ft^2$ ($m^2$) to all spider mite susceptible plants early in the season, or as soon as spider mites are detected. Use higher rates for established spider mite populations.
- Use a compatible miticide (see below) to treat "hot spots" until Fallacis populations build up.

Field crops:

Before introducing Fallacis, monitoring counts should be done to determine numbers of spider mites and existing predators. Spread Fallacis evenly throughout the field using 60-80/acre (150-200 release points/ha); concentrate extra predators where there are higher mite counts.

- Strawberries: For new plantings release 10,000/acre (25,000 predators/ha) as soon as possible after planting or 10 days after applying insecticides to control aphids. On producing fields, release 7000/acre (17,000/ha), if needed, in spring or early summer so predator numbers have enough time to build up and provide control before September. Before planning a strawberry biocontrol program, refer to the Oregon State University web site, which includes a Fallacis release rate calculator (http://www.orst.edu/Dept/entomology/ipm/mcalc.html). Releases can be made after picking, and after renovation when the foliage has recovered. In fields with a history of large overwintering populations, late summer and early fall releases are advised otherwise spring problems will be difficult.
- Raspberries and currants: Release 7,000-10,000/acre (17,000-25,000 predators/ha). Inoculate only those fields with spider mite populations of 0.3 mites/leaf and higher. Release predators early in the spring to achieve control the same season; release them during the summer for control the next season.
- Field mint: Add predators to newly established fields in mid-season.

**For Best Results**

- In field crops, placing higher numbers of predators on the prevailing upwind side of the crop will increase their dispersal throughout the crop by wind.
- In greenhouses, if spider mite numbers are high with visible webbing and clusters of mites stringing down from leaves, knock them down (see pesticide information below).
- Fallacis needs relative humidities of over 50% to survive, particularly in the egg stage. In hot, dry conditions, raise the humidity by watering or misting plants.
- For two-spotted mites in greenhouses, where temperature and humidity are consistently high [over 72° F (22° C) and 70% RH], release Persimilis as well as Fallacis. Persimilis works better in high density spider mite populations under these conditions Where over 60% relative humidity can be maintained, both Persimilis and the predatory midge *Feltiella acarisuga* can be used with Fallacis.
- The mite eating lady beetle, Stethorus is less affected by low humidity and may be used along with Fallacis on greenhouse cucumber, pepper and nursery crops. Stethorus is able

to fly and can detect and control small colonies of mites before they become well established.

**Program Success**
Predatory mites require proper conditions such as adequate humidity and compatible management practices to be effective. Start with clean plants and use good sanitation practices to avoid spreading mites. Carefully inspect new plant material with a 10x to 15x hand lens before bringing it into the greenhouse; disinfest plants if they harbor mites.

**Cultural Controls**
- High foliar nitrogen levels can favor outbreaks of some mites. Do not apply more nitrogen than necessary, and when possible use less soluble forms.
- Bending rose canes to increase flower production increases humidity within the lower canopy, providing a more favorable environment for predatory mites than in traditional trellis production.
- Pest mites thrive under hot dry conditions; properly watering plants dislodges some mites, slows pest mite dispersal, and supports predator mites.
- When using predatory mites, regularly monitor pest and mite populations to evaluate control efficacy and to determine whether predatory mite releases or other control methods are warranted.
- Control dust by using plastic dust barriers, speed limits on dirt roads, and covering bare soil.

**Organic Pesticide Controls**
- Apply OMRI or NOP listed oil, soap, or other miticide with relatively low impact on predators to reduce pest populations, and then introduce predators after leaves dry.
- Insecticidal soap, horticultural oil, and essential oils have low residual toxicity and provide control if applied thoroughly on plants where mites are feeding.
- Essential oil products, such as GCMite (containing cottonseed, clove and garlic oils) Ecotrol (rosemary, peppermint, and wintergreen oils) may work better than less expensive soap and oil treatments because of their multiple modes of action in controlling mites and other pests in 3 – 5 days, allowing the beneficial insects to come back quickly.
- Oil has little impact on predatory mites and can be a good choice if spraying is needed when natural enemies are present. For crops and growing situations where phytotoxicity is a concern, reduced rates (1% soap or 0.25-0.5% oil) can provide control.
- The habit of *N. fallacis* to overwinter in crevices can be used to advantage in the early spring with a pre-bloom horticultural oil application. This greatly reduces the number of European red mite eggs while not affecting predatory mite populations.
- Avoid using persistent pesticides for at least several weeks before releasing predator mites.

**Conventional Pesticide Controls**
See Pesticide Toxicity Chart and text box (below) about a resistant strain.
- To reduce mortality of predatory mites from pesticides, find out the length of residual harm on the Pesticide Toxicity Chart before releasing predators.
- Hot Pepper Wax and IGRs are the most effective low risk controls for mites and have no residual harm to predators. Cinnamaldehyde is likely to have a little or no residual. Abamectin has a two week residual.
- Fenbutatin oxide (Vendex®) is sometimes used on hot spots in a Fallacis program but it is a Pesticide Action Network Bad Actor Chemical. It does not harm Fallacis, but avoid over spraying, which reduces the predator's food supply and their ability to reproduce.
- Spreader-stickers, supreme oils and soaps are harmful to predators contacted by the spray, but have little residual activity.
- Overuse of mist-applied sulfur can suppress predator reproduction and reduce effectiveness and may have some residual effect on predators.
- A single application of a chemical considered highly toxic to Fallacis at any time during the season will have a large negative impact on its abundance.

**The Pesticide Resistant Strain of Fallacis**

A special strain of Fallacis, selected by H. Thistlewood (Agriculture and Agri-Foods Canada, Vineland Research Station) for resistance to commonly used pesticides is mass-produced under license by Applied Bio-Nomics Ltd. in Canada. When the following pesticides are used at low rates they are of low to moderate toxicity to this strain on Fallacis. Some as noted are not registered in the US and quite a few are listed as Bad Actor Chemicals by the Pesticide Action Network http://pesticideinfo.org/Search_Chemicals.jsp#ChemSearch

**Breeding populations of Fallacis should survive in the crop when the pesticides listed below are used at low label rates. Check with supplier before using other chemicals.**

| Active Ingredient | Commercial Product – Safety Listing with Pesticide Action Network |
|---|---|
| avermectin | Abamectin – PAN Bad Actor Chemical |
| azinphos-methyl | Apm/Guthion – PAN Bad Actor Chemical |
| Bacillus thuringiensis | Dipel –Not listed by PAN |
| captan | Captan – PAN Bad Actor Chemical |
| clofentizine | Apollo –Not listed by PAN |
| diazinon | Diazinon – PAN Bad Actor Chemical |
| dichlone | Phygon – Not Reg US, Not listed by PAN |
| diflubenzuron | Dimilin –Not listed by PAN |
| endosulfan | Thiodan – PAN Bad Actor Chemical |
| fenarimol | Rubigan –Not listed by PAN |
| fenbutatin oxide | Vendex/Torque – PAN Bad Actor Chemical |
| fenoxycarb | Sustain/Insegar – PAN Bad Actor Chemical |
| hexythiazox | Savey –Not listed by PAN |
| iprodion | Rovral – PAN Bad Actor Chemical |
| malathion | Malathion – PAN Bad Actor Chemical (some formulations not listed) |
| methoxychlor | Methoxychlor –Not listed by PAN |
| mycobutanil | Nova PAN Bad Actor Chemical (one formulation not listed) |
| mineral oil | Superior Oil/dormant oil –Not listed by PAN |
| phosmet | Imidan – PAN Bad Actor Chemical |
| pirimicarb | Pirimor/Pirliss – PAN Bad Actor Chemical |
| propargite | Omite/Comite – PAN Bad Actor Chemical |
| sulphur | Sulphur –Not listed by PAN |
| triadimefon | Bayleton – PAN Bad Actor Chemical |
| triforine | Funginex – PAN Bad Actor Chemical |
| vinclozolin | Ronilin – PAN Bad Actor Chemical |