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GROWING GREEN

BENEFICIALS

All Predatory Mites Are Not Created Equal

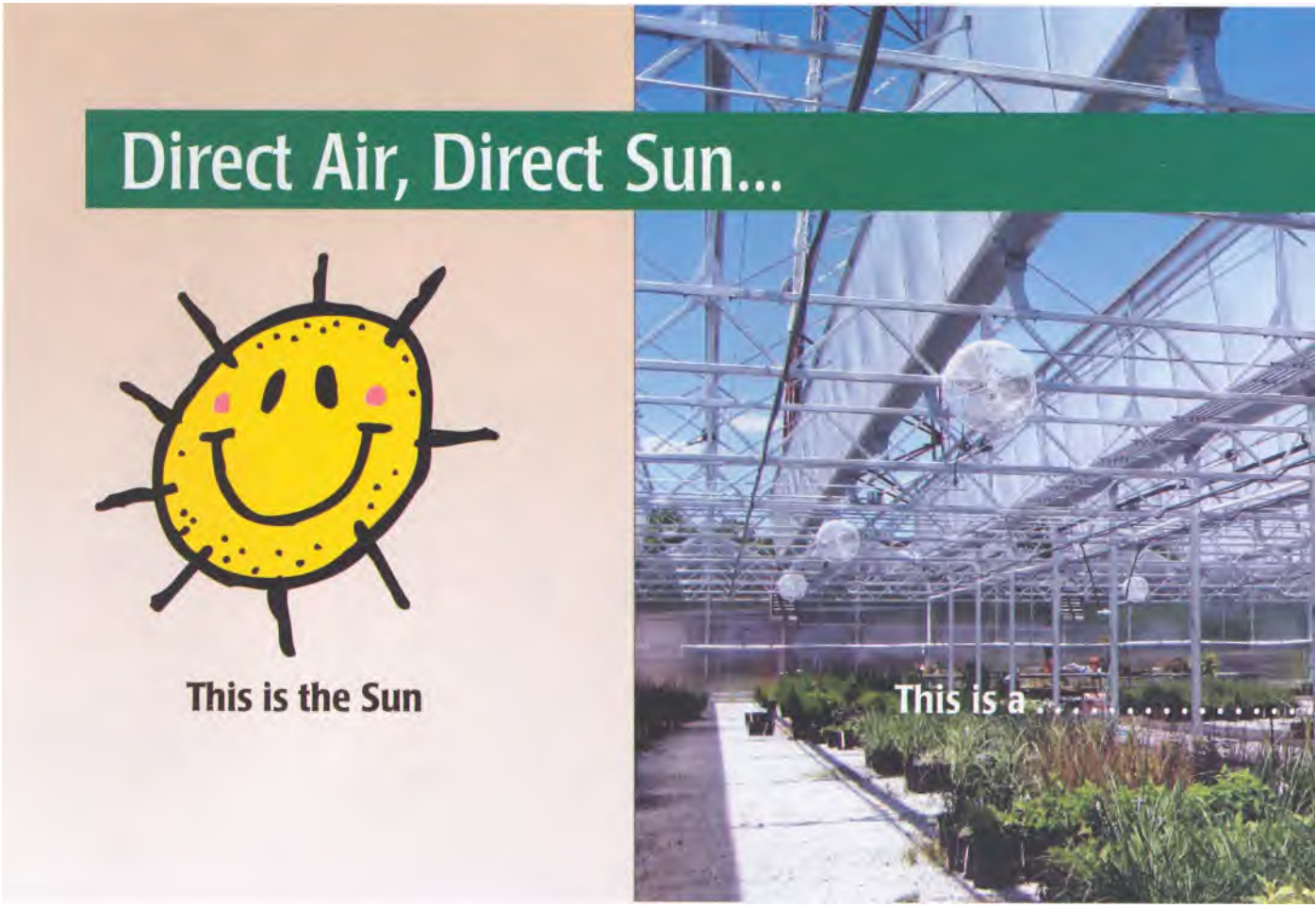
Food preferences and dispersal capabilities divide mites into three distinct categories.

by RAYMOND CLOYD

HAVE you ever considered implementing a biological control program in your greenhouse operation? Well, first of all, what is biological control? Biological control involves the release or application of natural enemies including parasitoids (parasitic wasps), predators and pathogens (in this case entomopathogenic fungi and nematodes) into a greenhouse in order to regulate an existing insect or mite pest population.

One of the most widely used groups of natural enemies are predatory mites, which are commercially available from most biological control suppliers. There are a number of predatory mite

Phytoseiulus persimilis. This is a Type I specialist predatory mite.



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species commercially available that are in the family Phytoseiidae, including *Phytoseiulus persimilis, Neoseiulus fallacis, Neoseiuluscalifornicus, Mesoseiulus longipes* and *Galendromus occidentalis.*

It is important to understand the behavioral characteristics of predatory mites before implementing a biological control program since behavioral responses to plant volatiles, feeding preferences and dispersal of predatory mites will influence their ability to provide control or regulate different "levels" of spider mite infestations. In addition, predatory mite species that utilize similar primary and alternative food sources are capable of coexisting if they have different foraging strategies and different distributions on plants. Predatory mite movement and ability to regulate mite pest populations is primarily dependent on feeding habit. As such, predatory mites (adult females) are classified into three distinct categories based on their food preferences and dispersal capabilities among and within crops: Type I, II and III.

Specialized Mites

Type I are considered specialist (specialized) predatory mites because they only feed and survive on spider mites in the family Tetranychidae (also referred to as Tetranychid), which includes the twospotted spider mite, *Tetranychus urticae.* These predatory mites have strong aggregation behaviors and commonly remain in prey patches longer than other predatory mites. An example of a specialist predatory mite is *Phytoseiulus persimilis.* It has the capacity to rapidly respond numerically to increasing twospotted spider mite populations, which makes this predatory mite the appropriate choice for augmentative biological control programs. However, this may result in the predatory mite population declining due to the inability of P. *persimilis* to survive on an alternative food source. In fact, *P. persimilis* may be difficult to find on plants, in some cases, after having reduced twospotted spider mite populations.

Galendromus (Metaseiulus) occidentalis. This is a Type II selective predatory mite.

Selective Predatory Mites

Type II are selective predatory mites with a broad host range and

they also tend to have strong aggregation behaviors. Selective predatory mites feed and reproduce on mites other than twospotted spider mite in other families, and on pollen. These predatory mites are less likely to cannibalize each other. Examples of Type II predatory mites include *Neoseiulus californicus, N. fallacis, Galendromus* (Metaseiulus) *occidentalis,* and *N.* (Amblyseius) *cucumeris. Neoseiulus cucumeris* feeds on broad mites and thrips (western flower thrips) and will also feed on pollen in the absence of Tetranychid mites, which means it can survive at low prey densities. *Neoseiulus californicus* feeds on different types of plant-feeding mites including the carmine spider mite *(Tetranychus cinabarinus)* and the European red mite *(Panonychus urticae).* However, it prefers feeding on twospotted spider mite. In addition, *N. californicus* females can survive and reproduce after feeding on alternative hosts and pollen in the absence of twospotted spider mites. Furthermore, *N. californicus* will also feed on *P. persimilis* in the absence of two spotted spider mites. However, this typically doesn't occur when twospotted spider mite populations are present. Although *N. californicus is* less voracious than *P. persimilis,* it has a higher survival rate when twospotted spider mite populations are low.

Generalist Predatory Mites

Type III are generalist predatory mites that feed on eriophyid mites and tarsonemids (broad and cyclamen mites). In addition, they may feed on pollen, honeydew and plant exudates. However, cannibalism is prevalent with Type III predatory mites. Type III predatory mites tend to aggregate less in response to mite colonies compared to Type I and II predatory mites. Generalist predatory mites are typically found on leaf undersides along

Neoseiulus (Amblyseius) cucumeris. **This is a Type II selective predatory mite.**

the midrib or in other protected locations. *Amblyseius swirskii is* an example of a Type III predatory mite that feeds on thrips and whiteflies. A majority of phytoseiids are Type III generalist predatory mites.

The classifications discussed above may be simple generalizations since there are exceptions, particularly within Types II and III. For example, *N. californicus* has characteristics of both a Type II (selective) and Type III (generalist) predatory mite.

Behavioral differences between generalist and specialist predatory mites may affect their effectiveness. In addition, "intraguild predation" may occur, which is when one predatory mite species feeds on another predatory mite species when both are occupying the same habitat. This commonly occurs when generalist predatory mites are used in biological control programs. Not only will they attack the target pest, but they may also feed on other natural enemies. Generalist predatory mites tend to disperse on individual plants more so than specialist predatory mites. However, generalist predatory mite females disperse more slowly and deposit eggs over an extended period of time. Specialist predatory mites tend to have higher reproductive rates and better searching abilities and reduce prey populations faster. In general, only one release of generalist predatory mites may be required, whereas several releases may be needed when using specialist predatory mites. Furthermore, generalist predatory mites may be more effective when pest populations are more dispersed. However, specialist predatory mites are more effective when pest populations are highly aggregated. Generalist predatory mites are commonly present in sufficient or abundant numbers because they utilize other food sources such as pollen and other arthropods (insects and mites). Generalist predatory mites feed on other phytoseiids more so than specialist predatory mites do. In addition, cannibalism tends to occur more frequently in populations of generalist predatory mites than specialist predatory mites. The immature stages (larvae and nymphs) may differ in dispersal behavior, food requirements and feeding habits compared to adults. For example, selective predatory mite (Type II) immatures, in general, develop more rapidly and require less food than generalist predatory mite immatures.

In order to implement a successful biological control program, it is essential to know the behavioral characteristics of predatory mites such as dispersal capabilities and food preferences prior to releasing them in the greenhouse so as to enhance their effectiveness in regulating the target pests' populations. GG

Comparing Predatory Mites

A comparison between two predatory mites; *Neoseiulus californicus* (Type II and III) and *N. fallacis* (Type II):

Neoseiulus californicus
- Moves around on plants more frequently.
- Greater within-plant dispersal.
- Feeds on pollen and plant sap.
- Tends to remain near release site.
- Less effective against highly aggregated mite populations.
- Migrates more frequently between prey patches, but stays for shorter periods of time.
- Disperses eggs more than *N. fallacis*.
- Females have a higher reproductive capacity than *N. fallacis*.
- Protonymphs and deutonymphs are more active than *N. fallacis*.

Neoseiulus fallacis
- Searches a broader area on plants.
- Disperses more between plants (greater dispersal capabilities).
- Only feeds on spider mites (Tetranychids).
- Tends to move or migrate away from the release site.
- Requires highly aggregated populations of spider mites.
- Provides better control of heavy infestations than *N. californicus*; however, tend to disperse too much after prey populations are reduced.
- Very active within prey patches, but less active between prey patches.
- May provide uneven control of spider mite populations. For example, may eliminate large patches of twospotted spider mites on one part of the plant, but another patch may not be affected.

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