Research Summary

Guardian plant system employs multiple strategies to manage greenhouse pests

Project title: Fungi, predatory mites and guardian plants for thrips IPM in organic greenhouse ornamentals

Spring bedding plants and greenhouse ornamentals are a significant source of revenue for many organic vegetable growers in New England. Western flower thrips (WFT) are a serious pest in organic greenhouse production nationally, and in Vermont they are the most common reason for organic growers suspending organic practices in their greenhouse crops, fearing the loss of their entire crop to this persistent virus-transmitting pest.

This project tested a novel approach to managing western flower thrips in a commercial greenhouse of organically-grown spring bedding plants, combining predatory mites, granular insect-killing fungi and marigolds into a "guardian plant" system.

The guardian plant/predatory mite and granular fungi thrips management system is based on the following assumptions: 1) that adult thrips will be attracted out of the crop to flowering marigolds, where they then become established; 2) that the immature thrips will serve as prey for the predatory mite, *Neoseiulus cucumeris*, both sustaining mite populations and encouraging their dispersal through the crop; and 3) that thrips escaping predation will drop to the soil to pupate, where they will become infected with the granular fungi. A granular formulation of *Beauvaria bassiana* enables the fungus to colonize the potting mix, eliminating the need for reapplication.

This represents a holistic, low-cost approach to achieving WFT management. Because fungal treatments and mite releases are applied to the guardian plants rather than the entire crop, management costs are reduced while control is maximized.

Project goals were to determine the effectiveness of marigolds as early pest detection tools and as trap plants for thrips; to assess the impact of granular insect-killing fungi applied to the marigold guardian plants on thrips populations; and to evaluate the combined effectiveness of predators and insect-killing fungi within marigold guardian plants to manage thrips and other arthropod pests in organic greenhouse-grown bedding plants.

Treatments

Marigolds ('Hero Yellow') were tested as a guardian plant in three greenhouses (~3,200 sq. ft.) of organic bedding, foliage and vegetable starter crops. This variety was selected because it is highly attractive to thrips, produces pollen which sustains predatory mites and has a prolific flower type that is suitable as a habitat for mites.

Greenhouse 1 (GPS): Marigold GPS and predatory mites and fungi

- Flowering marigolds were placed at least 2m apart in the spring bedding plant crop (6 per greenhouse)
- Inundative releases of the predatory mite *N. cucumeris* were made on guardian plant foliage every 2 weeks at a rate of 2 tablespoons (~850 mites) per plant.
- The granular fungal material was applied once to guardian plants at a rate of 6 g/pot.
- Yellow sticky cards to monitor thrips were placed at a rate of 1 per 1,000 sq. ft. according to standard guidelines.

Greenhouse 2 (IND): Marigolds as trap plants with no biological controls

- Flowering marigolds and yellow sticky cards were placed in the house at the same configuration as in the GPS greenhouse, described above.

Greenhouse 3 (YSC): No marigolds

- The last greenhouse served as an untreated control with only yellow sticky cards and no marigolds. This house primarily contained vegetable starter plants.

For 13 weeks from early April to early July, thrips and mite numbers were monitored weekly in the GPS and IND greenhouses by plant tapping and blossom sampling on marigolds and a random assortment of crops and yellow sticky cards. In the YSC greenhouse, only crop inspections and yellow sticky card counts were made. Scouting times for each variable and the time it took to find the first thrips were also recorded.

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Cheryl Frank/University of Vermont

The Guardian Plant System: How it Works

1. Marigolds draw thrips out of the crop.
2. Thrips lay eggs on the marigolds
3. Predatory mites are released on the marigolds to control thrips in the blossoms and foliage.
4. Insect-killing fungi are added to the pot's soil to manage thrips there.
5. Mites disperse through the crop for ongoing biological control.

Left: Marigold guardian plant in the greenhouse.

Right: Thrips on marigold blossom.

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Results

Effectiveness of marigolds as an early detection tool and as trap plants. In all of the greenhouses, thrips population levels were very low (≤2 thrips/plant) to low (3-5 thrips/plant) with little noticeable damage (<10% per plant). The IND greenhouse had slightly higher numbers of thrips over time than the GPS greenhouse. (It should be noted that because of the virus threat, conventional growers typically apply a chemical pesticide if as few as 2 thrips per yellow sticky card are found.) In all greenhouses more thrips were found on the marigolds and sticky cards than on the randomly inspected bedding and vegetable plants. More mites were present in the marigold flowers than on foliage. Thrips were also found in the blossoms.

Average scouting times were as follows: sticky cards (5 minutes), marigolds (10 minutes) and random plant inspections (15 minutes). On average when inspecting marigolds, it took 2 minutes to find the first thrips compared to an average of 4 minutes on the randomly inspected crops. This suggests that sticky cards and marigolds are effective monitoring tools that save growers time by detecting thrips quickly.

Impact of granular insect-killing fungi on thrips populations. We were not able to check thrips cadavers for fungal infection because no infected thrips were observed on the foliage or in the flowers. This may be because thrips larvae or pupae that became infected in the soil died there and did not emerge as an adult to feed on the plant. We observed significant fungal outgrowth from the granules throughout the course of the experiment. This eliminated the need to complete extensive fungal load studies.

Effectiveness of predators and insect-killing fungi within marigold GPS to manage thrips. Thrips and their predators are highly mobile, and it is difficult to effectively test different treatments within one greenhouse. Therefore, we compared the effect of using the total guardian plant system with marigolds alone or no marigolds at all among the three greenhouses. When thrips populations were compared among treatments, marigold flowers from plants treated with biological controls had fewer thrips than those without treatment.

While very low numbers of mites (mean=1.11) were observed from tapping the marigolds, and no predatory mites were found on randomly inspected bedding plants, blossom samples from the same marigolds showed very high numbers of predatory mites per blossom (mean= 22.23).

These data suggest mites preferred to remain in the marigold blossoms rather than dispersing in the crop.

More thrips were found within marigold flowers in the IND greenhouse (mean=1.76) than the GPS greenhouse (mean=0.29). These data suggest that marigolds with predatory mites and fungi have lower thrips populations in the blossoms than marigolds that have no biological control agents. This indicates that marigolds combined with predatory mite releases and fungi provide a useful thrips management tool.

Though thrips populations were low, we did observe consistently lower numbers of thrips in the GPS than the IND house, suggesting the biological control agents were affecting thrips populations on the GPS and the crop overall. Because we were unable to test each biological control agent separately, we can't determine if the lower populations were a result of the mites, the fungus or both. However, our results did demonstrate that the GPS combining mites and fungi reduced thrips populations. ■