Effect of GROWING MEDIA

Can media help manage the occurrence of western flower thrips and fungus gnats?

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Western flower thrips, *Frankliniella occidentalis*, and fungus gnats, *Bradysia* spp., are major insect pests of greenhouse production systems. Both insect pests have life stages that reside in the growing medium: prepupae and pupae for western flower thrips and larvae for fungus gnats.

We recently conducted a series of experiments replicated over time to scientifically determine if growing media containing a bacterium and arbuscular mycorrhizal fungus negatively affect western flower thrips pupae and fungus gnat larvae under laboratory conditions. Following are the procedures we implemented and the results we obtained.

MATERIALS AND METHODS

This study involved two experiments replicated over time to assess the effects of different growing media on the pupae of the western flower thrips and larvae of fungus gnats, respectively.

EXPERIMENT ONE: WESTERN FLOWER THRIPS

Western flower thrips, *Frankliniella occidentalis*, used in the experiments were maintained in a laboratory on green bean (*Phaseolus vulgaris*) pods and bee pollen (Prairie Harvest: Kansas Wildflower) at 75 to 81° F, 50 to 60% relative humidity, and constant light in the Department of Entomology at Kansas State University.

The experiments investigated the effect of three different growing media on western flower thrips pupae. The three different growing media (treatments) were: 1) Berger BM1 composed of 75 to 85% course sphagnum peat moss, perlite, vermiculite and a wetting agent; 2) Pro-Mix BX + Mycorrhizae (Premier Horticulture) composed of 75 to 85% Canadian sphagnum peat moss, perlite, vermiculite, dolomitic and calcitic limestone, wetting agent, and an arbuscular mycorrhizal fungus (Glomus intraradices); and 3) Pro-Mix BX + Biofungicide + Mycorrhizae (Premier Horticulture) composed of 75 to 85% Canadian sphagnum peat moss, perlite, vermiculite, dolomitic and calcitic limestone, wetting agent, a bacterium (Bacillus pumilus) and an arbuscular mycorrhizal fungus (Glomus intraradices).

The experiments were set up as a completely randomized design. There were three treatments (growing media) with five replications per treatment. The experiments were conducted in 2019 and repeated in 2020.

Using a soft-tipped camel hair brush, 20 western flower thrips pupae were transferred from the main colony into 473 mL (16 fl oz.) deli containers with approximately 400 mL (13.5 fl oz.) of moist growing medium. The treatments were prepared by mixing 1.6 L (0.42 gallons) of tap water into each growing medium, which were then moistened with an additional 40 mL (1.4 fl oz.) of tap water using a spray bottle before adding the western flower thrips pupae. The deli container lids were modified with insect screening [0.2 x 0.8 mm (0.007 x 0.031 inches): Greentek, Inc.] for ventilation and 12 holes were inserted in the bottom using a dissecting probe, which allowed for any excess liquid to drain or be reabsorbed by the growing medium. In addition, the holes prevented western flower thrips pupae from drowning or the growing medium from drying-out.

A 5 x 7.5 cm (2 x 3 inch) section of a yellow sticky card was hot glued to the lid of each deli container. Each deli container was placed into a plastic Petri dish [1.5 x 14 cm (0.6 x 5.5 inches)], maintained at 75 to 81° F and under constant light. The deli containers, with the plastic Petri dishes, were placed into 30 L (7.9 gallon) Sterilite containers (Sterilite Corp.) in groups of five (in accordance with each treatment) and the container lids [with six, 0.5 cm (0.19 inch) holes equally spaced] were replaced. After 21 days, each yellow sticky card section was inspected, and the number of western flower thrips adults captured was recorded. The use of the yellow sticky card was an indirect assessment of Western flower thrips pupal mortality.

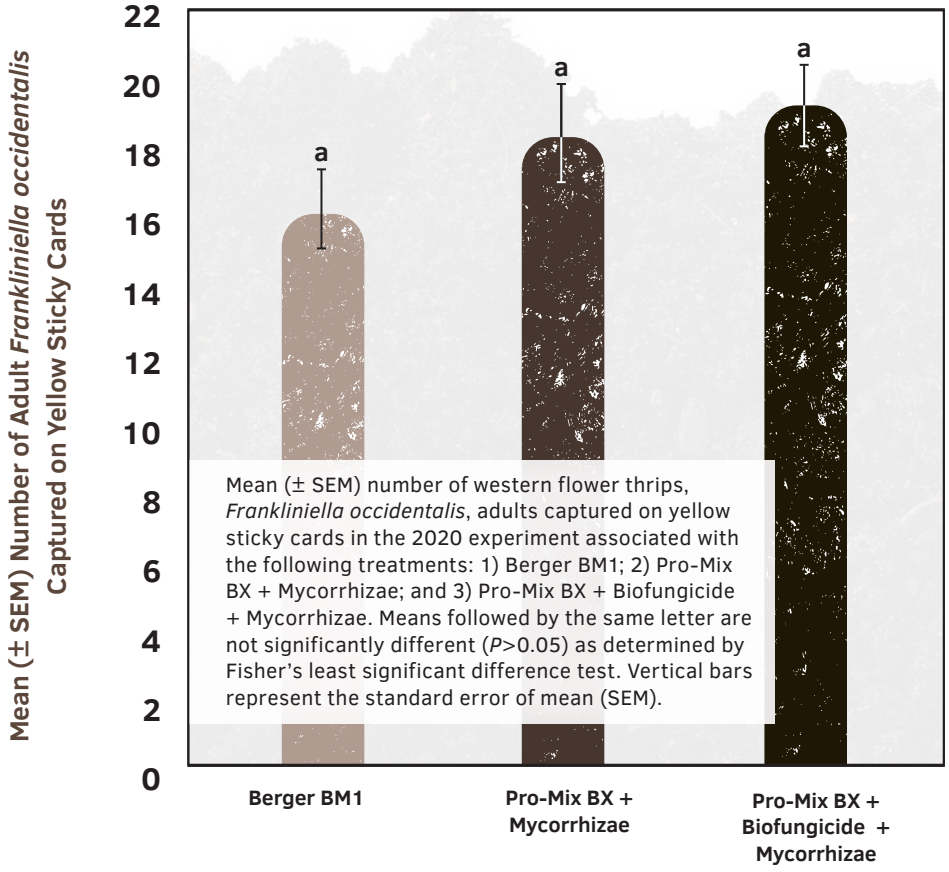
EXPERIMENT TWO: FUNGUS GNATS

Fungus gnat, *Bradysia* sp. nr. *coprophila*, larvae used in the experiments were maintained in 8 L (2.1 gallon) plastic containers with tight-sealing lids. Openings were cut in the lids [11.5 x 22.5 cm (4.5 x 8.8 inches)] with insect screening [0.2 x 0.8 mm (0.007 x 0.031 inches): Greentek, Inc.] hot glued to the lids to allow for ventilation. Using a 6 L (1.5 gallon) container, growing medium (Berger BM1) composed of 75 to 85% course sphagnum peat moss, perlite, and vermiculite was moistened with approximately 1.6 L (0.42 gallons) of tap water, pasteurized in a microwave (Panasonic Inverter: Panasonic Consumer Electronics) at 1,250 W for 20 minutes, and then cooled.

Two tubers [240 grams (8.4 oz.) each] of potato (*Solanum tuberosum*) were pureed into small particles, mixed with 125 mL (4.2 fl oz.) of tap water, using a food processor, and then uniformly mixed into the growing medium by hand. Approximately 3 L (0.79 gallons) of the growing medium and potato mixture were placed inside the 8 L (2.1 gallon) container. Sixty grams (2.1 oz.) of oats (*Avena sativa*) (The Quaker Oats Co.) were placed into two piles positioned in opposite corners of the container on the growing medium surface. The oats were initially moistened with 40 mL (1.3 fl oz.) of tap water using a 946 mL (31.9 fl oz.) plastic spray bottle.

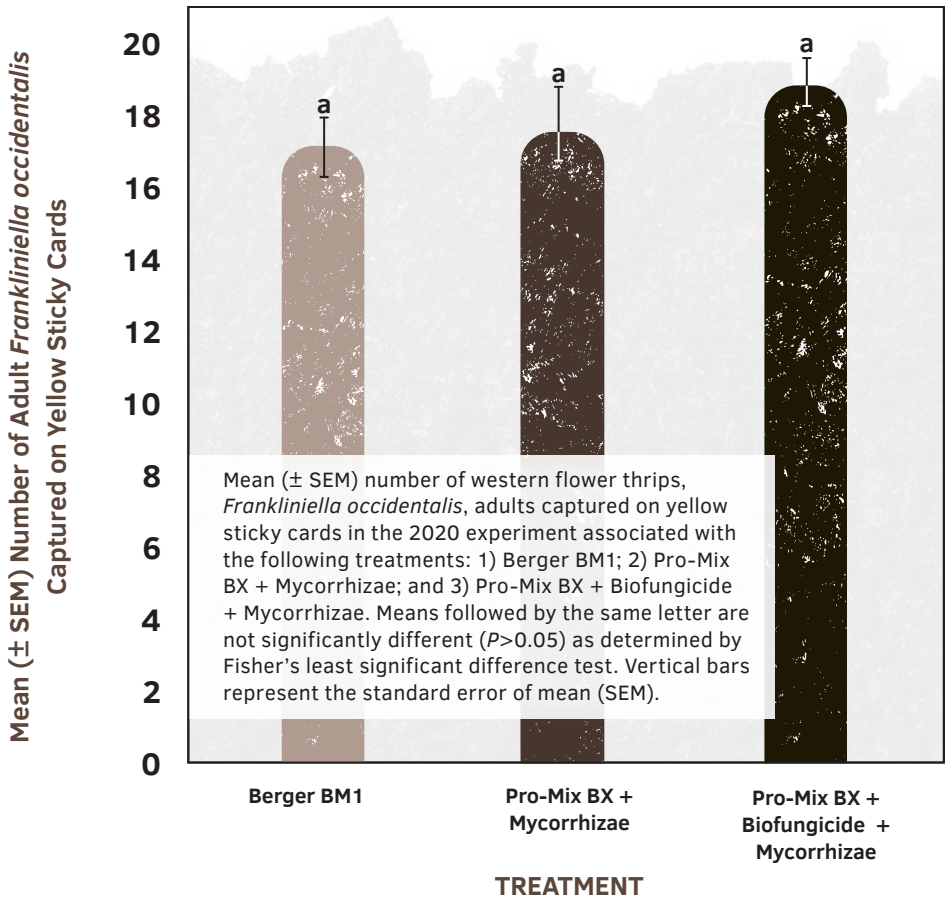
on Common GREENHOUSE PESTS

Figure 1.



Mean (± SEM) number of western flower thrips, *Frankliniella occidentalis*, adults captured on yellow sticky cards in the 2020 experiment associated with the following treatments: 1) Berger BM1; 2) Pro-Mix BX + Mycorrhizae; and 3) Pro-Mix BX + Biofungicide + Mycorrhizae. Means followed by the same letter are not significantly different ($P>0.05$) as determined by Fisher's least significant difference test. Vertical bars represent the standard error of mean (SEM).

Figure 2.



Mean (± SEM) number of western flower thrips, *Frankliniella occidentalis*, adults captured on yellow sticky cards in the 2020 experiment associated with the following treatments: 1) Berger BM1; 2) Pro-Mix BX + Mycorrhizae; and 3) Pro-Mix BX + Biofungicide + Mycorrhizae. Means followed by the same letter are not significantly different ($P>0.05$) as determined by Fisher's least significant difference test. Vertical bars represent the standard error of mean (SEM).

Afterward, the growing medium in the container was moistened daily. About 500 to 1,000 adult fungus gnats (± 4 days post-emergence) were aspirated into a 9 dram (33 mL or 1.1 fl oz.) plastic vial from the main colony and added to the container so that mated females could lay eggs. Fungus gnat adults were added to the container for two to three days. Colonies were maintained in a laboratory at 75 to 81° F, 50 to 60% relative humidity, and under constant light in the Department of Entomology at Kansas State University.

To isolate second and third instar fungus gnat larvae, a glass Petri dish (100 x 15 mm) was lined with 9 cm diameter P8 Fisherbrand filter paper (Fisher Scientific) and placed into a 750 mL (25.3 fl oz.) food storage container (Ziploc: SC Johnson). About 9.5 grams (0.33 oz.) of growing medium with pureed potato was placed on top of the filter paper and moistened with a spray bottle, avoiding any standing water. The lid was placed on the storage container and approximately 500 to 1,000 adults were collected from the main colony. The adults were released into the containers so mated females could lay eggs. After 11 days, second and early-third instar larvae were present for use in the experiments.

The effect of different growing media on second and early-third instar fungus gnat larvae was investigated in the experiments. The four different growing media (treatments) were: 1) Berger BM1 composed of 75 to 85% course sphagnum peat moss, perlite, vermiculite and a wetting agent; 2) Pro-Mix BX + Mycorrhizae composed of 75 to 85% Canadian sphagnum peat moss, perlite, vermiculite, dolomitic and calcitic limestone, wetting agent, and an arbuscular mycorrhizal fungus (*Glomus intraradices*); 3) Pro-Mix BX + Biofungicide + Mycorrhizae composed of 75 to 85% Canadian sphagnum peat moss, perlite, vermiculite, dolomitic and calcitic limestone, wetting agent, a bacterium (*Bacillus pumilus*), and arbuscular mycorrhizal fungus (*Glomus intraradices*); and 4) pasteurized Berger BM1 composed of 75 to 85% course sphagnum peat moss, perlite, vermiculite, wetting agent and pureed potato.

The pasteurized and pureed potato treatment was added to the fungus gnat experiment but not the western flower thrips experiment because western flower thrips pupae do not feed so no food source was needed. However, fungus gnat larvae do feed, so a treatment similar to our rearing conditions was needed to assess larval mortality with no food source. The experiment was set up as a completely randomized design. There were four treatments (growing media), including a control (pasteurized Berger BM1 + pureed potato), with five replications per treatment. The experiments were conducted in 2019 and repeated in 2020.

Using a glass pipette, 20 second to early-third instar fungus gnat larvae were placed into 473 mL (16 oz.) deli containers with approximately 300 mL (10.1 fl oz.) of moist growing medium. The control using pasteurized Berger BM1 with pureed potato was

Figure 3.

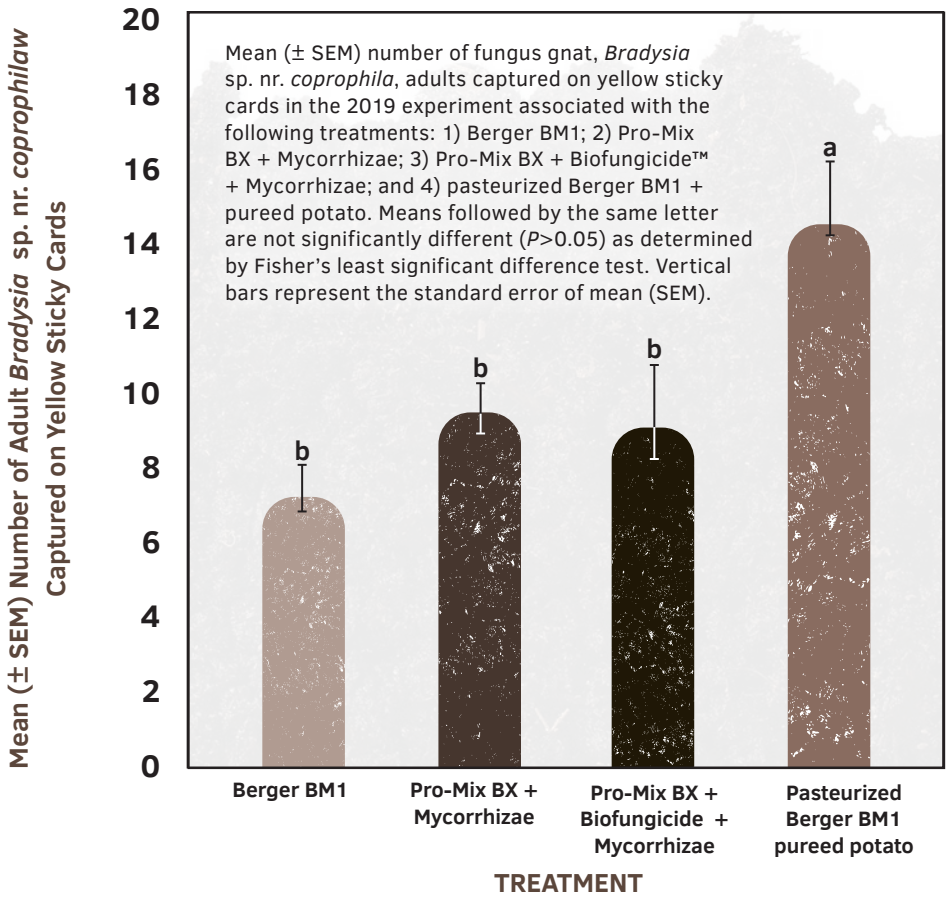
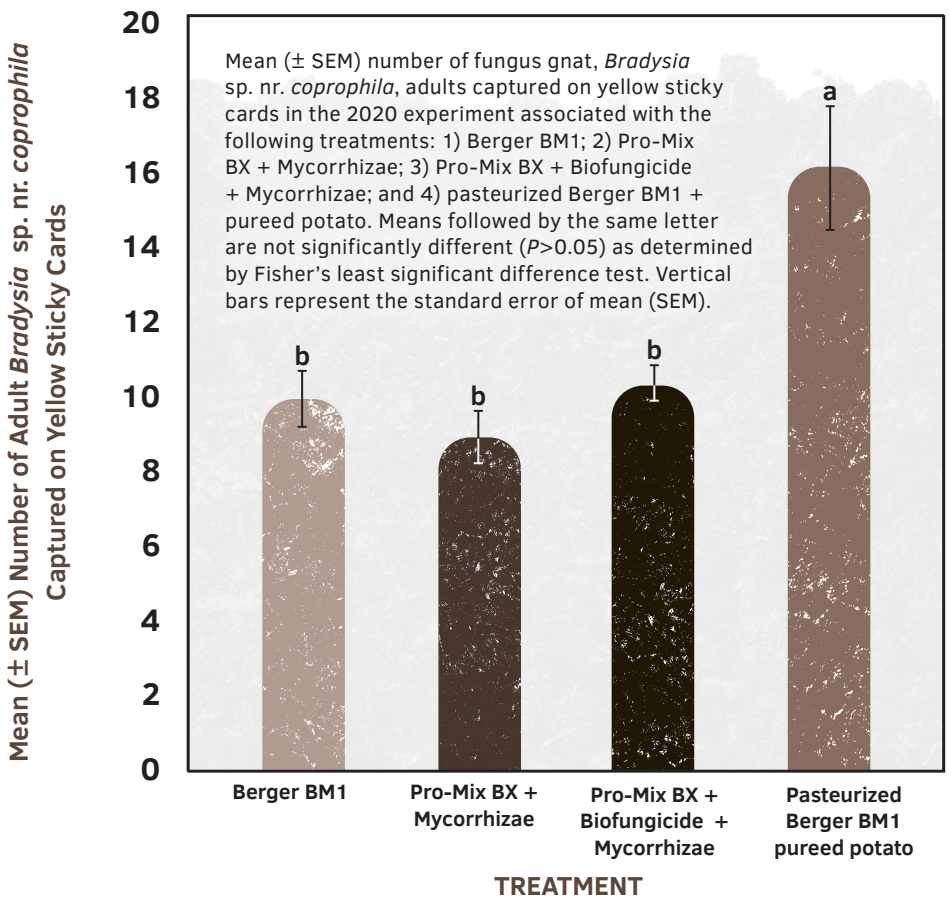


Figure 4.



prepared as described above. The remaining treatments were prepared by mixing 1.6 L (0.42 gallons) of tap water into the growing media, which were moistened with an additional 40 mL (1.4 fl oz.) of tap water using a plastic spray bottle before adding the fungus gnat larvae.

The deli container lids were modified with insect screening [0.2 x 0.8 mm (0.007 x 0.03 inches): Greentek Inc.] for ventilation and 12 holes were inserted in the bottom using a dissecting probe to allow for any excess liquid to drain or be reabsorbed by the growing medium. In addition, the holes prevented fungus gnat larvae from drowning or the growing medium from drying-out. A 5 x 4 cm (2 x 1.6 inch) section of a yellow sticky card was hot glued to the lid of each deli container. Each deli container was placed into a plastic Petri dish [1.5 x 14 cm (0.6 x 5.5 inches)], maintained at 24 to 75 to 81° F and under constant light.

The deli containers, with the plastic Petri dishes, were placed into 30 L (7.9 gallon) Sterilite containers in groups of five (in accordance with each treatment) and the container lids [with six, 0.5 cm (0.19 inch) holes equally spaced] were replaced. After 21 days, each yellow sticky card was inspected, and the number of fungus gnat adults captured was recorded. The use of the yellow sticky card was an indirect assessment of fungus gnat larval mortality.

DATA ANALYSIS

Data were analyzed using an analysis of variance (ANOVA, P=0.05) (SAS Institute, 2012) with treatment as the main effect. Individual treatment means were separated using Fisher's least significant difference test when the ANOVA indicated a significant treatment effect.

RESULTS AND DISCUSSION

There was no significant effect of the three growing media on the mean number of western flower thrips adults captured on the yellow sticky cards in 2019 (F=0.83; df=2, 6; P=0.46) (Figure 1) or 2020 (F=1.16; df=2, 6; P=0.36) (Figure 2). However, there was a significant treatment effect associated with the mean number of fungus gnat adults captured on the yellow sticky cards in 2019 (F=13.44; df=3, 7; P=0.0004) (Figure 3) and 2020 (F=9.25; df=3, 7; P=0.0019) (Figure 4), with more fungus gnat adults captured on the yellow sticky cards in the pasteurized Berger BM1 + pureed potato treatment. However, there were no significant differences in the mean number of fungus gnat adults captured on the yellow sticky cards among the Berger BM1, Pro-Mix BX + Mycorrhizae, and Pro-Mix BX + Biofungicide + Mycorrhizae treatments (Figures 3 and 4).

In conclusion, based on our results, none of the growing media tested that contained a bacterium and arbuscular mycorrhizal fungus had any effect on the survival of western flower thrips pupae or fungus gnat larvae. Greenhouse producers should always evaluate manufacturers' statements for accuracy before making product decisions and purchases for their growing operations. gpn

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