# POTENTIAL OF *BEAUVERIA BASSIANA* AND *PAECILOMYCES FUMOSOROSEUS* (DEUTEROMYCOTINA: HYPHOMYCETES) AS BIOLOGICAL CONTROL AGENTS OF *THRIPS PALMI* (THYSANOPTERA: THRIPIDAE)

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The melon thrips, *Thrips palmi* Karny, is one of the most important vegetable pests damaging pepper, eggplant, bean and cucurbits in South Florida. Eggs are laid in the leaf tissue. Life cycle consists of two aerial feeding stages and two subterranean non-feeding stages. Adults emerge from the soil and move to the leaves of the host plant (Walker 1992).

Literature on biological control of thrips is mostly about predators (Riudavets 1995) and parasitoids (Loomans et al. 1995). There have been only a few reports on the efficacy of entomopathogenic fungi. *Neozygites parvispora* (MacLeod & Carl) Rem. & Keel. (Saito et al. 1989) and *Verticillium lecanii* (Zimm.) Viégas (Saito 1992) have been documented infecting *T. palmi* in greenhouses in Japan. Also, an unidentified species of the genus *Hirsutella* Patouillard was found in Trinidad, British West Indies, infecting approximately 80% of *T. palmi* populations in the field (Hall 1992).

To determine the potential of *Beauveria bassiana* (Bals.) Vuill. and *Paecilomyces fumosoroseus* (Wize) as biological control agents of *T. palmi*, strains BbH and BbHa of *B. bassiana* and strain 97 of *P. fumosoroseus* (Table 1) were tested.

*Beauveria bassiana* and *P. fumosoroseus* inocula were cultured on Dodine medium (Oatmeal agar plus 0.8 g dodine and 0.2 g tetracycline) and grown on rice in an incubator at 26 ± 1°C, 75-85% RH and a photoperiod of 12:12 (L:D).

Green bean plants (*Phaseolus vulgaris* L. cv. Opus) were grown singly in pots in a greenhouse at 26 ± 2°C and 80 ± 5% RH. When plants had 3 to 4 leaves, they were inoculated with 50 *T. palmi* larvae taken from a laboratory colony.

TABLE 1. STRAIN ORIGIN OF *BEAUVERIA BASSIANA* AND *PAECILOMYCES FUMOSOROSEUS* TESTED ON *THRIPS PALMI*.

| Strains | Isolated from | Locality |
|---|---|---|
| *B. bassiana* BbH | *Cosmopoltes sordidus* Germ. (Coleoptera: Curculionidae) | Homestead, Florida |
| *B. bassiana* BbHa | *Bephrateloides cubensis* (Ashm.) (Hymenoptera: Eurytomidae) | Homestead, Florida |
| *P. fumosoroseus* 97 | Mealybugs (Homoptera: Pseudococcidae) | Apopka, Florida |

Four groups of 10 infested bean plants were tested. Three groups of plants were treated with the entomopathogenic fungi, each one with a different strain, by spraying one ml of conidial suspensions ($2.0 \times 10^8$ conidia per ml) on each plant. High conidial concentrations were used expecting a high mortality on *T. palmi*. Conidial suspensions were obtained by washing 100 g of rice with mycelium in 400 ml of sterile 0.05% Tween 80 water solution. One group of plants (control) was sprayed with sterile 0.05% Tween 80 water solution.

Plants were maintained in the same greenhouse and conditions for 24 h, then one leaf of each plant was placed in one 135 mm petri dish lined with moist filter paper. Plates were sealed with parafilm and incubated for 72 h at 26 ± 1°C and a photoperiod of 12:12 (L:D). Infection by the fungus was confirmed by microscopic examination of mycelium visible externally on the insect cuticle. Percent mortality was calculated. On the same days infected larvae on incubated leaves were counted, a sample of one leaf was taken from each plant in the greenhouse and checked for infected thrips larvae. Data were analyzed using Statistical Analysis System general linear models (SAS 1985) for balanced ANOVA. Means were separated by a Waller-Duncan k-ratio t-test.

No infected insects were found on the non-incubated leaves taken from the greenhouse. On the incubated leaves, *B. bassiana* BbHa caused the highest mortality but the percent of infected larvae was rather low (Table 2). It has been documented that a very high relative humidity (95%) is necessary for conidial germination of entomopathogenic fungi (Ramoska 1984, Walstad et al. 1970) and the average relative humidity in the greenhouse was below 85%. *P. fumosoroseus* 97 was not a good candidate for biological control of *T. palmi* because only a few insects (0.20%) were infected by the fungus.

Because *B. bassiana* BbHa was the strain that induced the highest mortality on the thrips in the previous experiment, it was further tested in the soil.

Bean plants were grown on PRO-MIX BX® (Les Tourbières Premier Ltée, Rivière-du-Loup, Québec, Canada) potting soil (75-85% Canadian Sphagnum Peat Moss, pH=6.5) in 49×34×5 cm plastic flats in a greenhouse (26 ± 2°C and 80 ± 5% RH) until 3 to 4 leaves developed. Plants were infested by placing bean leaves on top of them with *T. palmi* taken from a bean field in Homestead, Florida. Potting soil was infested with thrips pupae ten days later with plants that were cut and left to dry on the flats. The dried plants were removed from the flats 4 days later.

Eight flats taken at random were sprayed with 100 ml of a spore suspension ($3.1 \times 10^8$ spores per ml) obtained as described before, and eight flats also taken at random (control), were sprayed with 100 ml of sterile 0.05% Tween 80 water solution. Mean

TABLE 2. PERCENT MORTALITY OF *THRIPS PALMI* LARVAE TREATED WITH *BEAUVERIA BASSIANA* AND *PAECILOMYCES FUMOSOROSEUS*.

| Entomopathogens | % Mortality ± S.E[1] |
|---|---|
| *B. bassiana* BbHa | 24.23 ± 0.84 a |
| *B. bassiana* BbH | 12.90 ± 0.27 b |
| *P. fumosoroseus* 97 | 0.20 ± 0.02 c |
| Control | 0.00 ± 0.00 c |

[1]Means followed by the same letter are not significantly different according to a Waller-Duncan k-ratio t-test on arcsine transformed data ($p>0.001$, k-ratio=100). Untransformed means are presented.

temperature and relative saturation value of the soil (monitored daily) were 22.6 ± 2°C and 47.5 ± 3% RS, respectively.

Soil fungus concentration was determined 24 h after treatment by taking 5 g soil samples from each flat. Samples were suspended in 30 ml of sterile 0.05% Tween 80 water solution. Serial suspensions ($10^{-1}$ to $10^{-8}$) were plated on Dodine medium and incubated as in the previous experiment. The number of colony forming units (CFU) was determined after 6 days.

The effect of the pathogen on thrips survival was evaluated by placing one ground emergence trap (Peña & Duncan 1992) per flat and counting the number of emerging adults at 3, 4, 6, 9, and 12 days after treatment. Traps consisted of an opaque vinyl chloride pipe (20.5 cm diam, 15 cm high) covered with a transparent plastic plate coated with Tanglefoot® (The Tanglefoot Co.Grand Rapids, MI). New plates with Tanglefoot® were placed on top of the pipes after each counting. Means were separated using Statistical Analysis System t-test procedures (SAS 1985).

Concentration of the fungus in the potting soil 24 h after spraying was $1.2 \times 10^7$ CFU per ml. The number of adult thrips caught in the traps from sprayed flats was always significantly lower than in control flats (Table 3). Emerging adult thrips populations were 50.12%, 53.03% and 40.09% lower in the treated flats on the third, fourth and sixth days after spraying compared with the controls. Because all replicates were conducted concurrently under the same conditions, and flats were taken randomly, differences in adult emergence can be attributed to the action of *B. bassiana* BbHa in the soil.

This study shows that there may be potential for epizootics of *B. bassiana* in populations of *T. palmi* under certain conditions. *Beauveria bassiana* is a soil fungus and soil provides environmental conditions favorable to conidia (Gaugler et al. 1989). Because high aerial populations of the melon thrips are related to low rainfall periods (Etienne et al. 1990, Cooper 1991) and fungal pathogens need high relative humidity (Ramoska 1984, Walstad et al. 1970), the soil inhabiting pupal stage seems to be the most susceptible to fungal infection. However, much more information is needed to determine the impact of entomopathogens on pupal mortality, and on the frequency of pathogen inoculations to effectively reduce *T. palmi* populations in the field.

Thanks to R. M. Baranowski (Tropical Research and Education Center, University of Florida, Homestead, FL) and Roberto Pereira (Dept. of Entomology and Nematology, University of Florida) for reviews of the earlier version of this manuscript. This is Florida Agricultural Experiment Station Journal No. R-04892.

TABLE 3. CUMULATIVE NUMBER OF ADULT *THRIPS PALMI* EMERGED FROM FLATS TREATED WITH *BEAUVERIA BASSIANA* BBHA AND UNTREATED (CONTROL).

| | Emerged Adults ± S.E.[1] | | | |
|---|---|---|---|---|
| Days after Treatment | Treated with *B. bassiana* BbHa | Untreated (Control) | t-value (df =14) | Sig. level |
| 3 | 97.87 ± 15.81 | 196.25 ± 15.81 | 2.28 | P < 0.03 |
| 4 | 125.00 ± 20.15 | 266.50 ± 45.05 | 2.86 | P < 0.01 |
| 6 | 254.62 ± 41.35 | 431.37 ± 53.16 | 2.62 | P < 0.02 |
| 9 | 413.75 ± 48.14 | 587.75 ± 59.88 | 2.26 | P < 0.04 |
| 12 | 429.62 ± 47.64 | 612.62 ± 63.27 | 2.31 | P < 0.03 |

SUMMARY

The potential of *Beauveria bassiana* (strains BbH and BbHa) and *Paecilomyces fumosoroseus* (strain 97) as biological control agents of the melon thrips, *Thrips palmi*, was studied in greenhouse experiments. Twenty-four percent mortality was found on thrips larvae treated with *B. bassiana* BbHa but infection only developed when leaves with larvae were incubated after being sprayed with the pathogen. Mortality by *P. fumosoroseus* was very low (0.20%). A reduction of 50% in adult emergence was observed when potting soil with pupae was sprayed with *B. bassiana* BbHa.

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