Entomopathogenic Fungus, *Isaria fumosorosea*, and Aphid Parasitoid, *Lysiphlebus testaceipes*, -Managing Infestations of Brown Citrus Aphid, *Toxoptera citricida*

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In Florida, the continual use of broad-spectrum chemical insecticides has concerned growers in the citrus industry since "green" produce is viewed as healthier and more desirable to the consumer. Bio-insecticides, such as PFR 97 (*Isaria fumosoroseus* strain Apopka 97 [*Ifr*], [Fig. 1.5]) may offer an alternative to growers, and minimize ecological impact on non-target organisms (Opender et. al 2004). This study assessed *Ifr's* effects on *Lysiphlebus testaceipes* (Cresson) (Fig. 1.3), a non-target parasitoid of the citrus pest *Toxoptera citricida* (Kirkaldy), (Fig. 1.2).

MATERIALS & METHODS

- Four groups of citrus were labeled 1-4 (five carrizo citrus [25-30 cm tall] per group) for control (water only), *L. testaceipes* only, *Isaria fumosorosea* (*Ifr* only), and *L. testaceipes* plus *Ifr*, respectively, and kept in bugdorm cages (35 cm3) at 24±0.03 °C, 45±0.29 % RH, and 16L:8D hr photoperiod supplied by four 40W Philips full spectrum fluorescent tubes (Figure 1.1).
- Twice, aphids were added to each cage; the 1st set was added the same day as cage set up the 2nd set was added two weeks later (each time four adult alate aphids were added per plant).
- Two times, *L. testaceipes* adults were added to cages 2 & 4 the 1st set was added five days after the final aphid release the 2nd set was added one week later (each time two adult parasitoids were added)
- Prior to spraying *Ifr L. testaceipes* adults were removed
- *Isaria fumosorosea* was sprayed using a 180 ml sterile Nalgene® aerosol spray bottle (1 g PFR 97 20% WDG Certis [USA]/100 ml autoclaved de-ionized water).
- After the cage was sprayed *L. testaceipes* adults were replaced in their respective cages, and one additional adult was added to each plant.
- Data was recorded for the numbers of aphids, mummies, emerged parasitoids (mummies with holes) and dead aphids in each cage every day (except weekends) for 22 days.
- This experiment was conducted twice. (experiments 1 & 2)

Figure 1.1
From left to right cages 1-4; citrus aphids treatments control (water only), *Lysiphlebus testaceipes* only, *Isaria fumosorosea* (*Ifr* only), and *L. testaceipes* plus *Ifr*, respectively

Figure 1.2
A brown citrus aphid infestation on Carrizo Citrus

Figure 1.3
A *Lysiphlebus testaceipes* adult

Figure 1.4
A brown citrus aphid (mummy) killed by a now adult (emerged) L*ysiphlebus testaceipes* larva

Figure 1.5
***Isaria fumosorosea* infection on an adult apterous aphid**

RESULTS

- The fungal treatment did not have an apparent negative influence on parasitism rates even though in experiment one, significantly more aphids were successfully parasitized in the fungus-treated cage than in the non-fungus-treated cage this is considered a positive not a negative influence; however, in experiment 2 these numbers were not significantly different (figs. 2.1 & 2.2).
- No significant difference was observed in the emergence rate between mummies in the presence of fungus and the non fungus treatment (figs 2.3 & 2.4).
- Toxoptera citricida mortality rates were significantly higher in both parasitoid treatments, often nearly 100%, indicating *L. testaceipes* is a highly effective aphid BioControl agent even in the presence of *Ifr*.

DISSCUSSION

- *Isaria fumosorosea* and *L. testaceipes* were shown to be compatible biological control agents against *T. citricida*. The use of PFR 97 20% WDG will not likely interrupt the efficient naturally occurring control of *T. citricida* by *L. testaceipes*, and should be able to be used in citrus production without concern towards *L. testaceipes* (a big plus for citrus growers). These findings with *L. testaceipes* open new avenues for future IPM compatibility research.
- Although *Ifr* was a disappointingly ineffective manager of *T. citricida* during these experiments, an ~10 viable blastospores per mm were deposited by the sprayer, and *Ifr* was detected in treatments 3 & 4 up until the last day. This study did not endeavor to evaluate the efficacy of *Ifr* on *T. citricida* since this has been done (Poprawski et. al 1999). One potential explanation for *Ifr*'s limited effectiveness against *T. citricida* in this study is that dead aphids do not stay on their host plant. They fall off taking the *Ifr* inoculum with them, potentially slowing down would be epizootics. In which case, having another highly mobile insect such as *L. testaceipes* inoculating *T. citricida* individuals with *Ifr* might increase *Ifr*'s effectiveness. In fact, a higher mortality rate in treatment 4 (*Ifr* with *L. testaceipes*) was often observed. Under these considerations, the use of PFR 97 20% WDG may offer a greener alternative to citrus growers, and minimize ecological impact on non-target organisms.

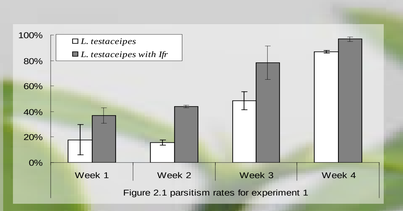

Figure 2.1 parsitism rates for experiment 1

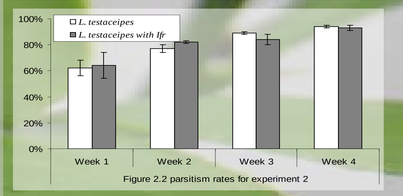

Figure 2.2 parsitism rates for experiment 2

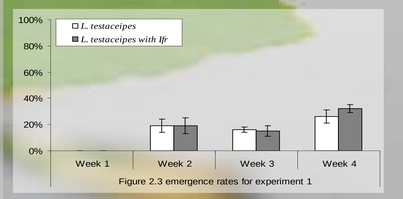

Figure 2.3 emergence rates for experiment 1

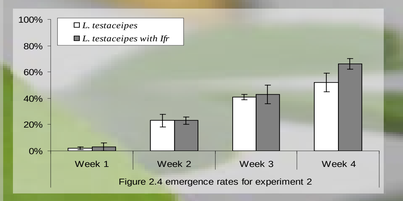

Figure 2.4 emergence rates for experiment 2

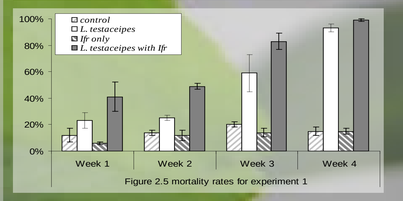

Figure 2.5 mortality rates for experiment 1

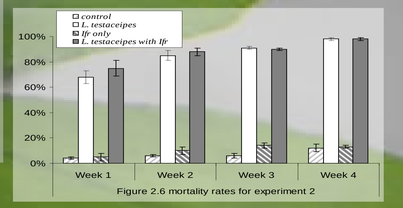

Figure 2.6 mortality rates for experiment 2

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Poprawski, T.J., Parker, P.E. & Tsai, J.H. (1999) Laboratory and Field evaluation of hyphomycete insect pathogenic fungi for control of brown citrus aphid (Homoptera:Aphididae). Environmental Entomology 28, 315-321.

Photo Credits:

Background, Figs. 1.3-1.5: David A. Pick; Figs. 1.1-1.2: Christine Lynch

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