ENTOMOPATHOGENIC FUNGI FOR CONTROL OF APHIDS AND LYGUS IN CALIFORNIA

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Abstract

Cotton aphid and western tarnished plant bug (WTPB) are the two most damaging pests in California cotton. *Neozygites fresenii*, a fungus common in Arkansas was released for biological control of aphids. Unfortunately, aphid populations in the release field were very low and the fungus did not establish. In addition, *Beauveria bassiana* was found infecting up to 65% of WTPB in alfalfa fields in the San Joaquin Valley (SJV). *B. bassiana* is a common entomopathogenic fungus but has not been previously reported from California populations of WTPB. This fungus is now being cultured and examined for potential use as a biological control agent.

Introduction

Aphis gossypii, the cotton aphid and *Lygus hesperus*, the western tarnished plant bug (WTPB) are the two most damaging insect pests in the San Joaquin Valley (SJV) growing area of California cotton. Estimates of loss due to WTPB and cotton aphid approach $30 million per year. Current control recommendations for WTPB call for application of broad-spectrum pesticides early and in the middle of the season as WTPB moves into cotton fields. These applications also affect natural enemies, which normally keep aphid, spider mite and caterpillar populations in check. Without the natural enemy complex, aphid populations can flare later in the season requiring further chemical applications. The purpose of this study was to determine if entomopathogenic fungi may play a role in regulating pest numbers.

Neozygites fresenii is a fungus specific to cotton aphid and is found commonly infecting aphids in the southeastern U.S. (Steinkraus et al. 1991). At times, epizootics can devastate aphid populations and eliminate the need for pesticide applications (Steinkraus et al. 1995). We wanted to determine if *N. fresenii* could be introduced into SJV populations of cotton aphid.

No published reports exist documenting naturally occurring fungi in SJV populations of WTPB. However, Noma and Strickler (1999) reported that commercial strains of *Beauveria bassiana* would infect *L. hesperus*. In addition, Steinkraus and Tugwell (1997) reported *L. lineolaris* naturally infected with *B. bassiana* in Arkansas. We wanted to determine if fungi were present in SJV populations of WTPB.

Material and Methods

Cotton Aphid

Three plots of cotton were established and irrigated with one of three procedures; furrow irrigation, overhead sprinkler, and no irrigation. Plots were sprayed with Warrior T to eliminate natural enemies to encourage aphid populations to build. In addition, plots were seeded with aphids from other fields. Three days before fungal release, irrigation was applied. Leaves with at least 20 aphids present were tagged with flagging tape and releases were made to each of five leaves per irrigation treatment per release method (Sept 18, 2000). Two methods of fungus release were made into each plot. Fungal infected, dried aphid cadavers, sent from AR (Steinkraus et al. 1993) were applied to the underside of misted leaves. Laboratory inoculated, live aphids were applied to other leaves by clipping the greenhouse leaf containing the infected aphids to the release leaf. In addition, five leaves in each irrigation plot were left untreated. Seven days after release, a leaf below each release leaf was examined for dead aphids. Four days later, the release leaf and a neighboring leaf were collected and the live and dead aphids counted.

WTPB

On Nov 21, 2000, WTPB were collected from alfalfa fields in the southern SJV. One hundred adults from each of five fields were held individually on beans in small glass vials. As individuals died, they were moved to water agar and observed for fungal development.

Results and Discussion

Cotton Aphid

Despite our efforts to establish large populations of aphids in the plots, densities continued to decline after fungal release making evaluations difficult. Entomopathogenic fungi typically need very high humidity or free moisture to sporulate and infect insects; hence the trials with different irrigation regimes. However, neither irrigation ($F=1.4$; $df=2, 36$; $P=0.26$) nor release method ($F=2.8$; $df=2, 36$; $P=0.70$) had an effect on the number of dead aphids observed 7 days after release (Table 1). By day 11 after release, populations had crashed in all plots, including the controls and analyses were meaningless, biologically. The one exception was in the plot with no irrigation receiving cadavers, where populations remained high on the release leaf. Attempts at releasing *N. fresenii* into California populations of cotton aphids had been made previously but without successful establishment (K.G. unpublished). Future attempts will be made to release the fungus into cotton, around irrigation scheduling, as well as into cotton aphid overwintering habitats in efforts to establish, permanently, this potentially effective biological control.

WTPB

WTPB adults began succumbing to *B. bassiana* within three days of collection. (Figure 1). Adults died through day 14 when the experiment was terminated. It is unlikely horizontal transmission occurred after collection because adults were held separately in vials. In every field sampled, *L. hesperus* adults were found infected with *B. bassiana* (Table 2). In one field, 65% of the individuals were infected. We have recently isolated the strains and have initiated studies to determine infectivity, growth parameters, heat tolerance and other characteristics essential to successful development of this pathogen. The potential of developing an effective microbial pesticide isolated from *L. hesperus* and from a hot dry climate should be enhanced.

Acknowledgments

The authors thank D. Ballard and N. Hudson for technical assistance and R. Humber for confirmation of *B. bassiana* in WTPB.

References

Noma, T. and K. Strickler. 1999. Factors affecting *Beauveria bassiana* for control of Lygus bug (Hemiptera: Miridae) in alfalfa seed fields. J. Agric. Urban Entomol. 16:215-233.

Steinkraus, D. C., T. J. Kring, and N. P. Tugwell. 1991. *Neozygites fresenii* in *Aphis gossypii* on cotton. Southwestern Entomol. 16:118-122.

Steinkraus, D. C., G. O. Boys, and P. H. Slaymaker. 1993. Culture, storage, and incubation period of *Neozygites fresenii* (Entomophthorales:

Reprinted from the *Proceedings of the Beltwide Cotton Conference*
Volume 2:960-961 (2001)
National Cotton Council, Memphis TN

Neozygitaceae) a pathogen of the cotton aphid. Southwestern Entomol. 18:197-202.

Steinkraus, D. C., R. G. Hollingsworth, and P. H. Slaymaker. 1995. Prevalence of *Neozygites fresenii* (Entomophthorales: Neozygitaceae) on cotton aphids (Homoptera: Aphididae) in Arkansas cotton. Environ. Entomol. 24:465-474.

Steinkraus, D. C. and N. P. Tugwell. 1997. *Beauveria bassiana* (Deuteromycotina: Moniliales) effects on *Lygus lineolaris* (Hemiptera: Miridae). J. Entomol. Sci. 32:79-90.

Table 1: Average number (n=5) of aphids on cotton leaves.

Release method	Irrigation method	Dead 7 d post appl	Dead 11 d post appl	Live on release leaf 11 d post release	Live on neigh-boring leaf 11 d post appl
Cadavers	Furrow	1.4	0.2	0.4	2
Inoculated	Furrow	2	0.3	0.5	3.8
Control	Furrow	0.8	0.8	1	2.8
Cadavers	None	0.8	1.8	17	3.6
Inoculated	None	1.8	0	4.2	8.8
Control	None	0	0.2	1.2	1.6
Cadavers	Sprinkler	1	0.8	0.5	2.6
Inoculated	Sprinkler	0.4	0	0.8	3.2
Control	Sprinkler	0.2	0	0.3	2.8

Table 2: Percentage infection of WTPB by *B. bassiana* in each of five alfalfa fields.

Field	Percentage Infection
1	2
2	19
3	65
4	15
5	13

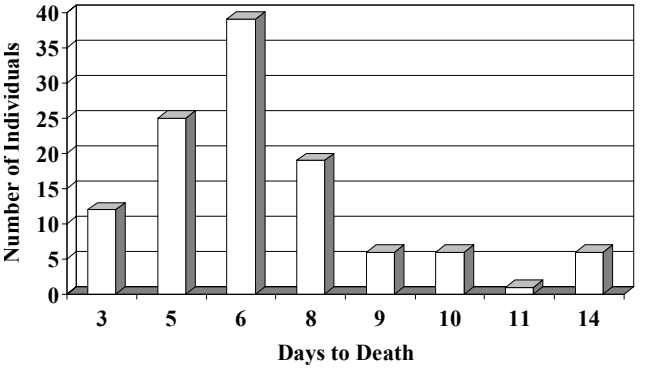

Figure 1: Number of days after collection, WTPB succumbed to *B. bassiana* infection (all fields combined).