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FIELD TRIALS OF BEAUVERIA BASSIANA AGAINST LYGUS SPP. IN CALIFORNIA AND MISSISSIPPI

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Abstract

Lygus hesperus and *L. lineolaris* are particularly devastating pests of cotton in the western and midsouthern US respectively. The fungal entomopathogen *Beauveria bassiana* infects and kills both Lygus species and new isolates of the fungus discovered in California and Mississippi were tested under field conditions for their effectiveness in infecting and controlling populations of Lygus. The commercial isolate, GHA was also tested. All three isolates could infect large percentages of Lygus in the field. However, populations of both species were not reduced as infection levels would have predicted. Infection levels were reduced as the application rate of conidia was reduced but infections were still > 50% at the lowest dose tested.

Introduction

Lygus hesperus is a long time pest of cotton in the Western US and controls consist of broad spectrum chemical pesticides. *L. lineolaris* is a pest of cotton in the Midsouth US but the problem has arisen more recently as Bt cotton and boll weevil eradication have reduced pesticide applications that were keeping *L. lineolaris* at low levels. Lygus has emerged to be a primary pest across the cotton belt now and efforts have been established to discover new chemistries and other controls that are more selective than existing broad spectrum control methods. Previous research (Steinkraus and Tugwell 1997) suggested the entomopathogenic fungus *Beauveria bassiana* could infect and kill *L. lineolaris* and more recent research reported by McGuire et al. (2005) and Leland et al. (2005) identified new isolates with better tolerance to higher temperatures and better insecticidal activity. Herein, we report the field effectiveness of three isolates of *B. bassiana*, one from Mississippi, one from California, and the commercial isolate, against both *L. hesperus* in California and *L. lineolaris* in Mississippi.

Methods and Materials

Three types of tests were conducted to determine if the three isolates of *B. bassiana* could infect and impact populations of Lygus species. All three tests depended on the same type of sampling. Basically, populations of Lygus were estimated by taking a known number of sweep samples in a given area or plot using standard procedures. Infection levels were obtained by collecting live Lygus adults and holding them individually in the laboratory for up to 10 days to observe infections.

The first test examined the impact of *B. bassiana* applied to alfalfa neighboring cotton on movement of *L. hesperus* to cotton following alfalfa harvest. Conidia were applied to alfalfa and 3 days later the alfalfa was mowed. Lygus were sampled in the alfalfa one day before application to determine baseline populations and percentage infections and then 3 (just before harvest), 7, 10 and 14 days after application. Lygus were sampled in both the alfalfa plots and in plots of cotton on either side of the treated alfalfa. Only the commercial isolate, GHA was applied to the alfalfa at the rate of $1x10^{13}$ conidia per ha in 0.05% Silwet L-77. In addition, another plot was treated with just Silwet L-77. Applications were made in June, 2005.

The second test examined the impact of the three different isolates of *B. bassiana* on percentage infection and populations of *L. hesperus* in California and *L. lineolaris* in Mississippi. In California, the three isolates were applied to replicated alfalfa plots at 5×10^{12} conidia per ha and populations were sampled at –1, 3, 7, 10, and 14 days after application. In Mississippi, applications were made to replicated pigweed plots at 2.5×10^{13} conidia per ha and populations were sampled at 2, 7 and 12 days after application.

The third test determined the impact of different application rates of conidia on percentage infection of *L. hesperus* in California alfalfa and *L. lineolaris* on Mississippi radish. In California, applications of all three isolates were

made at $2.5x10^{13}$ and $1x10^{13}$ conidia per ha in 2004 and at $5x10^{12}$ conidia per ha in 2005. Populations were sampled for infection at 3 days after application because previous test had shown that infection rates dropped quickly after the three-day sample was obtained. In Mississippi, applications of the Mississippi isolate were made at 1.3, 0.63, and $0.31x10^{13}$ conidia per ha and an application of GHA was made at $0.63x10^{13}$ conidia per ha. Populations were sampled two days after application only for percentage infection.

For further details on the application and sampling procedures see McGuire et al. (in press) or contact the authors directly.

Results and Discussion

Effect of *B. bassiana* on movement of *L. hesperus*: Populations of *L. hesperus* were consistently low in cotton, even after alfalfa harvest and no differences in populations were observed among plots. However, we did collect *L. hesperus* that were infected with GHA in cotton plots sampled after alfalfa harvest (Figure 1). More than 20% of the adults collected 7 days after application succumbed to infection suggesting that infected *L. hesperus* can move and potentially spread *B. bassiana* to other locations.

Effect of isolate on populations of Lygus: In California, populations were not significantly reduced in plots treated with any isolate of *B. bassiana* at 5E12 conidia/ha compared with populations in control plots (Table 1). However, infection levels of adults collected from plots three days after application of fungus exceeded 50% and there was no significant difference among plots (Table 2). In Mississippi, data were very similar; fungus did not impact adult *L. lineolaris* populations compared with control (Table 3) and percentage infection of adults collected 2 days after application exceeded 50% (Table 4). In Mississippi, however, the Mississippi isolate infected a higher percentage of adults than the commercial isolate. These data were somewhat confounding in that with more than 50% infection, we would expect the populations to show similar declines. Possible explanations include 1) the infection cycle is not being completed and Lygus are surviving in the field (due to behavioral fever), 2) recruitment of nymphal populations (nymphs are less susceptible than adults), 3) movement across plot boundaries is occurring and 4) variability in populations and emigration from plots confounds population estimates (particularly in wild hosts). Any of the three explanations could explain the lack of reduction of adult population estimates. Further laboratory and field work is in progress to sort out these possibilities.

Table 1: Effect of different *B. bassiana* isolates on populations of *L. hesperus* in alfalfa.
Adults per 20 sweeps (average of four replicates)

Days PA	Control	GHA	CA	MS
-1	4.8	3.5	8.75	8.5
3	4	6	6.5	11.5
7	4.3	2	4.3	3
10	14	11.5	22.2	13
14	22.5	24.5	28.5	29

Table 2: Effect of different *B. bassiana* isolates on percentage infection of *L. hesperus* (average of four replicates)

Days PA	Control	GHA	CA	MS
-1	4	4	3	1
3	23	53	50	66
7	10	31	19	24
10	6	13	6	5
14	6	5	7	4

Table 3: Effect of different *B. bassiana* isolates on populations of *L. lineolaris* in pigweed.
Adults per 25 sweeps (average of four replicates)

Days PA	Control	GHA	CA	MS

2	41	39	40	58
7	24	22	22	13
12	12	9	13	11

Table 4: Effect of different *B. bassiana* isolates on percentage infection of *L. lineolaris* (average of four replicates)

Days PA	Control	GHA	CA	MS
-1	2	0	0	0
2	11	57	61	71
7	4	16	23	11
12	0	3	4	6

Effect of conidia application rate on infection of Lygus spp.: In Mississippi, the rate of application of conidia affected the percentage infection of *L. lineolaris*. As dose was reduced, percentage infection was also reduced (Table 5). In California, all three isolates showed similar results. As application rate declined, percentage infection of *L. hesperus* also declined (Table 6). An important observation, however is that the reduction of percentage infection was not as great as the reduction of conidia; i.e. almost a log dose reduction in conidia application was tested but the reduction in infection of adults was less than half.

Table 5: Effect of application rate on percentage infection of *L. lineolaris.* Average of four replicates

Dose ($x10^{13}$) Conidia/ha	MS	GHA
1.3	56	
0.63	38	32
0.31	29	

Table 6: Effect of application rate on percentage infection of *L. hesperus.* Average of four replicates.

Dose ($x10^{13}$) Conidia/ha	GHA	CA	MS
2.5	81	83	93
1	71	71	71
0.5	52	50	66

Conclusions

Applications of *B. bassiana* can infect a high percentage of Lygus spp. Infection rates are somewhat dose dependent. Beneficial insects are not highly susceptible (data not shown). Populations of Lygus spp. do not respond according to percentage infection levels.

References

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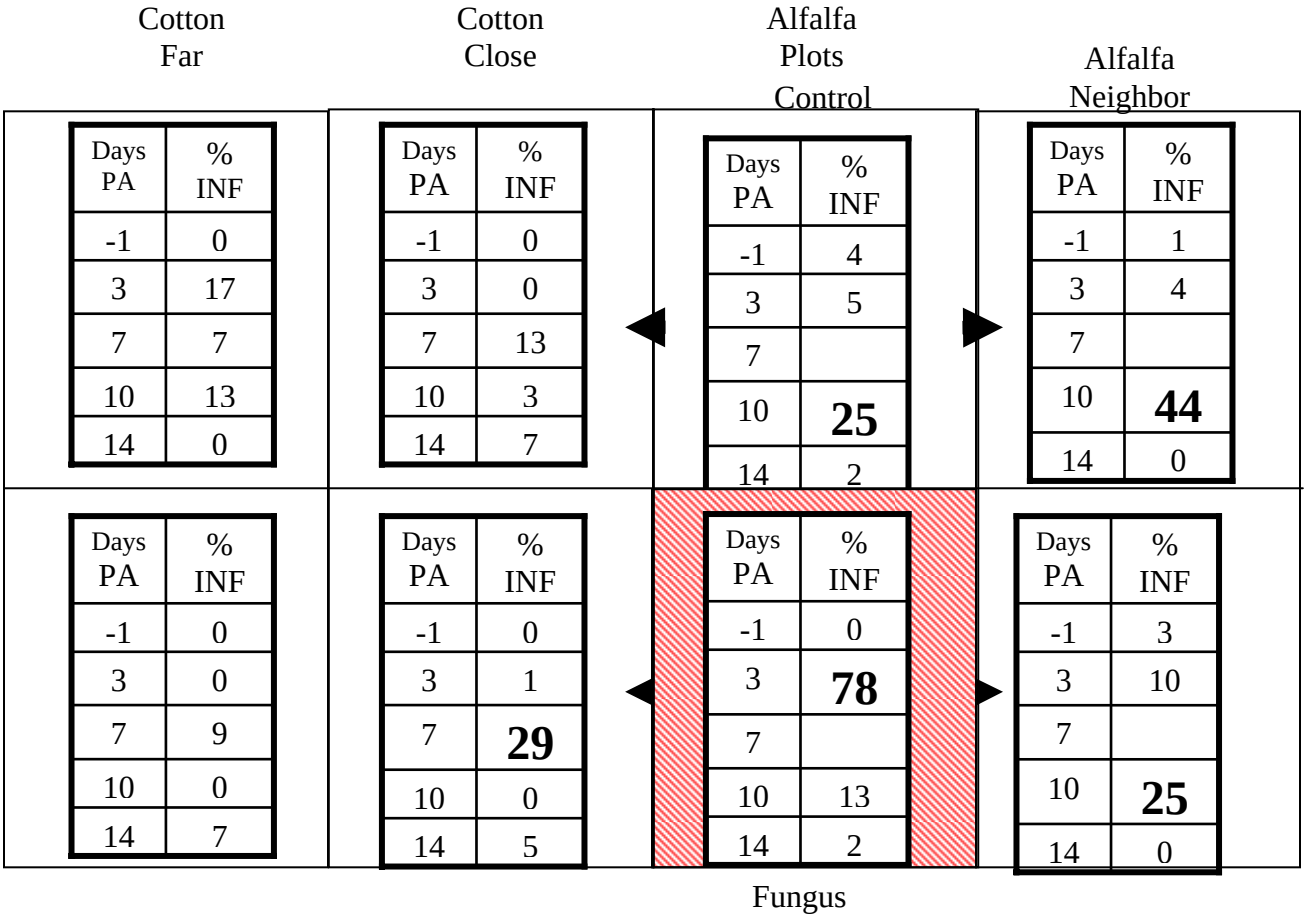

Figure 1. Percentage infection of *Lygus hesperus* collected before (-1) and after application of *Beauveria bassiana*. All alfalfa was cut 3 days after application and insects were collected in neighboring plots of alfalfa or cotton and held for development of infection (average of four reps)