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IMPACT OF NATURALLY OCCURRING *BEAUVERIA BASSIANA* ON *LYGUS HESPERUS* POPULATIONS

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Abstract

Surveys throughout the San Joaquin Valley of California revealed the presence of the entomopathogenic fungus *Beauveria bassiana* in *Lygus hesperus* populations. The fungus occurred in all counties sampled and at virtually all times of the year Lygus was present. In some samples more than 50% of the population was infected. In addition to the Valley-wide surveys, several fields were monitored weekly for Lygus population size and *B. bassiana* prevalence. Weak correlations occurred between population size and percentage infection and between time of year and infection levels. Again, in some samples, percentage infection exceeded 50% of the Lygus population.

Introduction

The Western tarnished plant bug, *Lygus hesperus* is one of the most damaging pests of cotton in the San Joaquin Valley (SJV) of California. Current methods of control rely on synthetic chemical pesticides that may also reduce natural enemy populations thus leading to other pests building up later in the season. Parasites of Lygus are rare in the SJVbut previous reports in the literature (Dunn & Mechalas 1963, Noma & Strickler, 1999, 2000) suggest the entomopathogenic fungus *Beauveria bassiana* is capable of infecting *L. hesperus*. Although field trials were basically ineffective, the strain of *B. bassiana* used was not isolated from *L. hesperus* nor was it isolated from the environment where Lygus occurs. Our efforts, therefore have focused on finding isolates of *B. bassiana* from *L. hesperus* from the SJV that may be particularly adapted to the environment and host. To begin these studies it is important to know the prevalence of *B. bassiana* in the SJV and whether it is impacting *L. hesperus* populations.

Materials and Methods

Distribution and Prevalence of *B. bassiana* in *Lygus spp*. Populations

Kern, Fresno, Merced, Madera, Kings, and Tulare counties in the San Joaquin Valley (SJV) were selected for sampling. At least four fields in each of these counties were sampled three times from April through September, 2001. Samples were typically taken in alfalfa fields, though the early spring samples consisted of roadside vegetation (mostly brassicaceous weeds) because *Lygus spp*. were not yet present in the alfalfa. At each site, Lygus populations were estimated using a 50 sweep sample count. Then efforts were made to collect 50 nymphs and 50 adults which were subsequently held individually on beans in the lab for up to two weeks. B. bassiana presence was noted by the characteristic outgrowth of fungus after insect death.

Impact of *B. bassiana* on *L. hesperus* Populations

Alfalfa fields in Kern Co, California were chosen for weekly sampling. In 2001, 6 fields were sampled; three first year fields (# 5, 44, 55), one second year field (#56) and two third year fields (#3, 54). In 2002, four fields were chosen including one (#101) first year, two (#44, 102) second year and one (#103) third year fields. One of the second year fields (#44) was the same field as a first year field from the 2001 samples, otherwise, all fields were different. Field 44 was strip cut (i.e., only half the field was harvested every two weeks); all other fields were entirely harvested at approximately monthly intervals. At weekly intervals, each field was sampled as above for density estimation and for fungus prevalence. Results were analyzed by analysis of variance and means among fields were separated by protected least significant difference (Statistix). Contrasts were used to determine differences among fields of different ages. In addition, linear regression analysis was done to determine if percentage infection was related to population density.

Results

Distribution and Prevalence of *B. bassiana* in *Lygus spp*. Populations

B. bassiana was present in every county sampled and, with the exception of one county, *B. bassiana* was present at all sampling times (Table 1). Prevalence of *B. bassiana* ranged from 0% in several fields across all counties up to 50% in one field in Tulare county from a fall sample. In most instances, infection levels were highest in the fall and *L. hesperus* populations were typically higher in the fall as well. Across all counties, populations of *L. hesperus* averaged 5.2, 14.5, and 13.3 per 50 sweeps for the spring summer and fall samples respectively. Percentage infection of nymphs and adults combined averaged 2.4, 3.0, and 6.7 for the three sampling periods. Typically, collected individuals succumbed to *B. bassiana* within 3-7 days but some infected individuals survived more than 10 days. No other pathogens or parasites were observed in any of the samples.

Impact of *B. bassiana* on *L. hesperus* Populations

In 2001, significant differences occurred among fields with respect to population size and percentage infection (Figure 1). Statistical contrast tests suggested that fields in their third year of production had higher percentage infection (9.45%) than first year fields (5.1%) (T=2.65, P=0.0089). Similarly, the field in its second year of production had higher prevalence of *B. bassiana* (13.41%) than the first year fields (T=4.41, P<0.001). However, the second year field also had higher prevalence of *B. bassiana* than the third year fields (T=2.18, P=0.031). Although significant differences in population size were observed among fields, no significant differences occurred with respect to years in production (T=0.33, 1.49, and 1.16 for first vs third, first vs second and second vs third, respectively). A significant linear regression existed between population size and percentage infection (F=10.77; df=1,141; P=0.0013) but the amount of variation explained by the regression model was low (r^2=0.07). A significant (F=7.33; df=1,141; P=0.008) but weak (r^2=0.04) linear relationship also existed between collection date and population size but no such relationship existed between date and percentage infection (F=3.41; df=1,141; P=0.07; r^2=0.02)

In 2002 (Figure 2), there were no significant differences among fields with respect to average population density (F=1.46; df=3,71; P=0.23) nor percentage infection (F=1.27; df=3,71; P=0.29). Similarly, there was only a very weak linear regression between density and percentage infection (F=3.81; df=1,73; P=0.55; r^2=0.05). However, when regressed against collection date, there was a significant linear relationship for percentage infection (F=19.00; df=1,73; P<0.001) and the model explained 21% of the variation. These results suggest a buildup of pathogen through the season. No such relationship existed for population density (F=0.59; df=1,73; P=0.45).

Discussion

These results suggest that *B. bassiana* is prevalent throughout the SJV and, at times may be an important natural mortality factor. Also important is the prevalence of the fungus during the hot conditions commonly found in the SJV during the summer months. Steinkraus and Tugwell (1997) demonstrated that an isolate of *B. bassiana* from *L. lineolaris* was more effective than the commercial isolate in field tests suggesting that isolates may be specifically adapted to host and/or environment. Future work will focus on developing SJV isolates into practical control agents.

References

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Table 1. Prevalence of *Beauveria bassiana* in *Lygus spp*. populations throughout the San Joaquin Valley, CA, 2001.

County	Season[1]	# Fields Sampled	Avg. No. *Lygus*/50 sweeps	Average Percentage Infection	
				Adults	Nymphs[2]
Kern	Spring	16	6.8	1.5	0.0
	Summer	8	10.9	2.8	2.6
	Fall	3	18.0	2.7	8.3
Fresno	Spring	13	5.1	4.7	N/A
	Summer	8	17.1	4.2	0.0
	Fall	4	20.0	14.0	0.0
Kings	Spring	11	8.2	2.0	0.0
	Summer	8	6.4	3.8	10.1
	Fall	4	12.7	8.3	0.0
Madera	Spring	5	1.8	0.0	N/A
	Summer	8	17.1	3.2	1.2
	Fall	4	6.2	8.0	0.0
Merced	Spring	10	3.4	10.0	N/A
	Summer	8	27.2	1.5	1.6
	Fall	5	10.6	5.2	3.4
Tulare	Spring	11	6.0	0.9	N/A
	Summer	10	8.3	5.6	0.0
	Fall	4	12.5	20.0	10.2

[1]Spring samples were taken in March and April; Summer samples were taken in June and July; Fall samples were taken in October.
[2]N/A No nymphs were present in the fields.

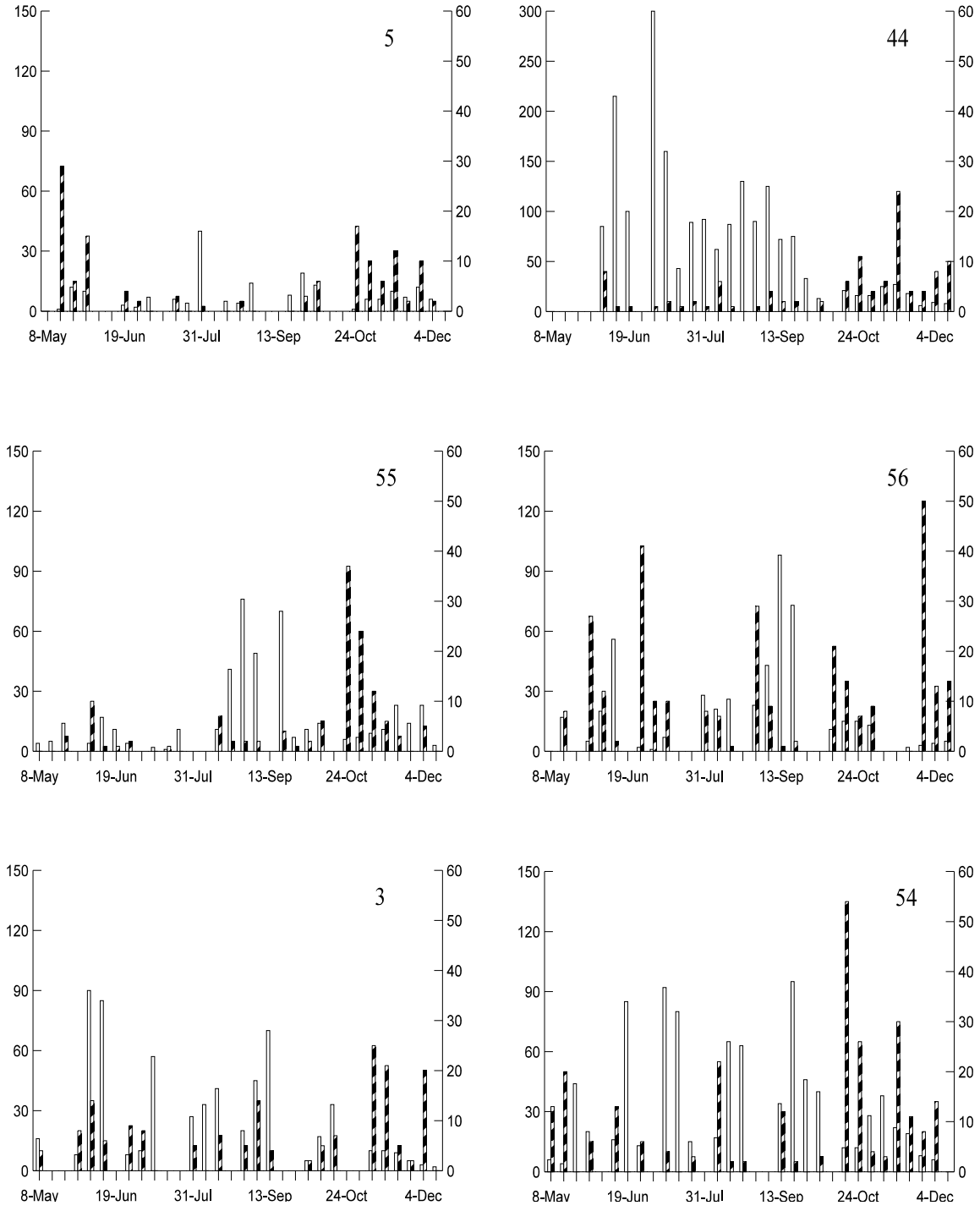

Figure 1. Results from weekly samples, 2001. Left axis represents number of *Lygus spp.* per 50 sweeps (clear bars), right axis represents percentage infection of collected *Lygus* (broken bars). Each pair of bars represents a collection. Field numbers are in the upper right hand corner of each chart; note difference in scale for field 44.

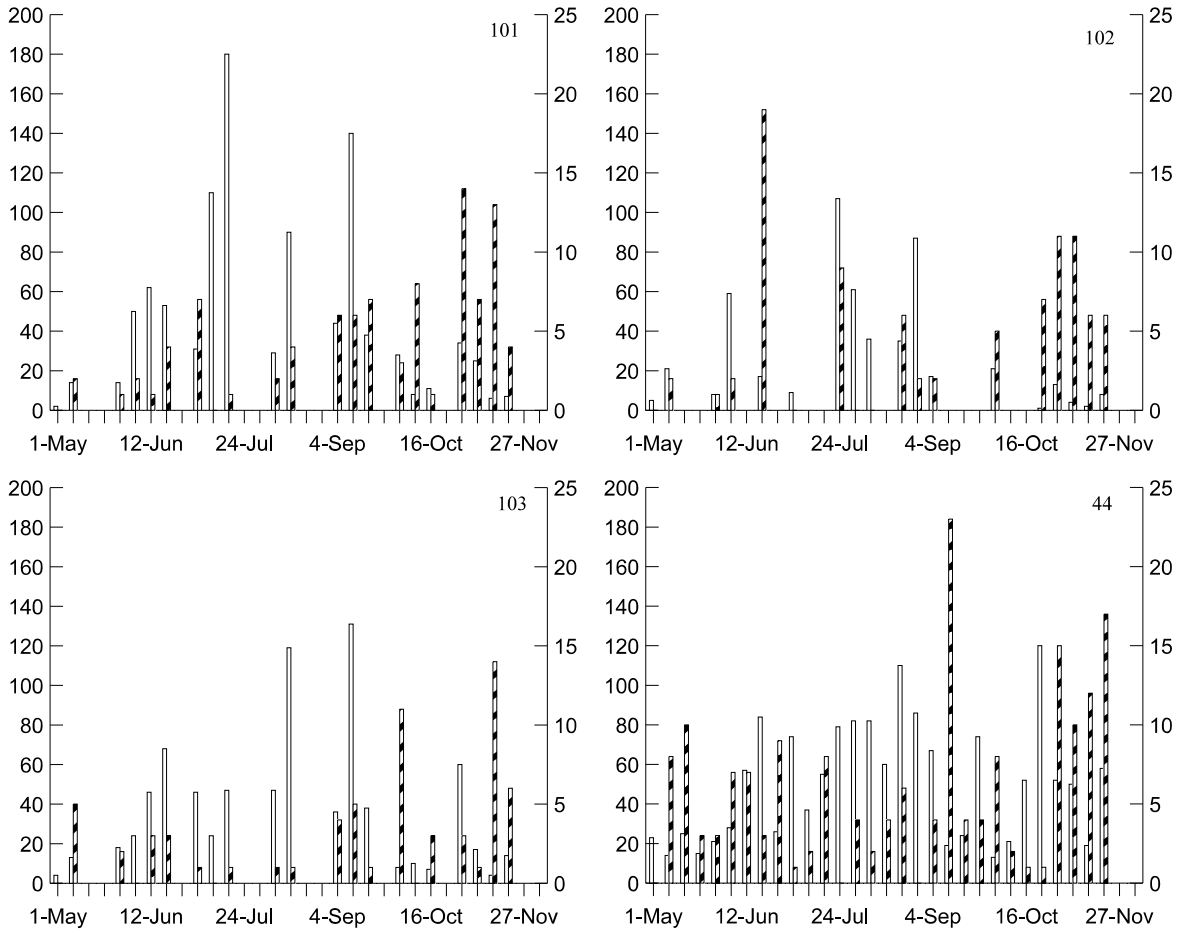

Figure 2. Results from weekly samples, 2002. Axes and bars are the same as Figure 1.