

PLANT-DERIVED COMPOUNDS ENHANCE BOLL WEEVIL RESPONSE TO GRANDLURE

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Abstract

Certain chemical compounds, found in cotton and other plants, enhance boll weevil attraction to Grandlure, the synthetic pheromone produced by the male boll weevil.

Introduction

In a study of the olfactory behavior of diapausing boll weevils, it was found that this species is attracted to several volatile constituents of cotton and other plant species. Extracts of several plants other than cotton were found to be attractive to boll weevils (McKibben et al. 1997), leading to speculation that this insect is attracted to green plants in general, but especially to the cotton plant. Three compounds, common in the essential oils of a wide variety of plants, were found to be synergistic with grandlure in field tests. The three compounds, myrcene, caryophyllene, and eugenol, are commercially available and are relatively inexpensive. The present study was done to investigate the feasibility of using these compounds to enhance response to grandlure.

Materials and Methods

In the studies before 1998, the three compounds were prepared for testing in traps by pipetting 25 mg onto ¼" X 1" cotton dental rolls. In one test a controlled release dispenser was prepared by adding 2.3 g caryophyllene to a 3 ml vial, adding 33 mg vegetable oil, and inserting a ¼ in. by 1 in. cotton dental roll. Beginning in the Spring of 1998 the three compounds were tested in controlled release dispensers prepared by Hercon Environmental Corporation, Emigsville, PA. These dispensers also contained 25 mg of active material, both with and without 9.5 mg grandlure.

Field tests were conducted by baiting with either grandlure alone, in the standard 9.5 mg dispenser used in the eradication programs, or with grandlure plus the candidate lure enhancer. Tests were run in Coahoma County, MS. Traps were placed 50 ft. apart in the vicinity of cotton fields, and were checked every 2 to 7 days, depending of the number of weevils being captured.

Results

Caryophyllene, eugenol and myrcene have been tested extensively as lure enhancers for the boll weevil throughout the season for the past three years. Caryophyllene and eugenol are synergistic with grandlure, giving a statistically significant increase in captures as compared with grandlure alone. Per cent increases in capture varied from zero to more than 100% increase. In most tests there was an increase. The overall average enhancement in capture for eugenol and caryophyllene was about 50%. Table 1 shows results from a typical test.

Five-day capture totals using the vial dispensers with 2.3 g caryophyllene were 141 for grandlure alone vs. 330 for grandlure plus caryophyllene. In 1999 testing was focused on controlled release dispensers prepared by Hercon. Although results with the plant compounds formulated separately (without grandlure) showed an enhancement effect, the greatest effect was with Hercon dispensers in which both one of the plant compounds and grandlure were both presented in the same dispenser. Table 2 shows results with caryophyllene and grandlure in separate dispensers compared with similar dispensers in which both were incorporated separately. The dispenser containing both grandlure and caryophyllene captured 49% more weevils than did the dispenser containing grandlure alone.

Problems with formulating eugenol with grandlure prevented the testing of this compound in the controlled release dispensers. In earlier tests with other dispensers eugenol was at least as effective as caryophyllene.

Discussion

Both caryophyllene and eugenol are synergistic with grandlure in attracting boll weevils to traps. Since the compounds are relatively inexpensive, they should provide a feasible way to improve the attractancy of pheromone baited traps. The cost of caryophyllene and eugenol is low enough that the final product should not cost much more than the current grandlure dispenser. The amount of grandlure can be reduced slightly to offset any additional costs associated with adding the enhancer compounds.

Future work will center on examining various ratios of grandlure to enhancer and testing combinations of enhancers in controlled release dispensers. Problems with formulating eugenol have been recently overcome. Since this compound was as effective or more so than caryophyllene, it will be tested also in the controlled release dispenser.

References

McKibben, G. H., P. A. Hedin, E. J. Villavaso, and T. L. Wagner. 1998. How do boll weevils locate overwintering sites? Proc. Beltwide Cotton Conf., San Diego, CA.

Hedin, P. A., G. H. McKibben, and Douglas A. Dollar. 2000. The selection of hibernation sites by boll weevils may be attributed to ground trash volatiles. Jour. Ag. Food Chem. In Press.

Table 1. Effect of plant compounds on boll weevil capture. May 11 – 18, 1998. Coahoma County, MS.

Compound	Avg/trap/day P>t ¹	
(GL alone)	40	--
Caryophyllene	57	.08
Eugenol	58	.06
Myrcene	49	.38

¹. Probability that mean is significantly different from grandlure alone. (2, 92 df).

Table 2. Effect of caryophyllene on boll weevil capture. Traps baited May 28, 1999. Coahoma County, MS.

	Total Capture in 10 Traps			
	6/3	6/7	6/11	Totals
GL alone	1035	1009	712	2756
GL + Cary. ¹	1291	1614	1210	4115
GL + Cary. ²	1212	1285	922	3419

¹. Grandlure and Caryophyllene in same dispenser.

². Grandlure and Caryophyllene in separate dispensers.