IMPROVEMENTS TO THE BWACT FOR EXTENDING THE RESIDUAL CONTROL OF BOLL WEEVILS

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Abstract

The use of the Boll Weevil Attract and Control Tubes or BWACTs (Bait Sticks, TMPs or TMBs) is expanding in the USA and Latin America. Field studies reported in the 1999 Beltwide Cotton Conference created an awareness for an improved residual activity. This paper reports on improvements that have been identified and have been implemented to ensure higher quality BWACTs with enhanced, extended residual control for use in Boll Weevil Eradication Programs (BWEPs) and IPM programs. It also presents results from bioassays that were conducted on the standard and an improved product. The improvements are consistent with Plato Industries' dedication of providing high quality, consistent products to its end users.

Introduction

The use of the BWACT in conventional IPM programs for cotton insect control and in area wide Boll Weevil Eradication Programs (BWEPs) is expanding in the USA and Latin America (Plato and Plato 1998). This expansion has created an increased awareness for a consistent high quality insecticidal coating on the Boll Weevil Attract and Control Tube (BWACT or "bait stick") and an extended release of malathion insecticide from the "tube" coating. In the USA, the "bait stick" is trade marked as BWACT™, whereas in Latin America, as the Tubo Mata Picudo (TMP™) and Tubo Mata Bicudo (TMB™).

This paper discusses the changes that Plato Industries Inc. (PII) implemented in 1999 to improve the insecticide residual activity of the BWACT. As with any new technology, there is a "learning curve" which must be experienced to ensure the correct manufacture and proper utilization of a new product. The BWACT is no exception; it has evolved from a coated, wooden "broom handle" with a pheromone "cap" (both produced by a handmade process), to a "semi-mechanized" produced, biodegradable "kill tube" with a 3 X 3 inch pheromone dispenser that is inserted into the top of the BWACT.

The formula of the "insecticidal coating" consists of specific ingredients that if altered in content or composition, create a serious reduction in insecticide (malathion) liberation for dermal toxicity to boll weevils. The BWACT formula was developed and patented by the USDA Boll Weevil Research Laboratory (BWRL) in Mississippi State, Mississippi in 1990/91; whereas, the BWACT pheromone dispenser was developed under a Cooperative Research and Development Agreement with the BWRL in 1992/93. In 1993/94, PII and the BWRL agreed to and published for interested collaborators a bioassay protocol as the "Standard" for use in determining the residual field life of the BWACT "kill tube." The grandlure dispenser liberation rate and residual life of the dispenser have been and are currently determined by a GC analytical method developed at the BWRL.

The aforementioned "Standard" for determining residual life or insecticidal activity of "weathered" BWACTs was established to facilitate efficacy determinations for product registrations in Latin America and provide US researchers with a method for "in-house" determinations. The scientific community was reasonably satisfied with using the "Standard" bioassay until the publishing of a report at the 1998 Beltwide Cotton Conference concerning minimal boll weevil control with BWACTs in the Rio Grande and Brazos Valleys (Spurgeon et al. 1998). An investigation of the manufacturing dates of the BWACTs used in the Spurgeon test illustrated that the product had nearly expired and the "expiration factor" helped to explain the "control failure." However, the report did create controversy and resulted in a greater focus for "in field" inventory control, enhancing the residual control of weevils with the BWACT, improved bioassay techniques and the development of a "chemical wash" method to determine analytically the amount of available malathion on a "tube" surface for boll weevil control. The "chemical wash" test method has been developed by the USDA-ARS and conducted in parallel to bioassays on the BWACT with the intent to establish an alternate method to the bioassay for determining residual field life or predicted percent control from weathered BWACTs. Data from the "chemical wash" analyzes should be available in the first quarter of 2000.

Plato Industries is dedicated to continuing the improvement of the BWACT technology for providing high quality products to BWEPs and IPM Programs, and has communicated this dedication (Plato et al. 1999) to interested collaborators and boll weevil eradication foundations.

Discussion

During 1999, PII and its collaborators identified several aspects about the BWACT system in which product improvements should be considered. Behavioral studies by Wolfenbarger and Cole (Plato et al. 1999) and certain bioassays in 1998 and 1999 by Eric Villavaso and others (personal communiqués) exhibited at times only 3 to 4 weeks

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residual control of weevils; whereas, other properly conducted bioassays at various locations in the USA and Latin America (Plato and Plato 1998; Gomez 1999) demonstrated 6 to 8 weeks of residual activity. As of today, the only reasonable explanation for the inconsistency in residual control is "too much" absorption of the malathion into the "tube wall" paper fibers, thus preventing its migration to the coating surface for insecticidal activity. One obvious method of preventing the absorption would be a "barrier" that would limit the absorption of the malathion into the "tube paper fibers", allowing for more malathion to be available for insecticidal action on the BWACT surface. The objectives of the improvements by PII in 1999 were to provide BWACTs of a more consistent high quality, within label specifications, with 6+ weeks of boll weevil control and a minimum shelf life of 18 months. The current and future product improvements should contribute to continued expansion of BWACT usage and improved implementation of the technology.

BWACT Improvements

Plato Industries internal "quality control and quality assurance" programs with the ingredients of the BWACT coating (alcohol, binding material, dye, thickeners, cottonseed oil and malathion insecticide) provided for a better formulated and more evenly applied, homogenous coating to BWACT "tubes". The "tubes" consisting of biodegradable fibers were manufactured with more emphasis to prevent "unraveling" due to rain and with better perforations of aeration holes for liberation of the pheromone.

During the fall of 1999, an extensive series of bioassays were conducted at the USDA-ARS-Boll Weevil Research Laboratory on BWACTs that had "barriers" to prevent the penetration of malathion insecticide into the paper fibers of the "tube" wall.

Two types of BWACTs were produced in the same manufacturing process and with the same coating, the only differences were the "barriers" used to prevent the absorption of the malathion into "paper fibers" of the "tube" wall. Each type of BWACT or "treatment" was aged for six weeks at the USDA-ARS-BWRL at MS State, Mississippi and bioassays were conducted weekly by the USDA-ARS-BWRL personnel experienced in the methodology of the bioassay "Standard".

The treatments were:

- BWACTs with "tubes" that were "barrier proofed".
- BWACTs with "tubes" that were not "barrier proofed".

The basic methodology to determine residual efficacy of the different treatments was to expose 50 lab reared boll weevils for 30 seconds to the surface of a BWACT, 10 each to 5 BWACTs at day 0, 7, 14, 21, 28, 35 and 42 (Photo 1). Exposures were accomplished by gently placing 10 weevils each on the surface of 5 different BWACTs each week (Photo 2). After exposure, the weevils were maintained for 24 and 48 hours in petri dishes for determining the percent mortality (Photo 3). Mortality counts were made by USDA-ARS-BWRL personnel. The mortality calculations for 2 and 4 minute exposure times were extrapolations based upon a large number of tests conducted during 1990-1994 by the BWRL.

The results reported herein do not account for sub-lethal dosage effects to weevils; the sub-lethal dosage effects were determined by McKibben (personal communiqué 1995, preliminary studies) to be a ceasing of feeding, mating, reproduction and egg deposition. Additionally, the Standard bioassay test accounts only for single exposures, whereas in a field environment, due to the "attraction power" of the Grandlure, weevils will fly to a BWACT and rest for an average of 1 to 3 minutes; if not intoxicated by the insecticide, they often leave and return to "rest" for another time. Upon intoxication less than 5% die rapidly and fall adjacent to the BWACT; the remaining 95%+ will die from a few feet to several yards away from the BWACT.

Results

The results from the bioassays on BWACTS weathered 6 weeks are reported at Graph 1, BWACT with "Barrier" and at Graph 2, BWACT without "Barrier".

Conclusions

It can be concluded from the bioassays performed that the "barrier" coatings to the "tubes" aided in reducing the absorption of the malathion into the tube wall and resulted in a greater availability of insecticide for initial "knock down" of exposed weevils. The BWACTs with the "barriers" provided an approximate 35% greater "knock down" at the 30-second exposure, 50% greater at the 2 minutes and 30% greater at the 4 minutes. Results illustrate that the BWACTs have a minimal, effective field life of 6 weeks.

The improvements were considered worthwhile by Plato Industries and have been implemented in the commercial production process for the BWACTs.

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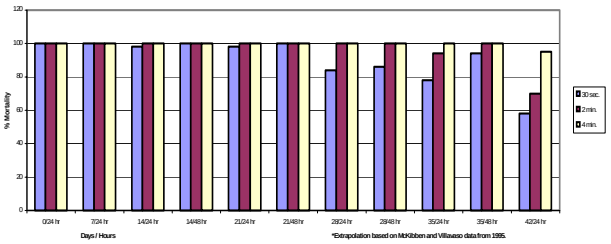
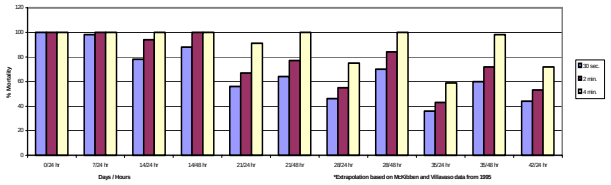
Photo 1

Photo 2

Photo 3



Graph 1. Boll Weevil Martality from BWACT Tubes with Barriers, August 1999. USDA-ARS-BWRL, MS State, MS.



Graph 2. Boll Weevil Mortality from BWACT Tubes Without Barriers, August 1999. USDA-ARS-BWRL, MS State, MS.