FINAL EVALUATION OF 1994 BOLL WEEVIL BAIT STICK TEST IN NOXUBEE COUNTY, MS

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Abstract

In 1994, the Integrated Pest Management Research Unit, in conjunction with USDA-APHIS, undertook a County Bait Stick Test involving 5,500 acres of cotton in Noxubee County Mississippi. Four applications of bait sticks were made at a ratio of approximately one bait stick per acre; two applications were made in the spring and two in the fall. The efficacy of this technology was evaluated the following spring with traps (one per acre) serviced by APHIS. The authors have concluded that the test was a success based on a comparison with a near-by county (Lowndes) and a farm in Noxubee County, all of which received seven diapause applications of malathion instead of the bait stick treatment. The authors strongly support the use of bait sticks in area-wide programs with low populations of boll weevils and cotton fields of moderate size (50 or more acres) out in open areas.

Introduction

The Integrated Pest Management Research Unit at Mississippi State, Mississippi, in conjunction with USDA-APHIS is continuing the evaluation of bait stick technology on large areas. This test was designed as a result of our highly successful test in Rutherford County, Tennessee (McGovern et al. 1993). This successful pheromone-based technology was made possible by the discovery and synthesis of boll weevil pheromone (Tumlinson et al. 1969). Reports on the design, development, and testing of the bait stick can be found in McKibben and Smith (1989, 1990, 1993); McKibben et al. (1990, 1991, 1992, 1993); Smith et al. (1991, 1992, 1993, 1994; Villavaso et al. (1993); McGovern et al. (1993); and Parvin (1995). One criticism of the Rutherford County, TN test was that the boll weevil population was well below economic levels. Very low levels of weevils are almost impossible to eliminate with conventional control technologies. Theoretically, the lower the population of weevils, the more efficient pheromone-based technologies become. Another large-scale test after the Rutherford County test was undertaken to demonstrate the effectiveness of bait stick technology against larger weevil populations capable of causing economic damage.

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Noxubee County, Mississippi, with eight cotton farms and 6,500 acres of cotton, was chosen for this test. This area was selected for the following reasons: proximity to the USDA-ARS laboratory at Mississippi State, Mississippi; moderately low weevil populations, which had nonetheless caused economic damage (Smith et al. 1993); relatively good isolation from other infested cotton; and its inclusion in the Southeastern Boll Weevil Eradication Program, which began in the fall of 1994 with about seven diapause applications of malathion. The involvement with APHIS would afford an excellent evaluation of this program in the spring since all cotton fields would be trapped at a rate of one trap per acre. Thus bait stick test would be evaluated by data collected from about 6,000 traps changed bi-weekly. These results would give a very thorough, in-depth evaluation of the boll weevil population remaining after four applications of bait sticks, two in the spring and two more in the fall at a rate of about one bait stick per acre.

Materials and Methods

The bait stick test began in Noxubee County, MS, during the first week in April 1994 when 1,400 traps were placed around 93 cotton fields totalling 6,500 acres. Each trap had 10 mg of pheromone in Hercon dispensers. These traps were checked bi-weekly and pheromone was changed through October.

The bait sticks used in the test contained about 35 mg of pheromone and were manufactured by Plato Industries, Inc., Houston, TX. The first application of bait sticks around cotton fields occurred on May 7, 7 - 10 days after planting. These sticks were replaced the first week in June. In the Noxubee County area heavy dispersal flights began the first week in August. We made the first late season application around the first of August and the second application the first week in September. It took a crew of eight people with five all terrain vehicles (ATV's) to check traps and place 20,000 bait sticks around cotton fields. Several applications of glyphosate (Roundup®) were applied to a 6' diameter area around the sticks to control weeds. A tractor mounted mower was used around some cotton fields to cut 6' wide swaths so that the bait sticks could be more easily installed and their effectiveness could be maximized.

Results and Discussion

We stated at the outset that this 1994 bait stick test would be evaluated by pheromone traps in the spring of 1995 (McGovern et al. 1995). We decided this for two reasons; 1) in late season, boll weevils flights of 10 to 20 miles are common making trap data less precise than in the spring; 2) we had 5,000 bait sticks with 40 mg of pheromone each out in Noxubee County competing with traps for weevils. Fortunately for our test, the winter of 1994-95 was one of the mildest on record, enabling our test to be evaluated successfully. Had there been a severe winter resulting in

very low spring emergence, it would have been impossible to partition out the amount of control attributed to bait sticks.

Approximately one-third of the cotton acreage in Noxubee County is rotated each year with corn and to a lesser extent, soybeans. Therefore, one-third of the 1994 cotton fields when evaluated in the spring, did not have cotton to interfere with the pheromone traps. This became a problem because Noxubee is the only county where this practice is common, and spring captures of boll weevils are considerably higher in the fields where cotton is not replanted than they would be otherwise.

Table 1 demonstrates the drastic differences in fields in close proximity to each other with and without cotton in 1995. There was a forty-fold difference in spring weevil catches around these two types of fields. This phenomenon resulted in an unfair evaluation of the Noxubee County spring weevil catches, necessitating an adjustment. This was very important prior to cotton squaring as Table 2 shows. Starting on 6/8/95, 13% of the weevils captured in the Mississippi eradication zone came from Noxubee County and on 6/15/95, 31% of the weevils captured came from Noxubee County. However, when corrected for the traps placed around non-cotton fields, those two figures became 6% and 11%, a drastic reduction from the uncorrected numbers. Table 2 further shows that even two weeks prior to cotton squaring, the efficacy of pheromone traps is substantially reduced.

Table 3 illustrates the importance of monitoring 1994 cotton not planted to cotton in 1995. We like to call fields of this type indicator fields. These fields give a true measure of spring emergence patterns. For example, Table 3 shows that traps around 1995 cotton fields give a deceptive picture of spring emergence. This data shows that spring emergence slows significantly beginning on 6/8/95. But, the indicator fields, not planted to cotton in 1995 show a different emergence pattern. Spring emergence continues to be heavy from 6/8 until 6/22 where no cotton is present to compete with traps. This information is vital to any program relying on pheromones or pinhead square treatments for control. The data collected from these fields in 1994 enabled us to determine that significant emergence occurred in late June. This phenomenon adversely impacted pheromone-based control and also the efficacy of pinhead applications.

There was one farm in Noxubee County which chose to have the standard treatment of seven diapause treatments with malathion starting on August 15. This farm consisting of about 1200 acres was used as our Noxubee County control. The unusual aspect of this farm was that, in contrast to the other farms in the county, this farm did not rotate cotton with corn. Table 4 com-pares this farm, (the Hayes Farm) with four other farms in the county which participated in the bait stick research. The comparison between the non-participating farm and the Deerbrook Farm is very interesting. Because both farms have large open fields, there should be a close correlation between boll weevil trap captures on the two farms if the bait sticks are effective in controlling weevils. Table 4 shows that the Hayes Farm out of the program averaged four weevils per acre while Deerbrook Farm averaged 15 weevils per acre, almost 4X as many as Hayes. However, Table 5 shows that Deerbrook had traps on 369 acres planted to cotton in 1994 but not in 1995, and those fields averaged 35 weevils per acre. Without those fields, the Deerbrook fields averaged 4.5 weevils per acre, almost identical to the Hayes fields.

In the final analysis, we would rate the bait stick test in Noxubee County successful. The spring catch of weevils with traps was comparable to Lowndes County, which had similar cotton acreage and is in close proximity to Noxubee. Also, the level of control was comparable to a farm in Noxubee County which chose to use the standard APHIS program of seven malathion applications instead of bait sticks. Climatic influences on boll weevils would be the same for both locations.

We believe the data shown here show that the bait sticks were equal to six diapause applications in the APHIS program. In the past, many researchers have tried to evaluate the effect of spring bait stick applications by using pheromone traps in late season. But, the number of boll weevils trapped around cotton fields in late season can be misleading because weevils disperse then, and dispersing boll weevils may be trapped many miles away from the fields in which they originated. Spring trap capture is a much more reliable indicator of populations around a particular field. In the spring of 1994, we trapped an average of about 3 boll weevils per acre, and in late season, this number rose to 21. In the spring of 1995, after the second mildest winter on record and at a time when very high numbers of boll weevils were being captured statewide, we were again back down to 4.5 weevils per acre thus demonstrating that a high level of control had been achieved around the bait stick fields. We further believe that the test was not as successful as it could have been because there was a late emergence of overwintered boll weevils in the spring of 1994. The onset of squaring decreases the efficiency of pheromone traps or bait sticks placed on the perimeter of a cotton field, and our data indicated that 35% of the emergence occurred in late June after squaring had begun. For bait sticks or any other pheromone-based technology to be successful in the spring, there must be adequate rainfall in late May and early June to flush 85-90% of the overwintered population out of hibernation before squaring occurs (Mitchell 1968). The data presented here show dramatically that as cotton begins to square, trap efficacy, therefore bait stick efficacy, declined sharply.

Table 6 shows that 45% of the cotton acreage with bait sticks in Noxubee County received no diapause applications

of malathion while 30% received one application. These applications were made in late maturing fields that had squares still available for weevils to feed on. These squares will hold weevils in the field making control with pheromone technology difficult.

Field size has a dramatic effect on weevil populations (Table 7). The smaller the field, the larger the number of weevils present on a per acre basis. There are several reasons for this. A farmer will, as a matter of course, devote most of his effort to his larger fields. They will be planted first, and chemicals will be applied in a more timely manner. The smaller fields are usually surrounded by better overwintering habitat plus the edge effect is greater on smaller fields. The data shown in Table 7 are for a farm outside the program in Noxubee County which was treated with seven applications of malathion for controlling diapausing weevils. For these reasons we believe that the use of pheromone technology on small fields should be avoided whenever possible. In conclusion, we strongly support the use of bait sticks in area-wide programs with cotton fields of moderate size (50 acres or more) out in open areas.

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Table 1. Comparison of boll weevil spring trap captures in 1994 in fields planted in cotton in 1994 only* and in fields planted in 1994 and 1995-- Noxubee County, Mississippi.

Field No.*	Acres	No. Captured	No. Captured	Acres	Field No.
23*	37	2,500	25	79	22
63*	34	2,200	20	36	47
91*	73	300	3	67	90
115*	62	150	25	125	114
11*	158	3,070	220	329	15
Total	364	8,220	293	636	--

Table 2. Percent of total boll weevils captured in Zone 4 of Mississippi Boll Weevil Eradication Program that came either from Noxubee or Loundes County -- 1995.

Date	4/27	5/11	5/25	6/8	6/15	6/22	6/29
Lowndes County	11	28	14	11	6	5	8
Noxubee County	9	9	12	13	31	20	5
Noxubee Corrected	9	9	12	6	11	6	4

Table 3. Number of boll weevils captured per acre in Noxubee County, Mississippi, in fields with cotton in 1994 and 1995 vs 1994 only.

Date	4/27	5/11	5/25	6/8	6/15	6/22	6/29
1994 & 1995 Cotton	--	--	18	5	1	0.5	1
1994 Only	18	13	20	18	16	11	3.5

Table 4. Comparison Hayes Non Bait Stick Farm vs. five bait stick farms

Grower	Total Acreage	Weevils /Acre on 6/8/95
Hayes	1,500	4.2
Deerbrook	1,050	1.5
Spurgeon	250	7.4
Bingham	450	3.7
Goode	1,250	.4
Huerkamp	1,000	.4

Table 5. Boll Weevil capture June 8, 1995.

Farm	Acres	Weevil/Acre
Hayes	1200	4.2
Deerbrook	950	1.6
1994 Cotton Only	369	3.5
1994 & 1995 Cotton	581	4.5

Table 6. 1994 Noxubee County Bait Stick Study

Frequency of Treatments	Fields Receiving 0 - 7 Treatments		Acres Receiving 0 - 7 Treatments		Cumulative Acres Treated
#	#	% of Total	#	% of Total	#
0	54	48	2,574	47	0
1	34	30	1,478	27	1,478
2	15	13	767	14	3,010
3	5	4	441	8	4,335

Table 7. Hayes Non Bait Stick Farm 5/25/95. Relationship between field size and weevil capture.

Field Acreage	Weevils/Acre
468	10
102	10
69	30
17	235
8	187