EVALUATION OF DIFFERENT RELEASE STRATEGIES FOR USE IN PINK BOLLWORM STERILE RELEASE PROGRAMS

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Abstract

Recapture rates of sterile PBW were not significantly different in cotton fields that received sterile releases in the evenings between 5 and 7PM and fields that received sterile releases in the morning between 6:00 and 9 AM.

Trap captures of native or sterile PBW moths were not significantly different between traps located 30 meters inside a cotton field and those located on the edge row of a cotton field. Furthermore, the sterile to native ratio of PBW moths captured in traps located inside the field was not different from traps placed on the field margin.

Introduction

In the early 1990's APHIS strategies were developed to implement an Integrated Pest Management (IPM) system for area-wide control of Pink Bollworm (PBW), *Pectinophora gossypiella* (Saunders) populations in the cotton growing areas of the southwest. One of several tools selected for use in this program was sterile moth release. Therefore, in anticipation of this expanded use of sterile PBW a major renovation of the PBW Mass Rearing Facility was made. These changes in rearing technology reduced rearing costs, improved release moth quality and expanded production abilities from the 5 million insects used per day in the San Joaquin Sterile Insect Technology Program (SIT) to 20 million per day for an area wide program to include the southern desert valleys of California and Arizona.

However, in the 27-year history of the San Joaquin SIT Program virtually no change has been made in the strategies used to release the moth. Review of current deployment strategies and development and evaluation of new release strategies of sterile PBW moths is necessary to insure that the current San Joaquin SIT program and future expanded programs are optimizing the use of its resources.

In 1997 we conducted a study comparing hand releases of sterile PBW moths released in the evening versus morning releases (Miller, et al. 1997). The San Joaquin Valley SIT Program has historically used only morning release of sterile PBW. Test results indicated the two release strategies produced similar sterile moth distribution patterns in the field as well as similar moth field longevity. However, pheromone trap captures of sterile PBW moths was 33% higher in cotton fields receiving PM releases than those receiving AM releases.

We report here on a study comparing PM releases (5:00 – 7:00 PM) of sterile PBW moths to AM (6:00 – 9:00 AM) releases using an aircraft fitted with the same type of release machine as employed by the PBW - SIT program. Additionally, we compared the efficiency of traps located 30 meters inside a cotton field and those located on the edge row of a cotton field in capturing native and sterile PBW.

Methods and Materials

Release and Recapture of Sterile PBW

Four commercial cotton fields ranging in size from 13.2 - 32 ha located near Coolidge, AZ served as the study site in 1998 and 1999. All fields in both years of testing were planted with Bt cotton. Each year the fields were evenly divided into 2 groups One set of 2-fields was randomly selected for morning release of sterile insects with evening releases made on the remaining two fields. The test was replicated 8 times over the two cotton-growing seasons. In each succeeding replicate the different release strategies were alternated between field groups and were initiated when sterile moth captures in two consecutive delta traps inspections yielded no sterile moth captures in both of the field groups. That is, we waited until the previous release was dead or "trapped out before switching strategies. This occurred 10 – 30 days after each release was made. Each replicate consisted of one moth release (per release strategy) at a rate of 3250 moths per hectare. Moths were released from a Cessna -206 aircraft flying at an altitude of 250 feet and a speed of 120 MPH. The aircraft flew in a round robin pattern between the two fields of a field group until all moths had been released.

All release moths were irradiated with 20 Kr of Co_{60}. Irradiated moths were then packaged in 1-liter paper containers and placed in an insulated aluminum box maintained at 4.5° C. for transfer from the rearing facility to the release plane. Moths were carefully poured from each container into the hopper of the release machine, which was also maintained at 4.5° C.

Delta traps (Foster et al. 1977) baited with PBW Biolure lures loaded with 2 mg of Gossyplure (Consep Membranes Inc. Bend, OR) were placed around the margin over cotton plants of each release field, at 0.16-km intervals. All traps were examined daily.

Infield Traps Verse Field Margin Traps

Two delta traps were placed at each end of the center cotton row of each field. One trap was positioned 30 meters inside the field and the second trap was positioned at row end over

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the first cotton plant. Traps were examined daily unless irrigation or insecticide treatments prevented access to the field. This part of the test was only conducted during the 1998-growing season.

Results and Discussion

Release and Recapture of Sterile PBW

Sterile PBW recapture rates were not significantly different ($t=0.34$, $DF=14$, $P<0.05$) between cotton fields that received sterile releases in the PM and fields that received sterile releases in the AM (Table 1).

As indicated in Table 1 native moth captures in test fields when designated for PM releases were 2.3 fold higher than those obtained in fields receiving AM releases of sterile PBW. Therefore, the degree of competition from native female moths as competitors with survey traps was higher in fields receiving PM releases than fields receiving the AM release of sterile moths. A 2.3 fold higher native population in the PM released fields may have reduced male response to pheromone traps more in these fields than in the AM released fields.

The number of sterile moths released for each of the 8 releases was constant. However, as indicated in Figure 2, a significant amount of variability in recapture rates was noted between releases. Releases with low recapture rates were directly correlated with insecticide applications that were applied 2-5 days before or after the releases were made. These insecticide applications were made to control Lygus and white fly populations.

Although we did not statistically show differences in recapture rates between the two release strategies, fields receiving the PM releases had 14.5% higher recapture rates than fields receiving AM releases. The numerically higher recapture rate coupled with the fact that the native population in the PM release fields was 2.3 fold higher suggests that moths released in the PM may have higher field survivability and/or vigor. This may be the benefit of spending fewer hours (12-16) in cold storage and also being field released at a time when temperatures are beginning to cool down in a desert environment. This allows more time for field acclimation is a less harsh environment. The reverse would be true of AM released moths. Temperatures can reach 46°C within 3-5 hours after release.

Test results reported here indicate no loss in field efficacy of sterile moths by shifting from the traditional AM release of sterile PBW to a PM release. The adoption of PM releases in the SIT program would increase versatility and reduce costs by creating the possibility of a single airplane doing the work of two airplanes by covering the same release area with AM and PM releases, instead of just morning releases. The use of PM releases would also allow sterile moths to be delivered to the field a day earlier in the San Joaquin Valley SIT Program rather than be held over night in cold storage and released the following morning as is the current practice.

Infield Traps Versus Field Margin Traps

Trap captures of either native or sterile PBW moths were not significantly different (Kruskal-Wallis test, $H=0.197$ with 3 DF $P= 0.978$) between traps located 30 meters inside a cotton field and those located on the edge row of a cotton field. Furthermore, the ratio of native to sterile PBW moths captured in traps located in the field was not different from traps placed on the field margin (Table 2). Identifying sterile: native PBW ratios in traps is critical in the management of fields using SIT as a pest control tool.

Under the conditions of our test, results indicate no advantage in placing traps inside a cotton field versus placement along the edge of a cotton field. Therefore, SIT managers are not at a disadvantage in utilizing data from edge traps to make program decisions. Additionally, as far as trap servicing is concerned, edge traps have the advantage in that: 1) Traps could be serviced when fields are under irrigation. 2) Servicing time is reduced because the trap Inspector can drive to most trap locations. 3) Insecticide contact by the trap inspector is reduced. 4) Reduce chances of irritating the grower as the result of trampling plants and distorting irrigation flow.

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References

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Miller, E., A. Lowe and S. Archuleta 1997. Comparison of field performance of morning versus evening release of sterile PBW. Annual Report January – December 1997, Phoenix Plant Protection Center, Brawley Plant Methods Station, Boll Weevil Plant Methods Station. USDA-APHIS, Phoenix, Arizona, pp. 24-27.

Table 1. Recapture rates of sterile PBW released in cotton fields at different times during the day. Results reported here are cumulative totals of 8 replicates collected over the 1998 and 1999 cotton growing seasons.

Release time	Total sterile moths released	Total sterile moths recapt.	%of sterile release moths recapt.	# native moths capt.	Sterile: native ratio
5 -7 PM	1,196,133	7515	0.63 a*	26,006	1.0 : 3.5
6-9 AM	1,191,733	6598	0.55 a	11,215	1.0 : 1.7

* Means followed by the same letter are not significantly different T-test P<0.05.

Table 2. Comparison of PBW captures in delta traps positioned in different locations in a cotton field. Results of 36 replicates.

Delta trap location	Mean number sterile PBW per trap	Mean number native PBW per trap	Sterile : Native ratio in traps
In field (30m)	40.8 a*	53.1 a	1 : 3.1
Field margin	37.4 a	48.8 a	1 : 3.1

*Means in block followed by the same letter are not significantly different Kruskal-Wallis Non parametric test on ranks. Test P=0.978.

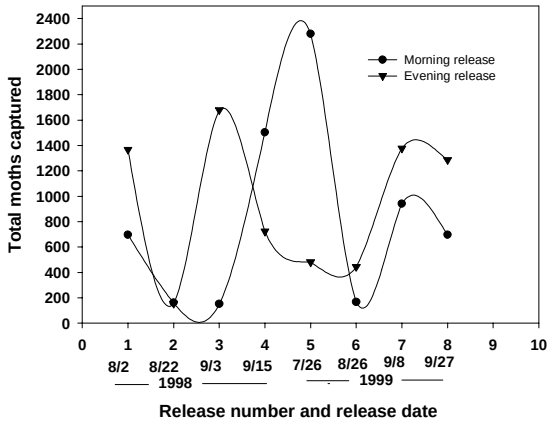

Figure 2. Comparison of recapture rates of Sterile PBW using different release strategies.