Trap Crops as a Component of a Community-Wide Pink Bollworm Control Program

Gary W. Thacker, Leon Moore, and Peter C. Ellsworth

Abstract

Trap crops were employed against the pink bollworm (PBW) as a part of a community-wide IPM program in Pima County, AZ. Levels of PBW larvae in the early squares of the trap crops were extraordinarily high, indicating that the trap crops were drawing overwintered PBW moths in from wide areas. This concentrated the overwintered moths in small areas where they could be easily and economically destroyed.

Introduction

In 1990, pink bollworm populations became devastating in Pima County, AZ; reducing yields by one third to one half and greatly increasing insecticide costs. At the same time, growers came under increasing public and regulatory pressure to minimize their use of pesticides. The growers formed the Marana-Avra Grower's Task Force, Inc. (MAGTF) to address these problems. The MAGTF requested the assistance of the University of Arizona Cooperative Extension in developing an IPM program centered around community action.

Our strategy focused on the key pest in the area, the PBW. The program involved a community-wide effort which included trap cropping, uniform optimal planting dates, pinhead square treatments, in-season pest management, and late-season management. This paper focuses on the trap crop component of the program.

The principle of trap cropping has been known for centuries, and could be used much more than it actually is. The principle rests on the fact that virtually all pests show a distinct preference for certain plant species, cultivars, or crop growth stages. Attractive host plants are offered at a critical time in the pest's phenology, concentrating them in a small area where they can be economically destroyed (Hokkanen, 1991).

Isley (1934) suggested early fruiting varieties of cotton could be utilized to concentrate infestations of overwintering boll weevils where they could be easily destroyed. The effectiveness of this tactic has been demonstrated in Mississippi by Scott et al. (1974) and in Arizona by Moore and Watson (1990). However, Hokkanen (1991) reported that no trap crop system successfully adapted to practical use had involved any lepidopteran pests.

Pink bollworm moths are highly mobile; Glick and Noble (1961) collected PBW moths in airplane flights of up to 2000 feet above the ground, and Barriola et al. (1973) reported that overwintered PBW moths traveled at least 35 miles to infest an isolated field of cotton. Van Steenwyk et al. (1978) studied the local dispersive nature of the PBW and found that overwintering adult males were highly dispersive from a cotton field in the early spring before the plants began producing squares. Dispersal was suppressed in mid- to late spring, possibly due to the onset of square and nectar production in the field.

In 1991, we incorporated a pilot trap cropping study into the community-wide IPM program in the Avra Valley and Marana. Early season square infestations in the trap crops were too low for us to measure the effectiveness of the technique. The MAGTF agreed to continue the study in 1992, the results of which are reported here.

Materials and Methods

Trap crop locations were selected throughout the area on set-aside and fallow land. Our objectives in locating the trap crops were:

1. Have at least one trap crop per square mile in the community, so that an overwintered PBW moth would not have over one-half mile to travel to a trap crop.
2. Stay away from power lines, schools, residences and other locations where aerial spraying would be difficult or restricted.
3. Locate the trap crops as twelve row strips to be sprayed in one pass of an airplane.

In 1992, we had nineteen trap crop locations in the community. Growers planted the trap crops about two weeks ahead of the main crop, beginning on March 25th and ending on April 5th (ca. 350 to 400 heat units after January 1). All trap crops were twelve 38- or 40-inch rows wide, varying from one quarter to one third mile long. Another component of this community-wide program is the uniform optimal planting date; none of the main crop was planted until April 15 (ca. 550 heat units after January 1). This resulted in a minimum of ten days separation between the trap and main crops.

We maintained three gossyplure delta traps in each trap crop throughout the study. The delta traps were located beside the trap crops to facilitate tractor work. One was placed at about fifty feet from each end of the twelve row strip and another in the middle. The use of pheromones has proven effective in trap cropping for boll weevils (Scott et al. 1974, Moore and Watson, 1990), and the traps gave us a method of monitoring PBW moth populations. The traps were emptied or replaced twice a week and the numbers of moths were recorded.

To destroy PBW moths in the trap crops, we used an intensive aerial spraying program beginning just before the trap crops reached susceptible square. Nine applications of azinphos methyl (Guthion) at 0.5 lb a.i. per acre began on May 22 (ca. 1235 heat units after January 1) and continued on a three-day schedule until June 15 (ca. 1750 HU). When the main crop reached pinhead square, growers implemented a pinhead square spraying program with ground rigs.

To evaluate the effectiveness of the spray applications on the trap crops, we selected three pairs of trap crops for intensive sampling. Each pair was located on opposite sides of the same field and included a sprayed trap crop and an unsprayed control. Immediately after the last spray application on June 15, we pulled 500 susceptible squares from each of the six trap crops and dissected the squares in the lab to count PBW larvae.

Growers plowed all of the trap crops under on June 16th. This was to insure that no second generation PBW's could complete their development in the trap crops and infest the main crop. At the onset of blossoming in the main crop, we examined 1,574 blossoms for rosetting.

Results and Discussion

The results indicate that trap crops are a useful component of a community-wide IPM program to control the PBW. These data are from the three intensively sampled pairs of trap crops located on the Pacheco, Murphey, and Worthey farms:

Pheromone Trap Catches

Early-season pheromone trap catches have been shown to reflect the magnitude of emergence from overwintering PBW populations (Chu and Henneberry, 1990). Our trap catches for the Pacheco, Murphey, and Worthey farms (Figures 1, 2, and 3, respectively) show that we did have a high probability of developing an economic infestation during the season.

It is interesting to note that trap catches in the sprayed trap crops did not decrease relative to unsprayed trap crops when the aerial applications began on May 22. This indicates that PBW moths are highly dispersive in the early spring, as reported by Van Steenwyk et al. (1978).

Infestation of Squares

The unsprayed trap crops averaged 3.4 percent of squares infested with PBW larvae (Table 1), which is a truly extraordinary level for early squares. Typical infestation levels at this point in the cotton plant's growth are usually so low that they are very difficult to measure. Watson (1992) found no PBW in intensive sampling of early squares in Yuma, AZ while his spring PBW emergence trapping data showed that high numbers of moths were present.

The infestation level of 0.67 percent of squares infested in the sprayed plots was not significantly less than the infestation level of the sprayed trap crops (Table 1). This together with the pheromone trap data suggest that moths were continuously moving into the trap crops. It also suggests that total elimination of spring PBW populations with insecticides would be very difficult to attain.

The high level of PBW larvae found in the trap crop squares indicated the potential for problems later in the season. However, early season blossom counts in nearby main crops showed zero rosetted blooms and throughout the program area economic infestations of PBW did not develop until very late in the production season. This indicates that early planted trap crops can be used to concentrate early season PBW populations where they can be destroyed with insecticides and/or plowing the trap crop under without risk to the later planted main crops.

Summary

These data suggest that the trap crops were drawing overwintered PBW moths in from a wide area, where we could easily destroy them. It was a very economical program. Growing costs of the trap crops were about $100 per acre of trap crop, amounting to $0.50 to $2.00 per acre of main crop, depending on how many trap crops an individual grower had. Trap crop spray costs were paid by the MAGTF and amounted to about $0.35 per acre cost for the main crop of about 14,000 acres. We will continue the project in 1993.

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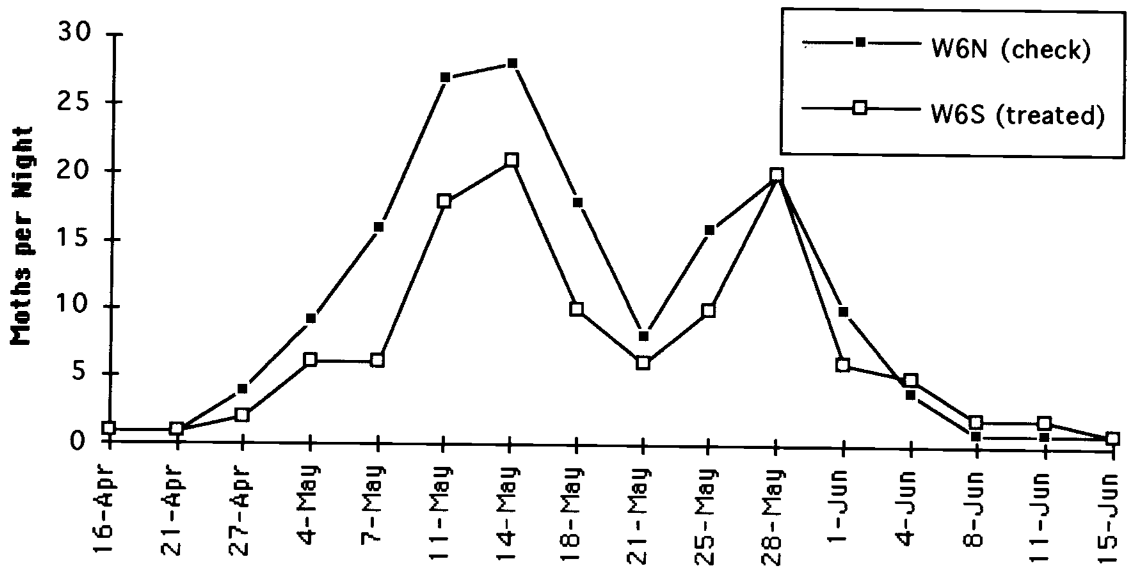

Figure 1. Pheromone trap catches in treated and untreated trap crops on the Pacheco farm.

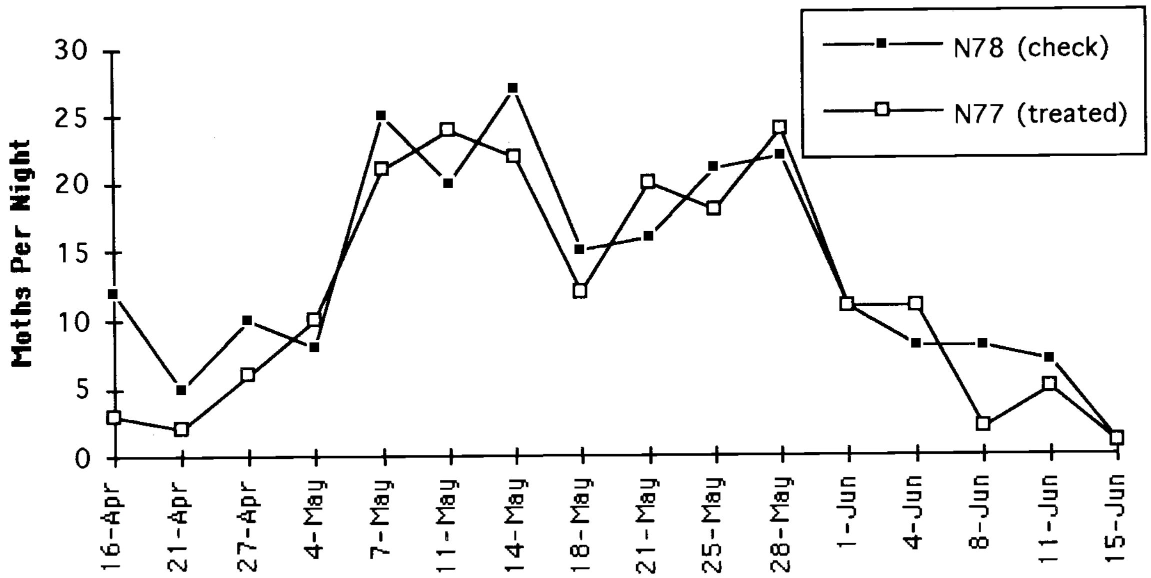

Figure 2. Pheromone trap catches in treated and untreated trap crops on the Murphey farm.

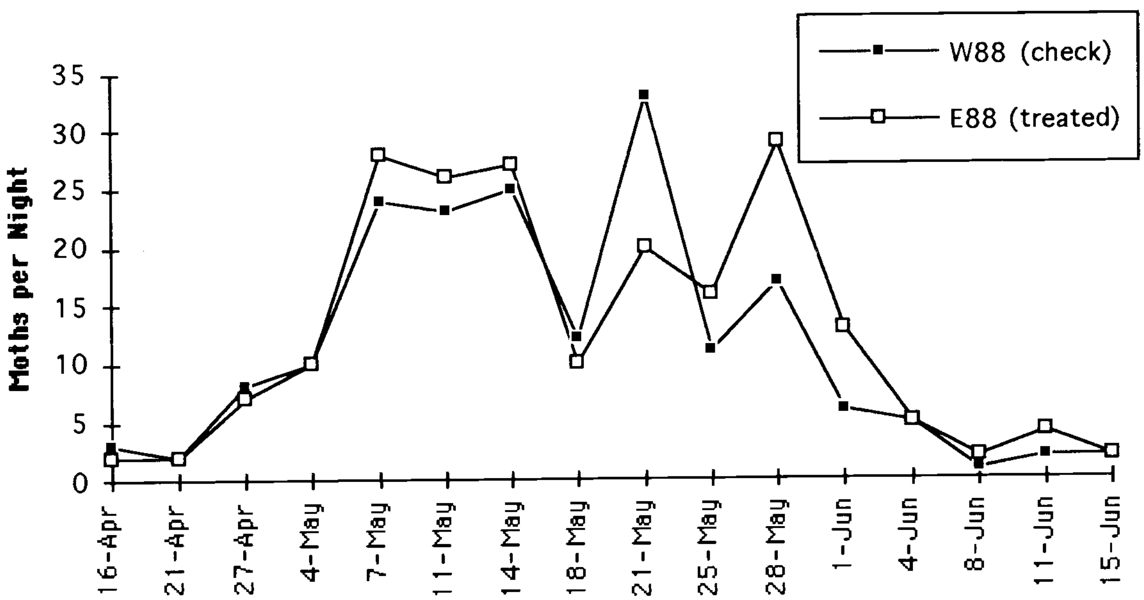

Figure 3. Pheromone trap catches in treated and untreated trap crops on the Worthey farm.

Table 1. Pink bollworm infestations of the first susceptible squares in treated and untreated trap crops.

Grower & Field No.	PBW Infested Squares, percent	
	Treated	Check
Pacheco - W6	1.4	8.2
Murphey - 77&78	0	0.6
Worthey - 88	0.6	1.4
Average Infestations	0.67a	3.40a

Average infestations were not significantly different at the 95% confidence level. Coefficient of Variation = 122%.