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## Studies on the Leftover Standing Cotton as Carry-over Sources of Pink Bollworm in Sindh

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**Abstract:** Several cultural or mechanical practices have been shown individually to reduce over wintering populations of the pink bollworm. It takes a combination of such practices to effectively control this insect during the over wintering stage. The combination of practices may be applied which provide effective control in different parts of the world: i) Harvest the crop as early and in as short a time as possible. ii) Shred stalks immediately after harvest. iii) Plow stalks under immediately, preventing re-growth of new fruiting forms that might provide food for diapausing larvae. iv) Prepare land for planting of the subsequent crop, including pre plant irrigation. v) Plant new crops during a designated planting period that allows for maximum suicidal emergence of moths from over wintering larvae. The pink bollworm does not attack cotton with the same severity in various regions of Sindh. One of the main reasons is the presence of left over bolls, which may be eliminated immediately after harvest. Indeed early crop termination is known to be a successful cultural control strategy as it denies the pink bollworm enough time to develop the diapause generation in the fall and leads to population decline.

**Key words:** Pink bollworm, diapause, leftover cotton, carry-over source

### Introduction

The pink bollworm, *Pectinophora gossypiella* (Saunders), is one of the serious pests of cotton in Pakistan as well as many other cotton growing areas of the world. The pink bollworm is best adapted to areas with low rainfall and long growing season. There may be as many as four to six generations a year where long growing seasons occur. Primordial introductions around the world are traced to shipments of infested seeds from India and Egypt in the very early part of the century. Besides the transport of bulk cottonseed there is a hazard in moving the baled lint, mechanical cotton pickers and vehicles that have been used to transport seed and seed cotton, oil mill products and other items subject to contamination by infested seeds (Noble, 1969).

Certain percentages of the populations of this pest are known to enter diapause as last instar larvae. Some of the larvae spend diapause inside the cottonseed. Diapause larvae pass the winter in seeds, old bolls and trash in the fields or at gins and seed storage. Larvae that over-winter in diapause produce adults that are the source of new infestation in spring (Henneberry, 1986). In most cotton growing countries where the crop is cultivated once a year and in rotation with other crops, the pink bollworm enters into diapause in the absence of cotton, Slosser and Watson (1972) stated that when squaring cotton is present, the females lay their eggs on it and larvae develop in the squares. Noble (1969) stated that there might be as many as four to six generations a year where long growing seasons occur. Population reaches at peak in August or September, usually in the fourth or fifth generation. Adkisson (1965) reported that shortening day length in fall (13 hours or less) stimulate fully grown fourth instar larvae to spin in to a light cocoon and enter into a non-active quiescent state called diapause.

Cotton growers in Pima County, Arizona are working together to implement a community-wide integrated pest management program. The IPM program employs many control components aimed at the pink bollworm, the principal cotton insect pest in the area. The components consists of a uniform optimal planting date, trap cropping, pinhead square treatments in season scouting and management and timely termination (Thacker *et al.*, 1994). The potential for a more satisfactory solution to the pink bollworm problem lies in cultural control, a method aimed at reducing over winter survival of diapausing larvae. Since research conducted in Texas showed that moth emergence could be reduced significantly by the use of stalk shredders (Chapman *et al.*, 1961). Similar research was conducted in Arizona to attempt destruction of that segment of the over wintering population that remained in the bolls. Because of the long growing season, large diapause populations developed in the late season will load, which if destroyed would significantly reduce the number of over wintering larvae.

Since 1995 in Sindh many farmers are practicing an unwise habit by keeping the cotton crop standing until March to pick as much yield as they could. The immature fruiting parts thus available would furnish a breeding site for some non-diapausing larvae. These studies were under taken to determine the pink bollworm population in extended cotton at farmer's field in Hyderabad and Sanghar districts and at CCRI, Sakrand in Nawabshah district.

### Materials and Methods

Studies were carried out for two consecutive years at three locations, one at Central Cotton Research Institute, Sakrand, the other sites were farmer's fields at Matiari (Hyderabad district) and Khipro (Sanghar district). The experiment had five acres field at all the locations. Variety

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Table 1: Pink bollworm larvae in flowers and green cotton bolls at different places during 1996-97

Months	Sakrand		Hyderabad		Sanghar	
	PBW Larvae (%)		PBW Larvae (%)		PBW Larvae (%)	
	Flowers	Green bolls	Flowers	Green bolls	Flowers	Green bolls
15th August	1.5 c	3.3 c	2.0 c	4.0 e	2.5 b	4.2 d
30th August	2.5 bc	5.0 bc	2.9 bc	6.5 d	3.2 ab	6.9 c
15th September	3.2 ab	7.7 b	3.8 ab	8.9 c	3.6 ab	9.5 b
30th September	3.0 bc	8.5 ab	4.0 a	9.6 b	3.5 ab	11.2 ab
15th October	3.5 ab	9.0 ab	3.0 bc	10.0 b	3.8 ab	12.0 ab
30th October	3.8 a	10.2 a	3.5 b	11.5 a	4.0 a	12.5 a

Means followed by similar letters do not differ significantly from each other according to DMR Test

Table 2: Pink bollworm larvae within green and open bolls after harvest in left over cotton at different places during 1996-97

Months	Sakrand		Hyderabad		Sanghar	
	PBW Larvae (%)		PBW Larvae (%)		PBW Larvae (%)	
	Green bolls	Open bolls	Green bolls	Open bolls	Green bolls	Open bolls
November	9.0 b	10.0 b	16.7 b	19.0 c	8.0 b	10.0 b
December	10.0 b	11.9 b	20.0 a	27.0 b	10.5 b	15.0 ab
January	13.0 a	15.2 a	20.0 a	30.0 a	12.5 a	16.5 a
February	13.5 a	16.0 a	21.0 a	31.0 a	13.0 a	17.0 a

Means followed by similar letters do not differ significantly from each other according to DMR Test

NIAB-78 was planted at farmer's field and CRIS-9 at CCRI, Sakrand farm. The crop was sown in third week of April at Matiari and Khipro and second week of May at CCRI, Sakrand farm.

Pink bollworm population was determined fortnightly starting from second week of August to end of October. Fifty flowers were observed in plants and hundred green unopened bolls were extracted at random. Lots of 100 bolls each were placed into plastic incubation boxes. These boxes were held in the laboratory for four days and then bolls were cracked/opened and examined. The numbers of larvae were counted per 100 bolls for each box on each sampling date (Henneberry, 1986). Cotton crop at three locations was harvested in last week of October and first week of November and continued till February. To determine the pink bollworm population immediately after harvest 100 green unopened bolls were extracted at random and with the same procedure cracked, opened and examined fortnightly starting from 15th November to 30th February. Hundred open bolls of each location were also examined for larval population. The Duncan's Multiple Range (DMR) test was applied to test the significance of the results.

### Results and Discussions

Examination of 50 flowers and 100 bolls collected during normal cotton season in July, September and October produced pink bollworm larvae with significant increasing percentage with the time at all the locations (Table 1). The data presented in Table 2 indicated that small and medium

pink bollworm larvae continued to feed and became large larvae in the green bolls over a period of few days to several days after harvest. Pink bollworm population gradually increased from November onwards. The population between the locations varied very much. The pink bollworm larvae percentage in farmers field after harvest was alarming in some cases ranging between 16.7 and 20.0 percent in green bolls, whereas 19.0 and 30.0 percent in open bolls in Hyderabad and 8 to 13 percent in green bolls and 10 to 17 percent in open bolls in Sanghar district (Table 2). Subsequently large numbers of diapausing larvae were found in late season bolls.

On the other hand, percentage of larvae in CCRI, Sakrand Field was low ranging between 9.0 and 13.0 percent in green bolls and 10.0 to 15.2 percent in open bolls (Table 2). This increasing trend of the population might be attributed to the fact that leftover cotton and the crop residues are the main source of carry-over of pink bollworm. Henneberry (1986) also stated that over-winter in diapause in the extended cotton produces adults that are the source of new infestation in spring during normal cotton season. In general observation of extended cotton during 1997 at CCRI, Sakrand farm, 80 percent pink bollworm larvae (second and third instar) were observed on new developed flowers, 17.0 percent *Earias* sp. on new developed squares and small bolls and 4.0 percent *Heliothis* larvae on squares and flowers. The results are in agreement with Bariola (1978) who reported that in the spring the over-wintering larvae pupate and moths emerged and mated. This emergence usually starts before cotton

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Table 3: Pink bollworm larvae in flowers and green cotton bolls at different places during 1997-98

Months	Sakrand (Larvae %)		Hyderabad (Larvae %)		Sanghar (Larvae %)	
	Flowers	Green bolls	Flowers	Green bolls	Flowers	Green bolls
15th August	2.2 c	4.0c	3.5 ab	6.2 b	3.5 b	7.8 c
30th August	2.5 b	4.5 c	3.8 ab	7.2 b	3.8 b	8.0 c
15th September	3.5 b	6.9 b	4.2 ab	9.5ab	4.0 b	10.8 b
30th September	4.2 ab	9.2 ab	5.0 ab	10.0 ab	5.5 a	12.5b
15th October	4.5 ab	10.0 ab	5.8 a	10.7 ab	5.8 a	15.6 b
30th October	5.0 a	10.8 a	6.2 a	12.5 a	6.8 a	18.5 a

Means followed by similar letters do not differ significantly from each other according to DMR Test

Table 4: Pink bollworm larvae within green and open bolls after harvest in left over cotton at different places during 1997-98

Months	Sakrand (Larvae %)		Hyderabad (Larvae %)		Sanghar (Larvae %)	
	Green bolls	Open bolls	Green bolls	Open bolls	Green bolls	Open bolls
November	12.5 ab	13.0 b	17.6 b	22.0 c	19.5 c	23.5 b
December	13.8 ab	15.2 ab	22.5 a	28.5 b	21.2 b	26.5 b
January	13.9 ab	15.5 ab	22.9 a	30.8 ab	23.8 b	38.5 a
February	15.2 a	17.0 a	23.5 a	35.0 a	28.2 a	38.9 a

Means followed by similar letters do not differ significantly from each other according to DMR Test

squaring and if no fruiting host plant is available these adults die without reproducing.

The results of 1997-98 season presented in Table 3 indicated that the pink bollworm larvae per cent in farmers field at Sanghar was alarming and ranged between 3.5-6.8 in flowers, 7.8-18.5 in green bolls followed by Hyderabad (3.5-6.2 in flowers, 6.2-12.5 in green bolls) and in Sakrand 2.2-5.0 in flowers and 4.0-10.8 in green bolls.

The results presented in Table 4 revealed that the number of larvae gradually increased during November to February ranging between 19.5-28.2 in green bolls, 23.5-38.9 in open bolls at Sanghar followed by Hyderabad (17.6-23.5) in green bolls, (22.0-35.0) in open bolls and in Sakrand 12.5-15.2 in green bolls and 13.0-17.0 in open bolls. These results show the increasing trend of pink bollworm population every year because of the increasing area of the leftover standing cotton throughout the year.

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