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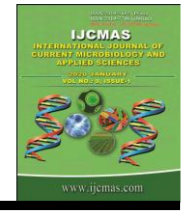

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Effect of Abiotic Factors in Termination of Diapause of Pink Bollworm, *Pectinophora gossypiella* (Saunders) (Lepidoptera: Gelechiidae)

Kiranamaya Pradhan*, M. Bheemanna, Arunkumar Hosamani and S. G. Hanchinal

Department of Agricultural Entomology, College of Agriculture, University Agricultural Sciences, Raichur – 584104, India

**Corresponding author*

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A B S T R A C T

The relationship of temperature and photoperiod was studied under laboratory conditions relative to termination of diapause in *Pectinophora gossypiella* (Saunders). For this experiment two different photoperiods (12 and 16 h) each at two different temperature regimes (25 and 35^{o}C) regimes at 70% RH were maintained in walk in growth chamber to study the effect of all these stimuli on the termination of diapause in the pink bollworm. When temperature and photoperiod was increased from 25° C to 35° C and 12 h to 16 h respectively, the diapause terminated more rapidly, which signify that the atmospheric temperature and photoperiod has significant role in the diapause behavior of pink bollworm.

Introduction

Cotton plant is susceptible to a number of insect pests in which pink bollworm (*Pectinophora gossypiella*) is a major worldwide pest of great economic importance on this crop. This pest is the major constraint in cotton production causing severe losses, inspite of several rounds of insecticidal applications and can cause locule damage to an extent of 55 per cent and reduction in seed cotton yield in the range of 35 to 90 per cent (Narayanan, 1962). Sometimes in serious cases, there may be a complete crop failure. The pink bollworm incidence is increasing year by year and the management of pink bollworm unlike *H. armigera* is very difficult with insecticides as it is an internal feeder.

During the developmental period it enters a state of arrested development called diapause. Diapause always occurs during the end of crop season, when maximum number of mature bolls are present, and larvae often form their hibernacula inside seeds. Hibernacula may occupy single seeds or double seeds. *Pectinophora gossypiella* hibernate as full fed larvae during cold weather. This insect is highly adaptable to different climatic conditions and the larvae hide over unfavorable season inside empty cotton seed in which they are well protected and remain alive for many months.

Survival of the pest from one season to another is entirely through hibernating larvae in seeds, soils and plant debris. Sharma (1999) reported sticks carrying green bolls, unopened and half opened bolls carried about 82 per cent diapause larvae, while seeds carried about 12 per cent diapausing larvae. Temperature, photoperiod and moisture plays an important role in the emergence of pink bollworm larvae from the diapause stage.

Adkinson and Wellso (1963) reported that diapause in the pink bollworm is primarily under the control photoperiod, day length of 13 hours and less induced diapause whereas longer day lengths averted the condition. As diapause results in carrying over the infestation from one season to other, a clear understanding of the response of diapausing larvae to temperature and moisture could provide a basis for altering field practices to ensure higher suicidal emergence.

Materials and Methods

Newly hatched pink bollworm larvae were transferred into each well of bioassay trays containing cotton seed diet with the help of sterile camel hairbrush (0 or 1 No.) and covered with pull and peel tabs properly and placed under diapause inducing daily photoperiod of 12 h and 20°C temperature. Larvae were held under these conditions until the hibernaculum was spun, at which time they were transferred to a 16 h diapause-averting daily photoperiod for 15 days at 27°C. Larvae which had not pupated during this time were considered as diapause larvae.

The diapause larvae were then held in the dark at 20°C until needed for the experiments. Two different photoperiods (12 and 16 h) and two temperature (25 and 35°C) regimes at 70% RH were maintained in walk in growth chamber to study the effect of all these stimuli on the termination of diapause in the pink bollworm. Diapause larvae were collected and placed individually in plastic vials (4 cm diameter and 5cm height) with a filter paper disc at the bottom and a lid with a mesh window.

The plastic vials containing diapause larvae were then placed in controlled walk in growth chamber maintained with desired temperature and photoperiod combinations (25°C -12hour photoperiod, 25°C-16 h photoperiod, 35°C-12 h photoperiod and 35°C-16 h photoperiod) (Plate 2). 30 larvae were taken per treatment combination to conduct the experiment. The number of diapause larvae terminated diapause were recorded regularly by counting the number or pupa formed in the respective treatment combinations.

Results and Discussion

The influence of temperature and photoperiod in terminating the larval diapause of pink bollworms held at 75 per cent RH is shown in (Table 1 and Fig 1). Diapause was terminated within eight weeks in substantial numbers of larvae held under 12 and 16 h photoperiod each at 35° C with pupation of 59.98 and 86.66 per cent, respectively. By the end of 11th week nearly all larvae treated in this manner had terminated diapause and pupated with pupation percentage of 83.31 and 100 per cent respectively.

It had been reported that when the diapause larvae exposed to 12 h and 16 h photoperiod each at 35° C the larvae pupated shortly when exposed to 16 h photoperiod as compared to 12 h photoperiod with pupation percentage of 93.32 and 63.31 per cent, respectively at 9th week. Similar results were also found when the diapause larvae were exposed to 12 and 16 h photoperiod each at 25° C with pupation percentage of 63.29 and 73.29 per cent, respectively recorded at 12th week. Results signify that irrespective of temperature treatment the diapause terminated more when exposed to longer photoperiod regimes as compared to shorter photoperiod.

The effect of temperature may be better illustrated by comparing certain treatments. For example, diapause was terminated more rapidly in larvae which received the 35°C at 16 h photoperiod regimes as compared to when treated with 25°C at 16 h photoperiod with respective pupation percentage of 93.32 and 46.63 per cent recorded in 9th week (Table 1). Similar results were also found when the diapause larvae were exposed to 25°C and 35°C each at 12 h photoperiod regime with pupation percentage of 36.63 and 63.31 per cent respectively. The corresponding results signify that the temperature has a big role in diapause behavior of pink bollworm as increase in temperature resulted in more diapause termination of pink bollworm.

Adkinson and Wellso (1963) showed that photoperiods between 13 hours and 16 hours per day will prevent diapause in developing pink bollworm larvae. The present study indicates that photoperiodism may also be the mechanism which determines when diapause will be terminated in this insect which is concurrence with the present findings. Kader *et al.* (1978) reported that when they exposed the diapause larvae to two temperature regimes of 200C and 300C each combined with three different photoperiods LD 0:24, 12:12 and 14:0, the diapause larvae exposed to high temperature terminated significantly faster than at the lower temperature in all the photoperiod tested.

The results are in line with the present findings. Similar results were also found by Wellso*et al.* (1964) where they reported that laboratory-reared diapause pink bollworm larvae exposed to photoperiods of 14 or 16 h daily, terminated diapause more rapidly than larvae held under 8 or 12 h.

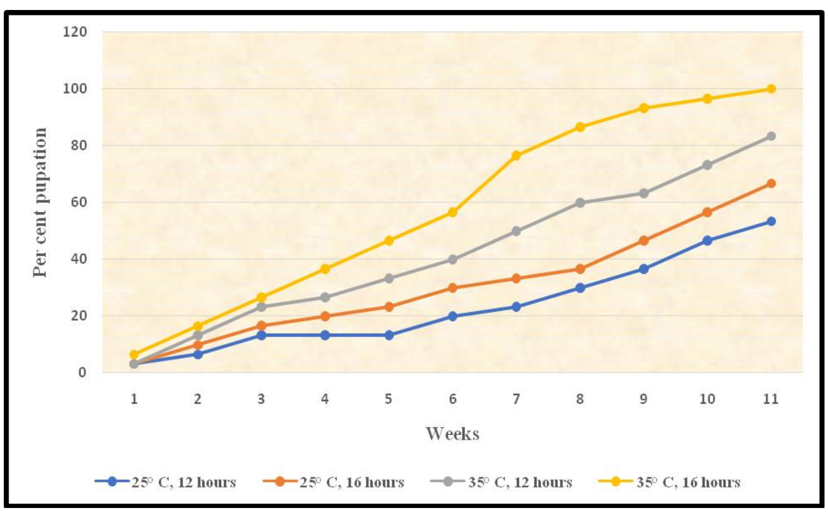

Fig.1 Per cent pupation of diapause pink bollworms at two photoperiodic regims each at 25^0 C and 35^0 C temperature

Table.1 Effect of temperature and photoperiod in termination of diapause of pink bollworm, *P. gossypiella*

Time (Weeks)	Per cent diapause larvae terminated diapause at different temperature and photoperiod combinations			
	25° C, 12 hours	25° C, 16 hours	35° C, 12 hours	35° C, 16 hours
1st week	3.33	3.33	3.33	6.66
2nd week	6.66	9.99	13.33	16.66
3rd week	13.32	16.65	23.33	26.66
4th week	13.32	19.98	26.66	36.66
5th week	13.32	23.31	33.32	46.66
6th week	19.98	29.97	39.98	56.66
7th week	23.31	33.33	49.98	76.66
8th week	29.97	36.63	59.98	86.66
9th week	36.63	46.63	63.31	93.32
10th week	46.63	56.63	73.31	96.65
11th week	53.29	66.63	83.31	100
12th week	63.29	73.29	89.97	-
13th week	73.29	83.29	96.63	-
14th week	83.29	93.29	100	-
15th week	93.29	100	-	-
16th week	100	-	-	-

From the data accumulated in the present study and the research reviewed, the following hypothesis is suggested. The natural photoperiod may function as a protective mechanism in such a way as to effectively prevent pupation of overwintering larvae until the period of unfavorably low temperatures is passed. Once the photoperiod is the appropriate duration, pupation may occur; however, the rate at which this takes place is apparently governed by prevailing temperatures and photoperiod conditions.

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