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RESEARCH ARTICLE

Peak period of moth emergence, fecundity, egg viability, egg parasitism and factors influencing the extent of carryover from one season to another of sugarcane plassey borer, *Chilo tumidicostalis* Hampson (Lepidoptera: Pyralidae)

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SUMMARY

Field and laboratory experiment was conducted in Krishi Vigyan Kendra, Tinsukia, Assam during 2014-16 to investigate the peak period of moth emergence, fecundity, egg viability, egg parasitism in different generations of plassey borer, *Chilo tumidicostalis* and factors influencing the extent of carryover of the pest from one season to another. The pest completed five generations in a year. The average fecundity of *C. tumidicostalis* ranged between 88.0 to 136.0 eggs in different generations, the maximum being recorded in fifth generation during the 1st and 2nd week of October and the minimum in the second generation during the 1st and 2nd week of June. The emergence of moths in each generation continued for more than one week (7-12 days), but the maximum emergence of moths took place within a week. The maximum moths (56%) were observed to be emerged during second generation. Late harvesting of crop after second week of March made emergence easy for the moths which would lay eggs on the ratoon sprouts, October planted crops and late tillers that remained un harvested in the fields. The population of winter brood through late tillers would also contribute to the extent of carryover of the pest to the succeeding crop.

Key Words : Plassey borer, Peak period, Fecundity, Carryover

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Sugarcane (*Saccharum officinarum* L.) is an important food cum cash crop grown extensively throughout India, In Assam, sugarcane is the important commercial crop grown in all the districts next to tea and jute. The insect pests problem is one of the important limiting factors in the production of sugarcane crop. About 125 insect species are reported to attack

sugarcane in India (Box, 1953). Phukan (1978) mentioned about 6 insect species which are major importance of sugarcane crop in Assam. Among the different internode borers associated with sugarcane, the plassey broer, *C. tumidicostalis* has assumed the status of a very serious endemic pest in recent years. The plassey borer contributes heavy yield losses due to its voracious feeding capacity of internodes tissue of the plants. Population dynamics is the study of key factors which contribute to natural mortality under field condition. Therefore, study of population dynamics involves not only the investigation of the causation of changes of the total number in a given time and space, but also of the mechanism of natural control (Atwal and Bains, 1974).

In view of the above factors, the present study was undertaken to investigate the peak period of moth emergence, fecundity, egg viability, egg parasitism in different generations of plassey borer and factors influencing the extent of carryover of the pest from one season to another.

MATERIAL AND METHODS

Peak period of moth emergence in different generations:

A total of 50 plassey borer infested cane was collected at random from different experimental fields at an interval of 3-5 days and was cut longitudinally. The exit holes and the left over pupal skins in the feeding tunnels indicated the emergence of moths. The observations was continued and percentage of moth emergence was calculated on the basis of total number of moths emerged per 50 infested cane shoots observed in each observation.

Fecundity of female moths in different generations:

To determine the fecundity of female moths of different generations, a large number of pupa (male and female) was collected from the field. The pupae were then kept in the laboratory in several glass jars (covered with fine muslin cloth and wet blotting paper at the bottom) for moth emergence. The emerging adults were used for determining the fecundity in each brood. Ten pairs of moth (male and female) were released on jars containing sugarcane leaves for oviposition. When the egg laying was completed, the egg masses were examined for counting the total number of eggs under a binocular microscope. The percentage of egg viability was also determined on the basis of emerged larvae of *C. tumidicostalis* from 100 number of eggs observed.

Parasitism of eggs:

To determine the extent of parasitism by the egg parasitoids, five egg clusters were collected from each of the three fields in each generation and kept in small glass specimen tubes separately for hatching and the number of hatching larvae as well as the number of parasitoids emerged was counted. On completion of hatching, each egg mass examined separately for recording the parasitoids. The percentage of egg parasitism was determined on the basis of the total number of eggs observed.

Sex ratio:

To find out the sex ratio of the insects, adults from laboratory reared population and those emerged from field collected pupae were observed for their sexes. A total of fifty moths were examined for this purpose. The total number of generation/year was determined continuously rearing the insects in the laboratory from April to next October. The total number of generations/ year was also determined in the field. The first appearance of the pest was determined by starting periodic observations from the last week of February where the pupation of fifth generation larvae commenced.

Fifty numbers of plassey borer affected canes were collected randomly from each field at the time of harvesting. The collected canes then cut open longitudinally to record the presence of larvae, pupae and also pupal exuvae (to ascertain moth emergence).

RESULTS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Peak period of moth emergence in different generations:

The peak period of moth emergence in different generations was studied and it was evident that the moth emergence during the period of study did not start on the same day in respect of different generations. It was seen that the emergence of moths in each generation continued for more than one week (7-12 days), but the maximum emergence of moths took place within a week (Table 1). The left over pupal exuviae in the feeding tunnels and the exit holes were also considered to record

the moth emergence.

Fecundity, egg viability and egg parasitism in different generations during 2014-15:

From the investigation, it was observed that the maximum average fecundity of 136.0 numbers was recorded in the fifth generation and minimum was in second generation (88.0 numbers). The highest per cent egg viability (82.8%) was recorded in fourth generation and lowest (77.20%) was observed in fifth generation. In case of per cent egg parasitism, the maximum (4.41%) was recorded in fourth generation and lowest of 1.83 per cent was observed in first generation (Table 2). However, no egg parasitoid could be recorded during the second and fourth generation in the year 2014-15. The larval parasitism was also lower as compared with that of the first and fifth generation.

Factors influencing carryover of pest from one season to another:

Time of harvesting:

Observations were made on sugarcane variety 'Barak' to determine the influence of the time of harvesting on the extent of carryover of the pest to the succeeding crop during the crop season, 2014-15. Three different fields, where the crop was harvested on three different dates were selected for the purpose.

The data presented in the Table 3 revealed that when the crop was harvested on 14.02.15, 28.02.2015 and 7.03.2015 (field 1, 2 and 3) only 5th instar mature larvae were observed in the crop. However, it was observed that the crop harvested on 7.03.15 indicated that most of the larvae transformed to pupae and the moths had already emerged to the extent of 12.0 per cent followed by the crop harvested on 28.02.14 where the plassey borer moths had already emerged to the extent of 8.0 per cent. Therefore, it could be assumed that when the crops were harvested earlier the population of larvae could be destroyed during operation of harvesting and crushing. It was evident from the table that late harvesting of crop after second week of March made emergence easy for the moths which would lay eggs on the ratoon sprouts (October planted crops and late tillers that remained unharvested in the fields).

The Table 3 indicated that the time of harvesting of the crop was one of the important mortality factors for the fifth generation of *C. tumidicostalis*, as only those larvae could contribute to the next generation, which survived due to delayed harvesting. It was evident from the present investigation that the *C. tumidicostalis* moths of overwintering brood emerged to the extent of 12.0 per cent, when the crop was harvested late on 7.03.2015 (Table 3). It was observed that when the crops were harvested by the end of February, the early sprouted ratoon growth of early harvested crop attracted the moths of fifth brood and provided sufficient food to the first generation and the infestation in this crop was higher than that in late harvested crop. Therefore, the late

Table 1 : Peak period of moth emergence of *C. tumidicostalis* in different generations

Generation/year	Date of observation	Emergence of moth	
		Peak period	Per cent emergence
I Generation	20.04.14	4th week of April	22
	25.04.14		38
	03.05.14		26
II Generation	2.06.14	3rd week of June	14
	9.06.14		56
	16.06.14		18
III Generation	22.07.14	4th week of July	49
	29.07.14		26
	4.08.14		19
IV Generation	17.08.14	2nd week of September	22
	24.08.14		52
	1.09.14		19
V Generation	3.10.14	2nd week of March	12
	10.10.14		08
	17.10.14		05

harvested crops after second fortnight of March facilitated easy emergence of the fifth brood moths which would lay eggs on the ratoon sprouts and late tillers that remain unharvested in the field. However, the removal of the late tillers that remain unharvested in the field might reduce the population of plassey borer on the sprouts of ratoon crops.

Late tillers:

Observation of the late tillers that remained in the field after harvesting, the crops were selected randomly from three different fields at different dates. From the investigation, it was observed that the fifth generation started during the 1st week of October, 2014. It was observed that during winter, the larval stage became prolonged. The borer continued its activity in the late tillers that remained after harvest of the crop. An investigation of the pest activity on left over tillers after harvest revealed that from March to April, the late tillers harboured late instar larvae, as in the case of main crop of canes. Fresh egg masses were also found in the late tillers during April, 2015.

The data presented on Table 4 showed that 10.0 per cent of borer larvae were recorded in late tillers. It was evident from that the population of winter brood through late tillers would also contribute to the extent of carryover of the pest to the succeeding crop.

These findings indicated that early ratoon sprouts helped in the carryover of the pest to the succeeding crop by producing sprouts after harvesting of crop. The late harvested crop helped in the emergence of the first brood moths which would lay eggs on the early ratoon sprouts. Therefore, simultaneous harvesting of the crops before February end in a locality would help in checking the carryover of the pest to a great extent.

Similar results were also obtained by Saikia (1993) in case of sugarcane early shoot borer, *Chilo infuscatellus* and reported that the early shoot borer moths of overwintering brood emerged to the extent of 56.4 per cent, when the crop was harvested late on last fortnight of March. The early shoot borers were found to develop on the late tillers and the maximum emergence of moths from these tillers was recorded to the extent of 9.5 per cent. The early ratoon sprouts helped in the carryover of the pest and also in the population build up of the pest to the succeeding crops by producing plants earlier than the late harvested crops.

Table 2: Fecundity, egg viability and egg parasitism of *C. tumidicostalisi* in different generations during 2014-15

Generation	Average fecundity	Per cent			Peak period of moth emergence
		Mortality/ sterility	Viability	Parasitism	
I Generation	109.0	19.23	78.89	1.83	4th week of April
II Generation	88.0	20.45	79.5	-	3rd week of June
III Generation	116.0	19.82	75.86	4.31	4th week of July
IV Generation	128.0	17.18	82.8	-	2nd week of September
V Generation	136.0	18.38	77.20	4.41	2nd week of March

* Average of 10 females

Table 3: Effect of harvesting time on the population of *C. tumidicostalis* during 2014-15

Field No.	Date of harvesting	Larvae		Pupae		Moth emerged	
		Live	Dead	Live	Dead	No.	Per cent
1	14.02.2014	15	2	0	0	2	4.0
2	28.02.2014	11	1	2	0	4	8.0
3	7.03.2015	18	0	3	1	6	12.0

Data based on 50 infested canes

Table 4 : Effect of late tillers on the population of *C. tumidicostalis* during 2015

Field No.	Date of observation	Larvae		Pupae		Moth emerged	
		Live	Dead	Live	Dead	No	Per cent
1	20.12.14	8	-	-	-	-	-
2	27.12.14	3	1	7	-	-	-
3	5.01.15	-	-	2	2	5	10.0

Data based on 50 late tillers in each field

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