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BEHAVIOUR OF COFFEE WHITE STEM BORER BEETLE IN THE FIELD#

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SUMMARY

Information on the behaviour of the coffee white stem borer adult in the field is scanty. Hence, the present investigations were undertaken to study in detail the flying, mating and oviposition behaviour of the beetle in the field by erecting a field cage to confine the beetles and observe their activity continuously during both the summer and winter flight periods. The observations indicated that, maximum mating occurred between 10 am to 4 pm during the summer period and 12 to 4 pm during the winter season. This indicates that the ambient temperature should be more for successful mating. These results correlated with flight activity in that the maximum flight activity of the beetles took place between 10 am to 3 pm during summer and 11 am to 4 pm during winter i.e. during bright sunshine. Under optimum temperature and sunshine, the mating duration was found to be 9.79 ± 1.28 seconds in winter and 7.97 ± 0.78 seconds in summer. The borers required bright weather rather than cloudy conditions for egg-laying which was more between 12 to 16 hours. More egg-laying was observed on the main stem rather than on other sites.

INTRODUCTION

The coffee white stem borer, *Xylotrechus quadripes* Chev. (Coleoptera: Cerambycidae) is one of the most serious pests of arabica coffee, which has the potential to destroy large acres of

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arabica coffee plantations leading to huge production lossess every year. The white stem borer, probably a South East Asian species, has been recorded from China (Kuang *et al.*, 1977; Rhainds *et al.*, 2001), Sri Lanka, Thailand, Vietnam, Java and Burma (Le Pelley, 1968) and India (Stokes, 1838). In India, it is distributed in all the coffee tracts of South India. It has also been reported from Assam and Bengal (Beeson and Bhatia, 1939). Stokes (1838) was the first person to report the borer attack on coffee in Mysore. The work on the biology of *X. quadripes* has been carried out by several scientists (Anstead 1915, Kunhi Kannan, 1918, Nicolson 1913, Coleman 1915, Subramanyam 1940, Subramaniam 1934 and Veeresh 1993). The behaviour of the beetle after emergence from the tunnels has been studied to some extent by Subramaniam (1941) and Veeresh (1993) in India and Visitpanich (1994) in Thailand.

The adult beetles after their emergence were able to fly from one plant to another for a long distance with a buzzing sound and had the habit of suddenly dropping down to the ground when disturbed and quickly taking shelter under dry leaves and cracks of the soil. The beetle emergence was more during the morning hours; from 9 to 12 noon. Though studies on fecundity, longevity and field behaviour of stem borer were carried out in Northern Thailand by Visitpanich, (1994), similar reports are not available from India. Hence, investigations were undertaken to understand the behaviour of the beetles in the field, like mating, egg laying and flight activity and the results obtained are presented and discussed in this paper.

MATERIALS AND METHODS

The emergence of coffee white stem borer is noticed in two bouts in a year. The beetles that emerged during April-May months were considered as summer beetles and those emerging during October-December as winter beetles. For monitoring the behaviour under the field conditions, a field cage of size 36 x 24 x 12 feet was erected using galvanized iron poles as frame, fixed firmly with

cement concrete, at the CCRI farm enclosing twenty-eight arabica coffee (S.795) plants. The top and sides of the cage were covered with white nylon mesh. A maximum-minimum thermometer and a hygrometer were kept inside to record the temperature and humidity. Fifty pairs of unmated male and female beetles were let into the cage and their behaviour was monitored constantly. Resting sites, flying and mating behaviour and egg-laying habit at different time intervals were noted. The observations were repeated during two flight seasons and a comparison of the behavioural activity was done.

RESULTS AND DISCUSSION

Flight activity

The observations recorded on the flying habit of the stem borer adult are presented in Table 1.

Table 1. Flight activity of *X. quadripes* in the two flight periods

Particulars	April-May	October-December
Flight activity	10.00 AM - 3.00 PM	11.00 AM - 4.00 PM
Distance of flight (feet)	4.27 ± 0.56 (1-12)	9.38 ± 1.50 (2-36)
Duration of flight (seconds)	3.06 ± 0.38 (0.5-8)	3.88 ± 0.39 (1.3-10)
Temperature - Minimum (°C)	28.72 ± 0.39 (26-35)	24.8 ± 0.56 (19-27)
Maximum (°C)	32.86 ± 0.56 (27-39)	28.58 ± 0.23 (26-32)
% Humidity	52.93 ± 1.73 (35-68)	58.70 ± 1.49 (40-75)
Nature of flight- Straight (%)	51.72	61
- Circular (%)	42.28	39
% Activity - in sun shine	82.75	83.87
- in cloudy	17.25	16.13

Values in parenthesis are range

The data obtained indicated that the maximum flight activity of the beetles was between 10 am and 3.00 pm in summer and 11 am to 4 pm in the winter flight seasons with an average flight

distance of 9.38 ± 1.5 feet/flight in winter and 4.27 ± 0.56 feet/flight in summer season. The average time taken for flight was 3.88 ± 0.39 seconds/flight in winter and 3.06 ± 0.38 seconds/flight in summer. It was observed that 61% flight in winter and 51.72% in summer were of the straight type whereas, 39% in winter and 42.28% in summer were of the circular or hovering type. The flight activity was more pronounced (83.87% in winter, 82.75% in summer) during bright sunshine and less during cloudy weather (16.13% in winter, 17.25% in summer). During the study period, the temperature range was between 24.8 and 28.58°C during winter and 28.72 to 32.86°C during summer while, the average relative humidity was 58.70 % and 52.93 % respectively. Similar diurnal behaviour has been observed in adults of *Xylotrechus chinensis*, the mulberry borers, which were active between 14 hr and 16 hr (Iwabuchi *et al.*, 1987). During the present study, observations in the night did not show any activity of the borer. Subramanyam (1940) had observed that the beetles remained in the same place during the night, indicating no nocturnal activity. It is evident that the incident light plays a crucial role in the behaviour of this pest. Hence, shade plants in the coffee plantation play a major role in the management of this pest as it has been observed that exposed coffee plants were more prone to attack, because of the fact that the beetles were active. Similarly pheromone traps must be set up when the beetles are very active. This is further strengthened by the observation that beetles were inactive and had no flight during the night. In this study the flight was restricted but it is possible that the borer adults are capable of flying long distances and this need to be investigated further.

Mating activity

The data on mating activity is presented in Table 2.

Table 2. Mating activity of *X. quadripes* during the two flight periods

Particulars	April-May	October-December
Time	10.00 AM–2.00 PM	12.00 Noon–4.00 PM
Duration of mating (in seconds)	7.97 ± 0.78 (2–17)	9.79 ± 1.28 (3–29)
Temperature - Minimum (°C)	29.11 ± 0.48 (24–35)	25.22 ± 0.21 (24–27)
- Maximum (°C)	32.23 ± 0.53 (25–39)	28.22 ± 0.24 (27–30)
Relative humidity (%)	49.43 ± 1.51 (39–68)	57.33 ± 1.61 (48–73)
Mating activity - in bright sun shine	94.58%	88.88%
- in cloudy conditions	5.72%	11.12%

Values in parenthesis are range

From the data it is clear that the time between 12 and 16 hours, during the winter flight period and 10 and 14 hours during the summer flight period was ideal for mating activities. This may be because of the optimum temperature prevailing at the respective time intervals during the summer and winter flight period. Further, during the early hours of winter the prevailing low temperature might not have stimulated the two sexes to court. The mating duration was found to be 9.79 ± 1.28 seconds in winter and 7.97 ± 0.78 seconds in summer. Statistically, these two values are not significantly different ($P > 0.05$). Thus, the duration of mating was same in both the seasons and hence seasons have no role in changing the mating duration.

Observations on the mating sites were recorded during both the flight periods and the data obtained are presented in Table 3.

Table 3. Details of mating at different sites inside the field cage

Particulars	April-May (%)	October-December (%)
Site of mating on the plant		
- main stem	5.98	33.33
- on the branch	1.50	11.12
- on the fruits	00	5.55
- upper surface of leaves	00	11.12
- lower surface of leaves	00	00
Total on the plant	7.48	61.12
Site of mating on sides of the cage		
North	8.95	5.55
South	25.37	5.55
East	25.37	11.12
West	2.98	00
Top	29.85	16.66
Total on the sides of the cage	92.52	38.88

Note: April – May (Summer flight period); October-December- (Winter flight period)

It was observed that the mating of the beetles took place more on the main stem (33.33 %) during winter compared to other places. On the other hand, during the summer period, the maximum mating of only 5.97 % was observed on the main stem. In observations made inside the cages, the sides of cages were more preferred for mating (38.88 % in winter and 92.54 % in summer). Site selection for mating is also an important behavioural trait. In the present investigations, during the summer season, the sites for mating were the sides of the cages (92.54%) whereas on the main stem of the coffee plants it was only 5.97%. But during the winter season, the mating activity was only 38.88 % on the sides of the cages and 33.33 % on the main stem. This might indicate that for successful mating beetles preferred a shady place. In summer, shade trees were without leaves and hence beetles moved on to the sides of cages possibly in search of a shaded area to mate. Whereas during the winter season, whether it was

the cage or the coffee plant, both were having same intensity of shade and hence recorded the same frequency for mating.

Egg laying activity

The comparison of egg laying activity of the two flight seasons is given in Table 4.

Table 4. Egg laying activity of *X. quadripes* during the two flight periods

Particulars	April-May	October-December
Time	12.00 Noon–4.00 PM	12.00 Noon–4.00 PM
Duration of egg laying (seconds)	10.86 ± 0.97 (6–20)	12.13 ± 1.07 (4–19)
Temperature - Minimum (°C)	31.16 ± 0.72 (26–38)	25.50 ± 0.43 (23–28)
- Maximum (°C)	34.33 ± 0.82 (31–39)	28.50 ± 0.49 (25–30)
% Humidity	48.33 ± 2.33 (39–60)	60.40 ± 2.47 (56–74)
Egg laying activity- in bright sunshine	88.42%	80.00%
- in cloudy conditions	11.58%	20.00%
Egg laying percentage - on main stem	78.57	98.00
- on branches	21.43	2.00

Values in parenthesis are range

During both the flight periods, egg laying occurred between 12 noon to 4.00 pm with an average egg laying duration of 12.13 ± 1.07 seconds in winter and 10.86 ± 0.97 seconds in summer season. More egg laying activity was observed on the main stem and thick primaries (98 % in winter and 78.57 % in summer) and less on the branches (2 % winter and 21.43 % in summer). Egg laying was also more during bright weather conditions (80 % in winter and 88.42 % in summer) and less during cloudy weather (20 % and 11.58 %) in the two-flight seasons. During the egg laying period, the average temperature ranged from 25.50 to 28.50°C in winter and 31.16 to 34.33°C in summer with an average relative humidity of 60.40 % in winter and 48.33 % in summer. The data indicated that more egg laying activity was on the main stem and thick primaries than on any other place. This may be because

of the availability of large number of cracks and crevices on the bark of the main stem, which is suitable for egg laying rather than on the other sites such as leaves, tender stem etc. Bright weather conditions were more suitable for egg laying than cloudy weather. It was interesting to note that the egg laying was not a continuous process and intermittent mating and egg laying were observed in the two-flight seasons. It was also observed that a female accompanied by a male laid more number of eggs than alone, indicating that repeated mating contributed to increased egg laying.

Resting sites

Observations on the resting sites indicated that 73.9% of adult beetles remained on the sides of the cage (North-12.3%, South-12.15%, East-21.97%, West-13.1%, and 14.58% on the top of the cage), 5.42% of the beetles rested on the main stem and thick primaries, 5.88% on the branches, 3.03% on the ground 5.21% on the upper surface of leaves and 4.5% on the under surface of leaves during the winter flight period. Where as, during the summer flight period 92.73% of adult beetles remained on the sides of the cage (North-13.58%, South-18.86 %, East-22.25%, West-9.58%, and 28.33% on the top of the cage), 3.52% of the beetles rested on the main stem and thick primaries, 1.72% on the branches, 1.75% on the ground, 0.22% on the upper surface of leaves and 1.46% on the under surface of leaves.

Observations on the resting sites of the beetles indicate that they tend to remain more on the sides of the cage. The beetles tended to remain more on the east side of the cage than the other sides during both the flight periods. In summer season they also spent more time on the roof of the cage. This activity might indicate that the beetles spend more time on the shade trees than on the coffee plants. Apart from this, they also remain on the main stem and thick primaries, branches, ground, upper and under surface of leaves for some time. This may be due to the fact that they may come down on to coffee plants specifically for egg laying.

The Information genetrated in this study on the behaviour of the coffee stem borer beetle could be useful for designing new methods for management.

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