Mysore J. Agric. Sci., 51 (2) : 240-243, 2017

Intermittent Mating and Egg Laying by Coffee White Stem Borer, *Xylotrechus quadripes* Chevrolat (Coleoptera : Cerambycidae)

F. R. Pattan and H. Khader Khan
Department of Agricultural Entomology, College of Agriculture, UAS, GKVK, Bengaluru-560 065

Abstract

The present investigation on reproductive biology of Coffee White Stem Borer *Xylotrechus quadripes* Chevrolat (Coleoptera : Cerambycidae) was carried out at the Chandrapore coffee estate, Mudigere, India during 2015 – 2017. Immediately after emergence the beetles started mating. The average duration of was 25 seconds but the oviposition started only after 24 hours. A female mated 5.07± 1.49 times with the same mounted male, before commencing egg laying. Maximum eggs were laid in the first week of emergence with an average of 35.28 ± 19.01 eggs on the 4th day. Oviposition period varied from 6 to 22 days. A female beetle mated multiple times 12.2 ± 2.04 in its life span of 27.74 ± 5.65 days, exhibiting peculiar intermittent mating and throughout egg laying behavior. Fecundity ranged from 89 to 265 eggs (140.72 ± 42.50).

Keywords: *Xylotrechus quadripes*, *coffea arabica*, oviposition, multiple mating

Xylotrechus quadripes (Chevrolat), the coffee white stem borer (CWSB), is a major pest of arabica coffee (*Coffea arabica* L.) in some Asian countries. CWSB grubs make tunnels in the main stem and thick primary branches of coffee plants. The pest causes substantial economic loss every year since infested plants have to be uprooted (they act as source infestation and further spread of the pest). CWSB has two flight periods in India (Subramanian, 1934): the pre-monsoon flight period begin in April and extends to the end of May and the post-monsoon period starts from September to until the end of December. In India, coffee has been at the receiving end of the onslaught by CWSB since several decades. Its preferential attack on arabica (as against robusta) and the persistently high population density has had a telling blow on coffee in India; farmers have either abandoned cultivation of coffee or have shifted to robusta coffee. CWSB was noticed as early as in 1838 (Stokes, 1838) and owing to its serious nature it was brought under the destructive insects and pests act VI, 1917 by the erstwhile Mysore Govt., making it compulsory to undertake strict control measures to prevent its spread. However, it has to be acknowledged that despite considerable efforts, the pest has not been brought under check till date. It is noteworthy that most of the efforts made so far have gone towards managing the pest rather than in understanding its biology and ecology, which may be the reason behind the series of failures throughout the coffee growing areas of the country. The present work is a part of detailed study on reproductive biology of CWSB conducted during 2015-17.

Material and Methods

Study area : The studies were conducted from 2015-17 at Chandrapore Coffee Estate in Mudigere, Karnataka (India) (13^0 0' 44^0 N; 75^0 41'36^0 E, 962.25 m above MSL). The estate is spread over the 432 acre of land and it was completely uprooted and replanted in 2008 because of the severe incidence of *X. quadripes*.

Mudigere is with in the range of Western Ghats of Karnataka and is located in the Agro Climatic Region-V, Zone-9. It receives an annual rainfall ranging from 900 to 3700 mm (mean: 2400 mm) and most of it is received from June to August months (104 rainy days). The average maximum temperature is 30^{o}C (April) and minimum temperature is 14^{o}C (January). The relative humidity ranges between 50 and 80 per cent.

The source and stock culture of adults for studies : In the month of September - October a total of 1229 infested plants were identified, uprooted and brought to the laboratory and were placed in nylon mesh house (10 feet x 10 feet x 06 feet). The uprooted

coffee plants were five to eight years old. Daily observations on emergence of the adult beetles in the mesh house were recorded and then sex ratio was calculated. When the adult beetles began to emerge in mesh house, they were collected and released in to plastic boxes (2 kg capacity) for mating. Each mated pair was carefully transferred to a larger cage (4 feet x 2 feet x 2 feet) provided with coffee sticks for egg laying.

To facilitate CWSB to lay eggs in the plastic container, the mouth of the container was closed tightly with muslin cloth. Then the container was inverted on a sheet of white paper in such a way that muslin cloth covered mouth was resting on the sheet of paper (Fig. 1).

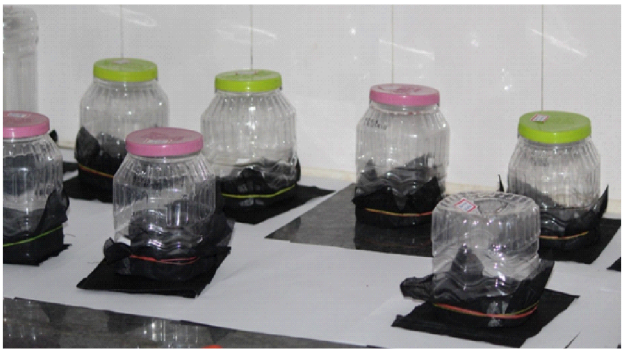

Fig. 1 : Plastic boxes with closed tightly with muslin cloth to facilitate eggs laying

Observations on the reproductive biology : Twenty five pairs (13 pairs in November, 2015 and 12 pairs in November, 2016) of virgin male and female beetles were transferred to the container immediately after emergence with sex ratio of 1:1. The observations were recorded on the copulation duration, pre-oviposition period, oviposition period, number of successful copulations to lay one clutch of eggs, process of alternative mating and egg laying against to the adult longevity and total number of eggs laid by a female.

Results and Discussion

Intermittent mating and egg laying: The mating started soon after emergence of both sexes from the stems of infested coffee tree. Each of them mated several times in a day but the oviposition started only after 24 hours (Table I). When the beetles were allowed to mate at 1:1 sex ratio, it was always the male that attracted the female, as was also observed by Venkatesha *et al.* (1995). However, Veeresh (1995) had reported that the males are attracted to females in CWSB. One successful copulation took 3-50 seconds duration. After 3-7 such copulations the female started laying eggs. The adult female intermittently mated with the male and laid batches of eggs. This intermitted mating and oviposition continued throughout its life. On an average a female mated 12.2 times (n=10). CWSB females seen occasionally mounted on conspecific females (Fig. 2). The maximum number of eggs per batch was 19.3. Most of the eggs were laid within such six batches and later the number of eggs per batch decreased as was the frequency of mating (Fig. 3).

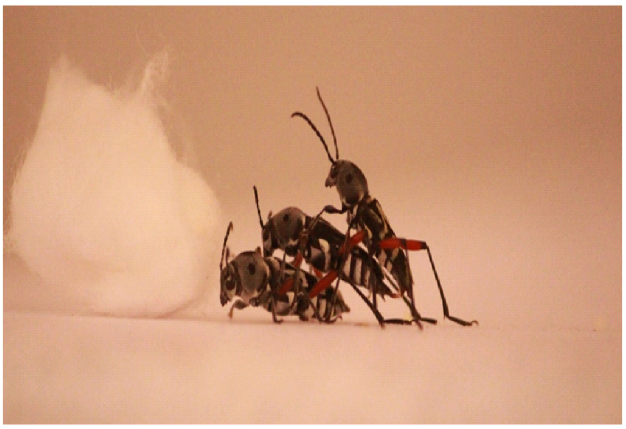

Fig. 2: Male successfully copulating with female and the female mounted on the other female under 5:3 (male: female) sex ratio

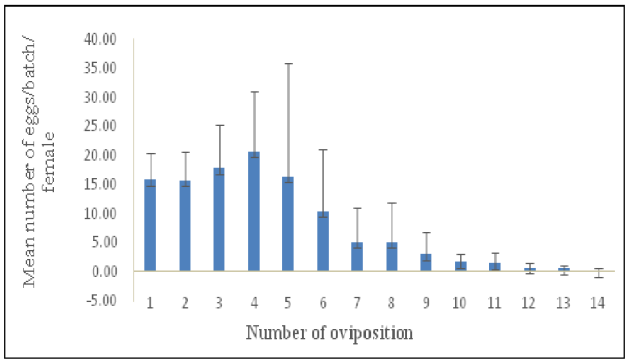

Fig. 3. The mean number of eggs per batch per female laid by *Xylotrechusquadripes*

Adult longevity: The average lifespan of 25 mated pairs were 27.74 days for females and 20.88 days for males (Table II). The longevity of females were longer than that of males. Linsey (1959) also

TABLE I

Courtship behaviour of Xylotrechus quadripes *under controlled condition*

Time of the day	Courtship behaviour exhibited by *X. quadripes*
10:30	Male sat on the floor of the mating box (designed for oviposition) and female was bit active often flying and sat at the roof of the box.
10:35	First male started fluttering wings and cleaning antennae then sidewise movement of antennae. Repeated movement of wings and antennae by male, but female just sat at the corner of the roof.
10:45	Female started fluttering wings and moving antennae.
10:55	Finally female started hovering around the male (not very close). Then again sat at the corner of the roof and did suchrepeated warm up exercises.
11:10	Later female started hovering around the male and finally landed at very close to male (approx. 5-6 cm).
11:13	Then female started antennal movement and wing fluttering movements.
11:25	Male makes the first move by moving towards female and touches the female and tried to mount on the females.
11:40	But female tried to escape.
11:43	Then male follows the female again attempted to mount on it, but female did not cooperate and again she ran away.
11:50	Finally this time male successfully mount on the top of the female and tries to copulate with female.
12:00	Male started mating with female (exchange of sexual organs).
13:10	One successful copulation took 3-50 seconds duration. After 3-7 such copulations the female started search of egg laying site. It started moving all along the border of the box and repeated insertion of the oviposition. Finally after 5-6 revolving rounds she starts laying eggs into the muslin cloths.
16:20	Again she sat at the roof of the mating box….

TABLE II

The longevity of mated adults of Xylotrechus quadripes

Sexes	No. individuals examined	Longevity (Days) Mean ± SD	Range (Days)
Males	25	20.88 ± 4.88	7 – 35
Females	25	27.74 ± 5.65	11 - 41

recorded longer lifespan of females compared to males. Majority of the eggs were laid within the first week and the eggs per day per female reached maximum (38.28 ± 19.01 eggs / day) on the fourth day of emergence (Fig. 4). On an average a single female was able to lay 140.72 ± 42.50 eggs. When the male of the mating couple died and a new male was introduced, the number of eggs per female temporarily increased in some mated females. Oviposition period varied from 6 to 22 days. Visitpanich (1994) reported that oviposition period varied from 2- 39 days with lower number of eggs per day (maximum of 15 eggs per female on fourth day) for longer duration. But in the present study the number of eggs laid per day per female was twice as many with a shorter oviposition period.

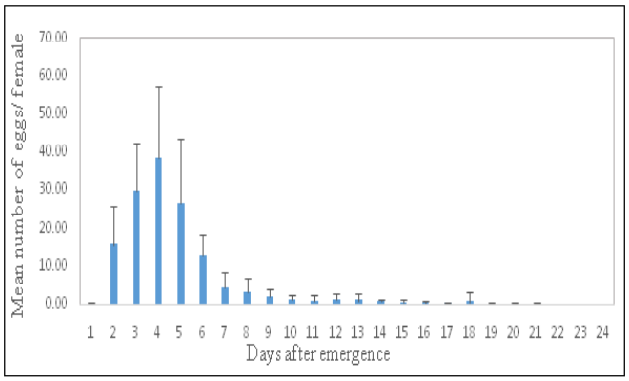

Fig. 4: The mean number of eggs laid by *Xylotrechus quadripes* (n = 25)

Sex ratio varied along the winter flight period

In two winter flight periods of 2015 and 2016 (both in laboratory and field conditions) males emerged first compared to females by four to five days (protandry) than that of females. At the flag end of flight period there were only females emerging but no males to mate. Sex ratio (Male : female) reduced as the flight period progressed. But in summer flight period (2016) protandry was not observed (Fig. 5).

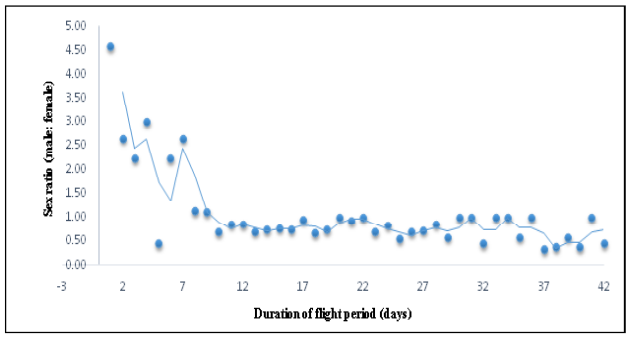

Fig. 5: Sex ratio of *Xylotrechus quadripes* varied along the flight period

The present study implies that the CWSB exhibits female biased sex ratio coupled with multiple mating to lay eggs. If the male is available at the time of emergence then they would mate within a week and lay maximum eggs, but it will not happen in nature because coffee estate is multistoried cropping system. It is difficult to locate mate hence the adult longevity of beetles is may be high.

REFERENCES

LINSLEY, E. G., 1959, Ecology of Cerambycidae. *Annual Review of Ent.*, **4** : 99-133.

STOKES, H., 1838, Report of the Commissioner, Mysore, p. 1838.

SUBRAMANIAM, T. V., 1934, The Coffee Stem Borer. *Entomological Series-Bulletin*, Dept. of Agriculture (Mysore, India), **11**: 1–18.

VEERESH, G. K., 1995, Bioecology and Management of Coffee White Stem borer: *Xylotrechus quadripes* (Chev.). University of Agricultural Sciences, GKVK, Bengaluru, p. 56.

VENKATESHA, M. G., BHAT, P. K. AND SEETHARAMA, H. G., 1995, Courtship behaviour of the coffee white stem borer, *Xylotrechus quadripes* (Chevr.) (Coleoptera : Cerambycidae). *J. Coffee Res.*, **25** : 88–93.

VISITPANICH, J., 1994a, The biology and survival rate of the coffee stem borer, *Xylotrechus quadripes* Chevrolat (Coleoptera, Cerambycidae) in Northern Thailand. *Japanese J. Ent.*, **4**: 731–745.

(*Received :* May, 2017 *Accepted :* June, 2017)