

Biology and Morphometrics of Cashew Stem and Root Borers (CSRB) *Plocaederus ferrugenus* and *Plocaederus Obesus* (Coleoptera: Cerambycidae) Reared on Cashew Bark

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Abstract- The biology of cashew stem and root borers *Plocaederus ferrugenus* L. and *P. obesus* Gahan (Coleoptera: Cerambycidae) was studied on cashew bark under laboratory conditions. In case of *Plocaederus ferrugenus* L the mean grub period was recorded 163.10 ± 20.55 and 168.37 ± 30.32 days, mean pupal period was 144.33 ± 29.57 and 145.16 ± 29.10 days for males and females, respectively. The total development period ranged between 261-363 days (male) and between 242-356 days (female). In case of *Plocaederus obesus* Gahan., mean grub period was 152.75 ± 31.35 and 158.49 ± 33.26 days, mean pupal period was 142.90 ± 22.57 and 152.34 ± 38.46 days for males and females, respectively. The total developmental period ranged from 226 to 379 days and 247 to 347 days for males and females respectively. The duration of grub stage was more than 40 per cent of the total life duration of *Plocaederus* spp.

The details of adult morphometrics of *P. ferrugenus* L. indicated that in case of males, the mean body length was 38.8 mm; mean body width being 8.76 mm and mean body weight being 0.89 g; the females had mean body length of 33.5mm; mean body width of 10.29 mm and mean body weight of 1.39g .

The morphometric details of adults of *P. obesus* males indicated a mean body length of 38.6 mm; mean body width of 8.63 mm and mean body weight of 1.4 g, while females had mean body length of 36.6 mm; mean body width of 9.31 mm and mean body weight 1.76 g.

In both the species, the length of pro, meso and meta thoracic legs did not differ significantly, wing to elytra length was in the ratio of 1: 0.9.

Index Terms- Biology Cashew stem and root borers, morphometrics, *Plocaederus ferrugenus*, *P. obesus*.

I. INTRODUCTION

The cashew stem and root borers (CSRB) *Plocaederus* spp. are major pests of cashew in all cashew growing tracts of India (Abraham, 1958, Pillai, 1976, Rao, E.V.V.B., 1998) and a few other cashew growing countries (Asogwa *et al.*, 2008) and pose a serious problem in realizing the maximum yield potential of cashew nut. The grubs form irregular tunnels in the cashew bark of the stem and roots, thereby damage vascular tissues resulting in gradual yellowing of the foliage of yielding trees and

subsequently lead to death of trees, thereby reducing the tree population. The presence of grubs can be recognized by the exudation of frass and gum in the infested region, usually in the collar zone in early stages and gum as well as coarse frass, yellowing canopy at the later stage of infestation.

Morphometrics of immature stages of *P. ferrugenus* L. was reported earlier by Senguttuvan and Mahadevan (1998). However, detailed morphometrics of all the developmental stages of both the species of *Plocaederus* have not been recorded. Keeping in view the lacuna of information particularly on these species, the present studies were undertaken at the Directorate of Cashew Research (DCR), Puttur, India from 2010-12 under laboratory conditions by rearing these species on the natural host, cashew bark in order to understand the life cycle and duration of the developmental stages and morphometrics of all the stages of both the species of CSRB.

II. RESEARCH ELABORATIONS

A. Field survey and collection of CSRB grubs

The grub stages of the pest species were collected from infested trees in the experimental plots of Directorate of Cashew research (DCR) Kemminje, Karnataka, India, from March 2010 to August 2012. These CSRB grubs were reared individually using cashew bark in rearing bottles which was replaced regularly at intervals of 8-10 days with spraying of water to conserve moisture. (Raviprasad and Bhat, 2000). The grubs were reared till pupation which was identified by smearing of calcium on the walls of the rearing bottles.

B. Adult rearing

The rearing bottles containing the cocoons were observed daily for collection of emerging adult beetles. The emerging beetles were transferred to acrylic cages (30x30x30 cm), containing cotton wad dipped in honey solution (20%) as feed. A total of 150 beetles of *P. ferrugenus* and 50 beetles of *P. obesus* were used for these studies on adult biology and morphometrics. The adult beetles selected for recording morphometrics were inactivated by keeping them under refrigeration for 30-40 min at 0°C. The body length (in mm), body width (in mm) and body weight (in g), length of antenna and antennomere, length of the legs, wings and elytra were

recorded. Longevity was recorded from date of adult emergence till death of the beetle.

C. Egg collection

A stout cashew stick (30 cm long and 2.0 cm dia.) wound snugly with a cotton tape was provided in the oviposition cage as standardized by Raviprasad and Bhat;2007, to facilitate oviposition by the pest beetle. Details of adult longevity, pre-oviposition period, oviposition period were estimated and the oviposition index was calculated for both the species as follows: Oviposition index = Oviposition life span of a female / total life span.

The cadaver of the female beetles was dissected for the presence of any unlaidd eggs and this was also considered to calculate the fecundity. Pre-oviposition period was recorded from date of adult female emergence till first oviposition. Eggs laid beneath the cotton tape were collected daily by unwinding the cotton tape. The number of eggs and date of oviposition were recorded. The length, width (at the longest and widest part, in mm) and weight (in g, using an electronic balance) of the eggs were recorded. (100 eggs were randomly used) Eggs obtained from lab cultures were placed in petri plates and the number of eggs and date of oviposition were marked suitably on these petri plate. A few cashew bark pieces (1 x 1 cm) were placed as feed for the nascent grubs, in order to check mortality due to lack of food. The eggs obtained were placed daily in separate petri plates and labeled with the date of oviposition.

D. Rearing of nascent grubs

Observations on egg hatching were done twice a day during 10.00 am and 3.00 pm. The date of first to last hatching was recorded for all the batches. The nascent grubs were weighed, measured and transferred into small incision on 1 x 1cm bark to facilitate feeding and entry by the grubs. These bark pieces with the nascent grubs inside were placed at 10 no.s per petri plate (15 cm dia.). Moisture content of the cashew bark was maintained by spraying clean water daily. Subsequently, after 15 days of hatching, the grubs were carefully removed from the bark pieces and transferred to individual rearing bottles to avoid cannibalism.

E. Feed change during rearing

Fresh cashew bark pieces were replaced regularly at ten days interval as per the standardized rearing technique (Raviprasad and Bhat, 2000). In order to obtain the percentage weight increase of the grubs they were weighed using an electronic balance simultaneously during the process of feed change. The mean percentage weight gain was calculated as follows:

$$\text{Net weight gain (N)} = \text{Final weight (F)} - \text{Initial weight (I)}$$
$$\% \text{ difference in body weight} = \frac{F - I}{I} \times 100$$

The rearing bottles were observed daily for the moulting of the grubs which could be confirmed by the presence of exuvium of the previous grub stage on the date of observation. The weight (in g) and morphometric details viz. length, prothoracic shield (PTS) width (in mm) of every instar of the CSRБ grubs were recorded with the help of a vernier slide caliper. (Raviprasad and

Bhat 2010) (A batch of 100 grubs was randomly observed for this purpose).

Observations were also done for the presence of pupation symptoms such as smearing of calcareous material in the rearing bottle. Date of pupation was labeled on the rearing bottle. Such bottles having indication of pupation were screw capped with porous cap to prevent the escape of the adult CSRБ beetles after emergence.

After one month of pupation the calcareous cocoons were carefully detached by prying out using a blunt tool from the sides of the rearing bottles and the morphometric details viz. weight (g), the length, width at the broadest part, were recorded. The cocoons were left without disturbing for future adult emergence in the rearing bottles.

III. RESULTS

A. Morphometrics of different stages of *P.ferrugineus*

a. Egg

The eggs were creamy white in colour, oval in shape, resembled rice grains, and were laid singly or rarely in groups of 3-5. The eggs were of 3.73 mm (range 3.0 - 4.2 mm) in length and 1.0 mm (range 0.8 - 1.1mm) in width and weighed 0.01 g (range 0.004-0.007).The incubation period was recorded to vary, in case of eggs leading to males it ranged from 3 – 12 days (Mean 6.6 ± 0.68) and in case of eggs leading to female it ranged from 4-8 days (mean 6.3 ± 1.3).



Egg of *P.ferrugineus*

b. Grub

It was observed that the CSRБ grubs passed through five instars as indicated by the moulting and increase in prothoracic shield width.(Raviprasad and Bhat 2010) The grubs were oval in cross section with the distal end tapering slightly, with cream coloured body having segmental protrubances. The head capsule was strongly sclerotised, deeply retracted into the prothorax. The grubs had prognathus mouthparts with strong, short, stout mandibles. There was a pro-thoracic shield with two crescent shaped markings, with three pro thoracic prolegs; 10 segmented abdomen with short abdominal ampullae ventrally. In total, nine bilabiate type spiracles were observed with one being mesothoracic and the rest eight being abdominal. The CSRБ grubs were found to be highly cannibalistic. PTS width and weight were correlating with age of the grub @ $p=0.01$ ($r = 0.956$ and $r = 972$ respectively) though constant increase was not observed.

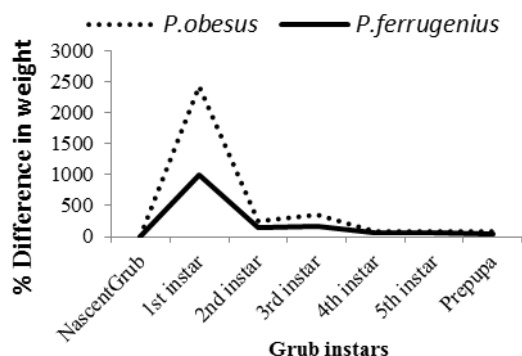
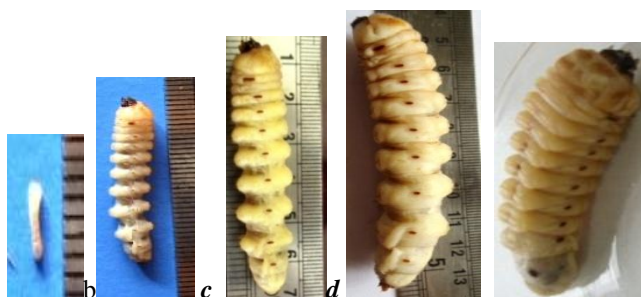


Fig 1. Mean percentage difference in weight of the CSRB grubs



Grub stages of *Placaederus* spp. (a to e, first instar to prepupa)

The mean percentage difference in weight of the both the species of CSRB grubs were high initially but later it was reduced (Fig 1). Grub stage extended in certain conditions of environment. The availability of feed influenced the number of instars in the grub stages. Under conducive rearing conditions the grubs had shown 5- 6 instars followed by a pre-pupa which had shorter body length due to stopping of feeding and excretion of gut content and later moved to the bottom part of the rearing bottle and constructed a calcareous cocoon, by smearing regurgitated calcium on to the nearby frass and on the surface of rearing bottle which hardened gradually to turn light creamy yellowish hard cocoon. The pupation of the grub was identifiable by the presence of white calcium smearing on the inner wall of the rearing bottle. Among the morphometric measurements of the developmental stages are mentioned in Table 1. Length and weight were significantly high in the 4th and 5th instars Fig 2.

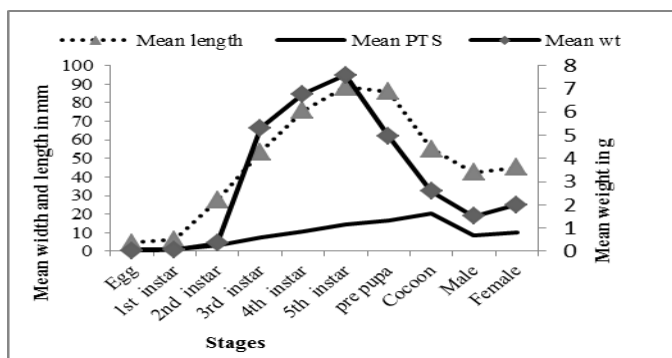


Fig2. Variation of different morphometric parameters in different biological stages of *P.ferrugineus*

TABLE1. Morphometric details of *Placaederus ferrugineus* L

Stage of development	Weight (g)		Width (mm)		Length (mm)	
	Mean	SEM	Mean	SEM	Mean	SEM
Egg	0.01	0.01	1.01	0.01	3.73	0.11
1st instar*	0.07	0.01	1.03	0.01	5.20	0.15
2nd instar	0.35	0.02	3.15	0.15	24.40	0.35
3rd instar	5.32	0.23	7.70	0.21	45.80	0.94
4th instar	6.76	0.30	10.60	0.17	65.05	0.75
5th instar	7.58	0.31	14.40	0.29	73.95	0.56
pre pupa	4.95	0.20	16.69	0.38	69.38	1.37
Cocoon **	2.58	0.15	20.40	0.42	34.80	1.19
Adult(Male)	1.51	0.06	8.76	0.34	33.79	0.60
Adult(Female)	2.00	0.07	10.29	0.41	34.79	0.47

*= PTS width was measured for the grub stages ** = Cocoons and adults were measured at the broadest region

c. Cocoon

The prepupa moulted to an exarate pupa inside the calcareous cocoon. The metamorphosis was completed inside the cocoon after which the adult beetle lay quiescent till emergence. The morphometrics of the cocoon is listed in Table 1. The duration of pupal stage was not significantly different in two sexes. (Table 2)



Cocoon and pupa of *Placaederus* spp.

TABLE 2. Duration of biological stages of *Placaederus ferrugineus* L.

Developmental stage	Mean ± SD (Days)	
	Male	Female
Egg (Incubation period)	6.60 ± 2.35	6.30 ± 1.34
1st instar	21.55 ± 5.67	21.90 ± 8.01
2nd instar	29.10 ± 8.96	29.75 ± 8.37
3rd instar	33.60 ± 6.54	33.60 ± 9.76

4th instar	34.47 ± 4.19	34.23 ± 4.32
5th instar	40.29 ± 11.63	35.85 ± 11.47
Pre-pupa	20.90 ± 14.73	17.00 ± 7.40
Grub period	163.10± 20.55	168.37± 30.32
Pupal period	144.33± 29.57	145.16 ± 29.10
Total	307.33± 29.03	313.53 ± 28.36

d. Adult

The adult beetles of *P. ferrugineus* were chestnut red coloured longicorn beetles, males with antenna more than double of the length of the body (mean 62.67 ± 6.09mm) whereas, in case of females, the antenna was more or less of the same length as that of the body (mean 35.38 ± 7.66mm). The antenna was filiform with scape in antennifer, pedicel comprising of nine antennomere. The antennal segments contributed variously for the length of the flagellum. (Table 3). The beetles, when disturbed produced sound by scraping of the back edge of the pronotum against a file on the mesonotum. The beetles displayed high level of aggregation.

Longevity was 21-56 days (mean 32.60 ± 12.06) in female while male longevity was 20 to 37 days (mean 33.64 ± 12.21) under laboratory conditions. The female adults had a higher body weight (2.00 g) than the males (1.51 g). The duration of different stages of development were recorded (Table 2) and percentage duration of developmental stages in life cycle was calculated. Fig 3.

TABLE 3. Antennal morphometrics of *Plocaederus ferrugineus* L.

Segment	Male		Female	
	Mean Length mm	% Contribution by respective antennomere	Mean Length (mm)	% Contribution by respective antennomere
Scape	5.02± 0.62	8±0.004	0.68±0.24	19±0.003
Pedicel	5.5±0.40	8.8±0.08	3.04±0.14	9±0.021
F1	4.86±0.91	7.7±0.01	4.81±1.03	13.7±0.014
F2	5.85±0.58	9.3±0.001	4.03±0.88	11.4±0.007
F3	5.85±0.58	9.3±0.001	3.26±0.81	9.1±0.05
F4	5.85±0.58	9.3±0.001	3.26±0.81	9.1±0.05
F5	5.85±0.58	9.3±0.001	3.26±0.81	9.1±0.05
F6	5.85±0.58	9.3±0.001	3.26±0.81	9.1±0.05
F7	5.85±0.58	9.3±0.001	3.26±0.81	9.1±0.05
F8	5.85±0.58	9.3±0.001	3.26±0.81	9.1±0.05
F9	6.36±0.94	10.2±0.012	3.26±0.81	9.1±0.05
Total antenna	62.67±6.09	1.00	35.38±7.66	100

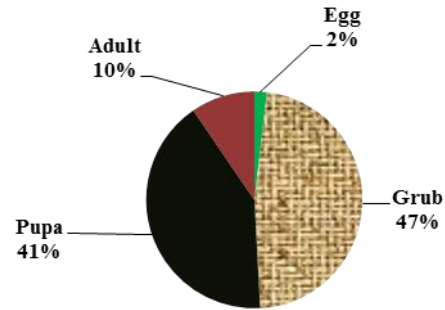


Fig 3. Percentage duration of biological stages in *Plocaederus ferrugineus* L.



Fig. *P.ferrugineus* female and wing



Fig. Male *P.ferrugineus*



Fig. Elytra of *P.ferrugineus*

d. Mating

The beetles were nocturnal and repeated matings were observed during morning hours and late evening hours. The aggression among the males in securing the mate led to loss of body parts especially, antennae and legs. Sex ratio indicated the male to female ratio to be generally 1.05: 1.0. (Field collected), 1.02:1 (lab reared)

e. Fecundity

The mean pre-oviposition period was 2.5 ± 0.5 (range 2-5days), mean longevity 51days with an oviposition index

96.07%.The female beetles laid varied number of eggs, mean oviposition period 49.5 days, mean fecundity 54.94 ± 12.58 .

B. Morphometric details of *Plocaderus obesus* Gahan

a. Egg

Physical appearance was similar to *P.ferrugenus* eggs, but showed significant difference in length (LSD @ 0.05= 0.2989); , width and weight, had a mean length 2.13mm (range 1.5 – 3.0 mm), width 0.6 mm (range 0.4-0.8mm) and weighed 0.002 g (range 0.001-0.004).Incubation period, in case of eggs leading to males it ranged from 3 – 10days (Mean 5.77 ± 1.44) and in case of eggs leading to female it ranged from 4-8 days (mean 6.1 ± 1.29) in female .



Fig. eggs of *P.obesus*.

b. Grub

The grubs of *P .obesus* passed through five instars as indicated by the moulting and increase in prothoracic shield width. The grubs were morphologically similar to that of *P.ferrugenus* grubs; the morphometric measurements of the grubs are mentioned in Table 4 and their variations over different stages is compared in Fig 3.

All the grub instars of *P.ferrugenus* and *P.obesus* were statistically on par different in morphometrics of the various instars. Statistical analysis was done in SAS software under DMRT. Grub stage was found to dominate. The duration of different stages are listed in the Table 5 and Fig 4

TABLE 4. Morphometric details of bark reared *Plocaderus obesus* Gahan

Stage of development	Weight (g)		Width (mm)		Length (mm)	
	Mean	SEM	Mean	SEM	Mean	SEM
Egg	0.0058	0.0002	1.02	0.001	2.10	0.1003
1st instar*	0.07	0.0049	1.03	0.002	3.13	0.05
2nd instar	0.35	0.024	3.15	0.15	24.15	0.40
3rd instar	5.32	0.23	7.70	0.21	49.45	1.60
4th instar	6.76	0.30	10.60	0.17	65.75	0.59
5th instar	8.61	0.27	14.40	0.3	74.65	0.66
pre pupa	4.95	0.20	16.69	0.38	68.06	0.94
Cocoon **	2.58	0.15	21.35	0.65	36.10	0.77
Male	1.46	0.22	8.63	0.30	38.80	1.68
Female	1.76	0.07	9.31	0.30	33.50	1.26

*= PTS width was measured for the grub stages ** =The cocoons and adults were measured at the broadest region *** Staiistically different @p=0.05 from the egg of *P.ferrugenus* as indicated by DMRT.

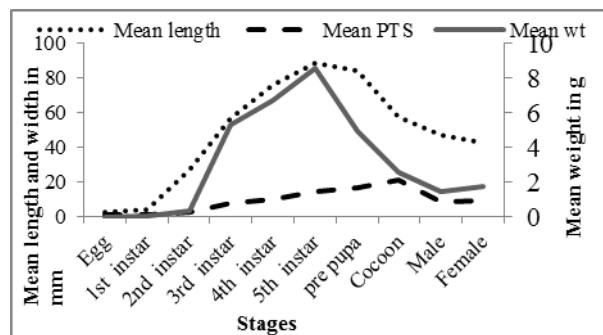


Fig4. Comparison of different morphometric parameters in CSRB *P.obesus*

c. Cocoon

The duration of pupal stage varied among the sexes. (Table 5) Pupal sages of both the species of *Plocaderus* were statistically on par in all of the morphometric parameters.

d.Adult

The adult beetles of *P. obesus* were dull grey brown coloured longicorn beetles, males had the antenna more than double of the length of the body (mean 57.62 ± 6.80 mm) whereas, in case of females, the antenna was more or less of same length as that of the body (mean 35.39 ± 7.67 mm). The antenna was filiform with scape, in antennifer, pedicel comprising of nine antennomeres with dark bands at the junction of antennomeres. The antennal segments contributed variously for the length of the flagellum. (Table 6) The beetles, when disturbed produced sound by scraping of the back edge of the pronotum against a file on the mesonotum. The beetles displayed high level of aggregation .The longevity of male beetles was statistically significantly different from *P.ferrugenus* (LSD=2.739@ p=0.05) but females were on par in longevity. The female adults had a higher mean body weight ($1.76 \text{ g} \pm 0.07$) than the males ($1.46 \text{ g} \pm 0.22$).The duration of developmental stages were found to vary (Table 5) and percentage contribution of each stage of development was different and dominance of grub stage was observed (Fig 5) .The adult female and male beetles of two species of *Plocaderus* had shown statistically significant difference in the antennal morphometric details (LSD=1.795@p=0.05). The other parameters viz. body length, body weight were on par in both the sexes of both the species.



Fig. *P.obesus* Female and male

e. Mating

Mating behaviour was more or less similar to *P.ferrugenus*, the beetles were nocturnal and showed the aggregation behaviour and concealed under dry leaves. Sex ratio

indicated the male to female ratio to be generally 1.14: 1.0. (Field collection) 1.21:1(Lab reared)

f . Fecundity

The mean pre-oviposition period was found to be 2.5 ± 0.5 (range 2 - 5days), with an oviposition index 76.19%. The female beetles laid varied number of eggs. Further, the mean fecundity was 74.17 ± 8.25 .

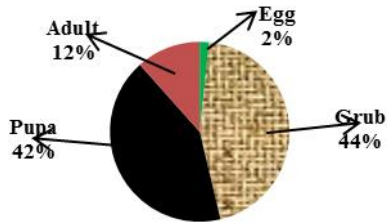


Fig 5 .Duration of life stages in *Plocaeaderus obesus* Gahan.

TABLE5. Duration of biological stages of *Plocaeaderus obesus* Gahan:

Developmental stages	Mean \pm S.D (Days)	
	Male	Female
Egg (Incubation period)	5.77 \pm 1.44	6.1 \pm 1.29
1st instar	20.24 \pm 4.68	26.45 \pm 7.54
2nd instar	21.48 \pm 6.15	28.2 \pm 6.69
3rd instar	31.10 \pm 5.4	25.5 \pm 3.07
4th instar	29.78 \pm 4.37	34.04 \pm 5.01
5th instar	22.88 \pm 7.28	27.44 \pm 7.38
Prepupa	16.25 \pm 7.09	20.25 \pm 12.52
Total Grub period	152.75 \pm 31.35	158.49 \pm 33.26
Pupal period	142.9038 \pm 22.57	152.34 \pm 38.46
Total	294.43 \pm 42.55	306.23 \pm 30.49

TABLE 6 Antennal morphometrics of *Plocaeaderus obesus* Gahan.

Segment	Male		Female	
	Mean Length mm	% Contribution by respective antennomere	Mean Length mm	% Contribution by respective antennomere
Scape	4.584 \pm 0.84	8 \pm 0.008	0.68 \pm 0.25	2 \pm 0.003
Pedicel	5.24 \pm 0.49	9 \pm 0.005	3.05 \pm 0.14	9 \pm 0.02
F1	4.11 \pm 1.02	7 \pm 0.01	4.82 \pm 1.03	14 \pm 0.01
F2	5.40 \pm 0.55	9 \pm 0.002	4.04 \pm 0.89	11 \pm 0.007
F3	5.41 \pm 0.55	9 \pm 0.002	3.26 \pm 0.82	9 \pm 0.005
F4	5.41 \pm 0.55	9 \pm 0.002	3.26 \pm 0.82	9 \pm 0.005

F5	5.41 \pm 0.55	9 \pm 0.002	3.26 \pm 0.82	9 \pm 0.005
F6	5.41 \pm 0.55	9 \pm 0.003	3.26 \pm 0.82	9 \pm 0.005
F7	5.41 \pm 0.55	9 \pm 0.002	3.26 \pm 0.82	9 \pm 0.005
F8	5.41 \pm 0.55	9 \pm 0.002	3.26 \pm 0.82	9 \pm 0.005
F9	5.41 \pm 0.55	1.0 \pm 0.003	3.26 \pm 0.82	9 \pm 0.005
Total	57.62 \pm 6.80 *		35.39 \pm 7.67	

*= Statistically different from the antenna of *P.ferrugineus* @p=0.05 under DMRT

C. Morphometrics of legs and wings of *Plocaeaderus* spp.

The pro, meso and meta thoracic legs did not show significant difference in length in both the species. (Table 7)

TABLE 7. Legs and wings of *Plocaeaderus* spp.

Structure	Mean Length in mm \pm SD			
	<i>Plocaeaderus ferrugineus</i>		<i>Plocaeaderus obesus</i>	
	Male	Female	Male	Female
Fore leg; Coxa	1.09 \pm 0.03	1 \pm 0	1.09 \pm 0.03	0.96 \pm 0.08
Trochanter	0.69 \pm 0.03	0.5 \pm 0	0.7 \pm 0.03	0.5 \pm 0
Femur	5.9 \pm 0.3	5 \pm 0	6.8 \pm 0.76	5.19 \pm 0.77
Tibia	6.9 \pm 0.31	6 \pm 0	6.9 \pm 0.30	6 \pm 0
Tarsus	5.9 \pm 0.31	4 \pm 0	5.9 \pm 0.30	4 \pm 0
Claws	Present, bifid	Present, bifid	Present, bifid	Present, bifid
Mid leg; Coxa	1 \pm 0	1 \pm 0	1.05 \pm 0.22	0.5 \pm 0
Trochanter	0.5 \pm 0	0.5 \pm 0	0.5 \pm 0	0.32 \pm 0.1
Femur	8 \pm 0	8 \pm 0	9.45 \pm 0.88	9.05 \pm 1.5
Tibia	6 \pm 0	6 \pm 0	6 \pm 0	5.76 \pm 0.5
Tarsus	5 \pm 0	4 \pm 0	5 \pm 0	4.15 \pm 0.6
Claws	Present, bifid	Present, bifid	Present, bifid	Present, bifid
Hind leg; Coxa	1 \pm 0	1 \pm 0	0.8 \pm 0.25	0.8 \pm 0.25
Trochanter	1 \pm 0	1 \pm 0	1 \pm 0	1 \pm 0
Femur	5 \pm 0	10 \pm 0	9.6 \pm 1.04	9.6 \pm 0
Tibia	6 \pm 0	10 \pm 0	6 \pm 0	6 \pm 0
Tarsus	6 \pm 0	5 \pm 0	6 \pm 0	6 \pm 0
Claws	Present, Bifid	Present, Bifid	Present, Bifid	Present, Bifid
Elytra	37.4 \pm 3.5	27.9 \pm 2.57	36.05 \pm 2.93	34.45 \pm 1.39
Wing	40.4 \pm 3.5	31.4 \pm 2.51	39.05 \pm 2.93	37.95 \pm 1.39

The wings and elytra had shown proportionately same difference in length in them (0.9: 1). The results agree with the earlier report on the cucurbit longicorn beetle *Apomecyna saltator* F. (Khan 2012).



Fig . *P.obesus*- wing, elytra and antenna

IV. DISCUSSION AND CONCLUSIONS

CSRB were primarily bark feeders. The eggs were visible on the tree trunk as white rice grain like structures. The eggs hatched into an invisibly segmented nascent grub that penetrated the bark by tunneling, developed to a considerably damaging stage with its cryptic tunneling habit. The morphological structure and behavior of grubs was well suited for the bark feeding habit and the subterranean life. The major destructive stage was the grub stage. In both the species of *Plocaederus* grub stage was found to dominate in the life history. The grub and pupa were found within the tunnels and need to be excavated and removed with minimum injury to the infested bark. The adult beetles were nocturnal. Biology of this pest species matched with earlier report regarding multiple mating among cerambycid beetles (Altaf Hussain Mir; 2012). The above pest also showed intermittent mating. The adults aggregate and conceal beneath the dry cashew leaf or any other hiding place in the weed grown cashew plantations during day as the pest species is nocturnal. The PTS widths of the grubs in its successive stages was in correlation with the age. This agrees with the earlier report on the age estimation technique for the field collected CSRB grubs (Raviprasad and Bhat 2010) It is reasonable to assume therefore that molting in softbodied insects is a device that allows them to increase the size of their mouthparts and optimize their rate of feeding. Senguttuvan and Mahadevan (1998) reported the morphometrics of immature stages of *Plocaederus ferrugineus* L. and the grubs had 6-7 instars in the life history and stated that the grub did not obey the growth laws of Dyar and Prazibram. The results of the above observations evidenced that proportional weight increase did not remain constant in the moulting stages. But the pro thoracic shield (PTS) showed increase in width after every moult. The prepupa recorded a decrease in length and weight, stopped feeding and pupation was by regurgitation of the gut secretion. The host plant range and morphometrics of CSRB *Plocaederus ferrugineus* L were reported by Asogwa *et al* .2008 The larva (grub) had a mean body length of 2.72mm, while an average pupal length of 3.66mm was recorded. He reported that, the adult *P. ferrugineus* was a medium sized dark grey beetle, 2.91cm long and 0.92cm wide at the base of the abdomen. They had longer antennae (3.58cm), which was significantly longer ($P < 0.05$) than their body (2.91cm). The findings of this study did not exactly match with the report. The present study indicated

the morphometrics of the different stages of *P.ferrugineus* and *P.obesus*.

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