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Description of Nymphal Instars of *Chrysocoris stolli* Wolf (Heteroptera-Pentatomidae - Scutellerinae)

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Abstract: ***Chrysocoris stolli Wolf (Heteroptera- Pentatomidae-Scutellerinae) is a phytosuecivorous bug, which infests Cassia occidentalies, Croton sparisiflorum, Pennisetum typhoides, (Bajra) and Litchi chinensis at Saharanpur in good number and by its desapping habit causes considerable loss to these plants of economic value. The first food plant of this bug is Cassia occidentalies, (Kasaundi) (Leguminasae) (This plant is grown throughout India and it is useful in ringworm, elephantiasis and scorpion sting. The leaves are tasty, aphrodisiac, lexeteric, cure cough, Asthma, Kafka and vita. It is also used for stoma chic cure, Fridosha, fevers, sore throat and biliousness (Ayurveda). Nymphal period: Nymphs of Chrysocoris stolli develop gradually and nymphal period starts soon after emergence. The first instr nymph after hatching undergoes five moults before emerging into adult. It has been noticed that all the nymphs are active feeder 27 and feed gregariously on the water soaked Bajra seeds and leaves of Cassia occidentalies, Litchi and Croton, etc in laboratory while in field on the host plant only. The duration of nymphal periods varies from 37 to 48 days with an average of 39 days depending upon the temperature, R.H., food and other climatic factors (Table- 1) The maximum length of time for first nymphal instar is of 11 days and the minimum 5 days. The average period for 150 individuals is calculated as 8.05 days. Seven days are required as minimum period and 13 days as maximum period for IInd instar nymphs. Average period being 9.08 days for 150 individuals. A minimum of 7 days and maximum 13 days are required for 3rd instr to moult. An average ecdysis period of 10 days is calculated for 150 individuals. The 4th instar required 8 days as minimum and 15 days, as maximum period in rainy season and 11 days as an average period for 150 individuals. The fifth instar takes 9 days as minimum period and 16 days as maximum period with 13 days as an average moulting period for 150 specimens.***

Keywords: Nymphal Instars of *Chrysocoris stolli* Wolf

1. Introduction

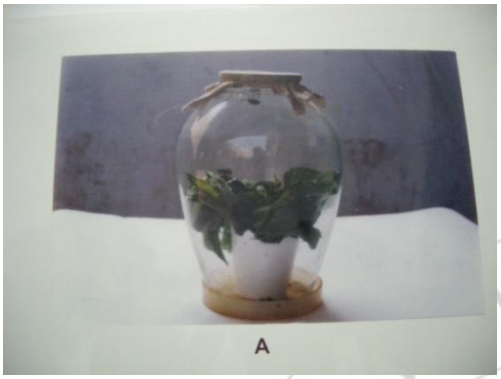
Insect an is the largest class of phylum arthropods and members of this class are characterized by the presence of three pairs of legs; hence, called Hexapoda, Besides, these tracheate organisms have usually one or two pairs of wings. Insects always have been associated with mankind in one way or the other as some of them are beneficial other are pests of crops and house hold articles. ***Chrysocoris stolli*** Wolf (Heteroptera- Pentatomidae-Scutellerinae) is a phytosuecivorous bug, which infests ***Cassia occidentalies***, ***Croton sparisiflorum***, ***Pennisetum typhoides,*** (Bajra) and ***Litchi chinensis*** at Saharanpur in good number and by its despising habit causes considerable loss to these plants of economic value. The first food plant of this bug is ***Cassia occidentalies,*** (Kasaundi) (Leguminasae) **Nymphal period:** Nymphs of ***Chrysocoris stolli*** develop gradually and nymphal period starts soon after emergence. The Ist instar nymph after hatching undergoes five moults before emerging into adult.

It has been noticed that all the nymphs are active feeder 27 and feed gregariously on the water soaked ***Bajra*** seeds and leaves of ***Cassia occidentalies***, ***Litchi*** and ***Croton***, etc in laboratory while in field on the host plant only. The duration of nymphal periods varies from 37 to 48 days with an average of 39 days depending upon the temperature, R.H., food and other climatic factors (Table-1). The maximum length of time for first nymphal instar is of 11 days and the minimum 5 days. The average period for 150 individuals is calculated as 8.05 days. Seven days are required as minimum period and 13 days as maximum period for IInd instar nymphs. Average period being 9.08 days for 150 individuals. A minimum of 7 days and maximum 13 days are required for 3rdinstar to moult. An average ecdysis period of 10 days is calculated for 150 individuals. The 4th instars required 8 days as minimum and 15 days, as maximum period in rainy season and 11 days as an average period for 150 individuals. The fifth instr takes 9 days as minimum period and 16 days as maximum period with 13 days as an average moulting period for 150 specimens.

2. Materials and Methods

Biological studies: Studies on biology were conducted by rearing the adult's bugs and their stages in the hurricane glass lantern chimneys as well as in wooden wire gauge cage as mentioned above. The present study deals with ***Chrysocoris stolli***, a pest of ***Cassia occidentalies***, Croton and Bajra and Litchi etc. Regarding this, the method of collection of bugs, biology, ecology, population dynamics, studies, rearing techniques and mounting methods are described here-**A. Rearing of *Chrysocoris stolli*:** For the study purpose, district Saharanpur was divided in 5 regions, i.e., Saharanpur proper, Nakur, Behat, Sarsawa and Nagal. Plants are selected randomly in these regions and bugs were picked up from ***Cassia occidentalies*** and ***Croton sparisiflorum*** and Bajra by hand picking method. These were kept in perforated polyethylene bags (20×24 cm) as well as in plastic containers and then brought alive in laboratory along with tender twigs and leaves of ***Cassia occidentalies*** and ***Croton sparisiflorum*** at atmospheric temperature and humidity and reared in hurricane glass lantern chimneys.

Rearing of bugs in hurricane glass lantern chimney: Five hurricane glass lantern chimneys were fitted with fine muslin cloth on the top to allow circulation of air and the bottom of each chimney was placed in large petridish. A water filled glass vial was kept in each one to maintain necessary RH. fresh tender twins of ***Cassia occidentalies*** and ***Croton sparisiflorum*** were also kept in each chimney as a food source. Then, each chimney was placed on wooden table in laboratory near a window at room temperature and humidity. Now, one male and one female bug were released in each chimney.



Hurricane glass lantern chimney use of rearing C.*stolli*

Cassia occidentalies, a food plant of *Chrysocoris stolli*

3. Results

Description of nymphal instars: There are five nymphal instars in ***C.stolli*** and each nymph differs from other in size and other characters.**(a) Ist instr nymph.** Newly emerged first instr is of red colour which on exposure to air gradually changes to dark red on different days of development. After hatching from the eggs these remain aggregated on empty egg shell chorion for few hrs and thereafter feed on the sap of host plant leaf. Body of this in-stars measures 2.0 to 2.4 mm in length with an average 2.3 mm. Width varies from 1.4 to 1.6 mm with an average 1.5 mm table-18. A light red dorsal line is present from pronotum to abdominal end. Head is bluntly triangular, convex with laterally bulging dark red eyes. Two black coloured ocelli are present behind the eyes on occiput which are prominently visible. Average width in between the eyes is calculated 1.2 mm and across the eyes 1.5 mm. Antennae is four segmented which has brown scape and pedicel and brown black first and second flagella r segments. Terminal lower half segment is brown and upper half brown black and it is clavate in shape.. However, pedicel and first flagellar segment are not clearly demarcate. Hence, this segment is hereby, given name as pedicel + flagellum first. This condition occurs in all the nymphal instars but in adults these segments are separate. The comparative length of antenna segments are scape 0.1, pedicel + flagellum Ist 0.4 mm, second flagellar segment 0.6 mm, flagellum IIIrd segment 0.5 mm and total average length is 1.6 mm table-19. Pronotum, mesonotum and metanotum are distinctly marked. Wing buds are absent. Their dorsal abdominal scent glands are present which can be distinguished by bulged out openings. Rostrum is brown, four segmented. Fourth rostral segment is brown and tip is brown black. Sensory setae are present on the tip of rostrum. Maxillary and mandibular stylets are lying in mid rostral groove giving an impression of dividing rostrum in two lateral parts, In first rostral segment maxillary and mandibular styletes can be differentiated which come together at the end of first segment. Rostrum measures 1.2 mm in total length. Tp of the rostrum reaches upto the Ist abdominal segment. Comparative lengths of rostral segments are 0.2, 0.5, 0.3 and 0.2 mm. Prothorax, mesothorax and metathorax are clearly distinguished having butted surface. Legs with setae on distal tibia as well as on tarsi. Tarsi are two segmented and dark brown in colour.. Prothoracic lege measures 3.0 mm and its segment measures, coxa 0.1 mm, trochanter 0.2 mm, femur 1.2 mm tibia 1.1, tarsal Ist 0.2, and tarsi IInd 0.2 mm table-21. Prothoracic leg has antennae and rostrum cleaner device at the tibial extremity named by Dhiman and Dhiman (1985) to clean and remove foreign particles from antennae and rostrum. Abdomen is brown with dark brown punctuations. The abdominal tip is brown black in colour. It is a feeding stage which lasts from 5 to 11 days with an average of 8.05 days table-1 and then moults, into second instar nymph. During moulting, the first instar, at first, tightly holds the host substratum with powerful claws and then slowly body cuticle ruptures through mid cranial sulcus which extends up to metathorax. After rupturation, a wide slit appears through which second instars makes its way out. At first, its head is pulled out from exvuium, then antennae, rostrum and thorax. Gradually legs are pulled from moulted skin. At last, abdomen is pulled out after coming out from the exuvium of first moult. The second instars takes rest to dry its appendages so that its cuticle gets hard. Then, the instars clean its head and other parts and moves for feeding in nearby vicinity. The entire process of moulting lasts from 5 to 15 minutes with an average of 8.6 minutes. It was further noticed that in some cases the instar could not free from the moulted skin and remained entangled and died later on.

(b) Second instar nymph. Newly emerged second instars is green and red in colour which changes into dark pinkish green metallic colour on exposure to air. Newly emerged instars are pear shaped. Body of the second instars measures 3.3 to 3.6 mm with an average of 3.5 mm in length and 2.3 mm to 2.4 mm in width with an average of 2.2 mm. It has light red green mid dorsal line from pronotum to abdominal end. Head is less convex than first instars, bluntly triangular with laterally bulging red eyes. Two black coloured occlli are present behind the eyes on occiput. Average width in between the eyes is 1.6 mm and

across the eyes 2.0 mm table-16.Like preceding instars, antenna bears scape, pedical, flagellum, flagellum IInd and flagellum IIIrd. The terminal segment is clavate. Total length of antenna is 2.4 mm and comparative length of its segments are - scape 0.2 mm, pedicel + flagellum first 0.4 mm, flagellum second 0.6 mm, and flagellum third 1.2 mm. Like first instar, pronotum, mesonotum and metanotumare distinctly marked. Wing buds are not prominently marked. Three dorsal abdominal scent glands are now more prominent with dark punctuation at the base of first abdominal scent gland and semicircular punctuations at second and third abdominal scentglands. Rostrum is brown, four segmented with dark brown second, third and forth rostral segments. Tip of fourth rostral segment is black with sensory hairs. In first rostral segment, maxillary and mandibular styletes can be differentiated and they unite at the base of first rostral segment. In further rostral segments they lies in the middle of rostrum in the rostral groove. Rostrum measures 2.3 mm in length and comparative length of its segments are, first segments 0.2 mm, second 0.5 mm, third 0.3mm, and fourth 1.3 mm table-20.Legs are moderately sized with hairy setae on distal tibia as well as on tarsi. Pro thoracic leg measures 3.6 mm, in length and comparative length of its various segments are-coxa 0.2 mm, trochanter 0.2 mm femur 1.4 mm, tibia 1.2 mm, first tarsus 0.3 and second tarsus 0.3 mm. This is a feeding stage and remain in dispersed condition. It generally feeds upon tender parts of host plant which are full of sap. This stage lasts from 7 to 13days with an average of 9.08 days. The moulting process is like that of preceding instars. After coming outof exuvium the third instars hardens its cuticle on exposure to air and turns reddish to dark reddish green metallic colour. It cleans its different body parts with the help of cleaning device present on prothoracic tibial extremity. It now moves nearby for feeding. Metallic colour in the instars provides warning mimicry to escape from enemies (predators). It was further observed that smell of scent fluid also helps in repelling the predators.

(c) Third instar Nymph. Newly emerged third in stars are red green which changes into green metallic co lours with more punctuation. It measures 6.9 to7.3 mm in length with an average of 7.1 mm. Width of body is 3.6to 3.9 mm, average being 3.8 mm table-18. Head is bluntly triangular with laterally bulging red eyes. Two black ocelli are present behind the eyes on occipital which are prominent. Average width of head capsule in between the eyes is 2.0 mm and across the eyes 2.5 mm. Antenna is like preceding instars. It measure 4.2 mm in length and comparative length of its segments are-scape, 1.0 mm, pedicel and first flagellum 0.8 mm, flagellum IInd 1.1 and flagellum IIIrd 1.3 mm table-19. Small wing buds start appearing. Abdominal scent glands are like preceding instars except bigger n size. Rostrum is brown and four segmented. The fourth half segment is brown and lower half is brown black having a tuft of sensory setae on its tip. Rostrum measures 3.9 mm in length and comparative length of its segments are first 0.5 mm, second 0.7 mm, third 0.6 mm and fourth0.9 mm. Different thoracic segments are clearly distinguished as in second instars, having moderately sized legs with hairy setae on distal tibia as well as on tarsi. Pro thoracic leg measures 6.2 mm in length and comparative length of its various segments are- coxa 0.5 mm, trachanter, 0.7 mm, femur 2.1mm and tibia 1.9 mm. Comparative length of two tarsal segment are first 0.4 mm and second 0.6 mm in length. Abdomen is metallic greenish red and blue with punctuations of this instars is also a feeding stage and feeds upon tender parts of host plant which are full of sap. This stage lasts from 7 days to 13days with an average of 10 days.

D. Fourth instars nymph. Newly emerged fourth instar is metallic reddish green in colour at the time of emergence and gradually turns into yellow and green metallic colour with black punctuations on exposure to air. It measures 9.7 to 9.9 mm in length with an average 9.8 mm and width 5.7 to 5.9 mm with an average of 5.8 mm. Head is bluntly triangular with laterally bulged red and black eyes. Like proceeding instar two black co loured ocelli are present behind the eyes on occipital. Average width in between the eyes is 2.4 mm and across the eyes 3.3 mm. Antenna measures6.2 mm in length and comparative length of its segments are-scape1.3 mm, pedicel + flagellum I, 1.4 mm, second flagellum segment1.5 mm and third flagellum segment 2.0 mm. Second and third abdominal scent glands are more prominent then previous instars. Abdomen is same as in third instar except bigger in size. Rostrum is brown black four segmented. The fourth lower half rostral segment is dark black and a tuft of sensory setae on it tip in present. Rostrum measures 5.2 mm in length and comparative length of its segments are-first 0.7 mm, second 1.0mm, third 1.5 mm and fourth 2.0 mm. Different thoracic segments are clearly visible as in third instar having moderate lysized legs with hairy setae on distal tibia as well as tarsi. Prothoracic leg , measures 8.1 mm in length and comparative length of its various segments are-coxa 0.9 mm, trochanter 1.0 mm, femur 2.6 mm and tibia 2.1 mm. Comparative length of two tarsal segments are first 0.7 mm and second 0.8 mmin length.. Abdomen is metallic green with yellow and black spots and punctuations. Spiracles on lateral side of abdomen are clear and black in colour. This is also an active feeding stage and feed upon tender host plant twigs and leaves. Wing buds are well developed. This stage lasts from 8 to 15 days with an average of 12 days. It moults into fifth instars nymph and moulting process in like preceding instars.

5. Fifth instars nymph. Fifth instars at the time of emergence from fourth instar nymph are also red green metallic yellow with black spots. One exposure to air, its first turns yellow and green than light green with black punctuations. Its body measure 11.0 to 11.7 mm with an average of 11.4 mm and width 6.4 to 6.9 mm with an average of6.7 mm. Head is bluntly triangular with red black eyes. Two black coloured occlli are present behind the eyes on occiput. Average width in between the eyes is 3.3 mm and across the eyes4.0 mm. A dorso-median black and green metallic coloured line extends from pronotum to last abdominal segment. Antenna has brown black scape, dark black pedicel +first flagellum and second flageller segments is black brown and last segment also black brown with upper half light brown equipped with sensory setae. Antenna measures 7.1 mm in length and comparative length of its segments are-scape 1.3 mm,

pedicel+ flagellum first 1.4 mm, second flagellum 1.9 mm and third segment is 2.5 mm. Total length of antenna is 7.1 mm. Wing buds are larger and more prominent. Abdominalscent glands are like preceding instars and are more prominent. They are situated in 3rd, 4th and 5th abdominal segment. Semicircular marking around the scent glands are clearly visible. Rostrum is four segmented reaching upto anterior part of third abdominal segment. It measures 5.9 mm length and comparative length of its segments are-first 0.7 mm, second1.2 mm, third segment 1.5 mm and fourth segment 2.5 mm. Different thoracic segments and marking of thoracic scentglands are clear. Prothoracic lege, measures 10.2 mm in length and comparative length of its segments are-coxa 1.2 mm, trochanter 1.5 mm, femur 3.2 mm and tibia 2.6 mm..Comparative lengths of two tarsal segments are first 0.8 mm and second 0.9 mm. Abdomen is green metallic and yellow with blackspots. Like preceding instar, it is also an active feeding stage and feeds upon tender twig as well as on main host leaves of ***Croton sparisiflorum*** and ***Cassia occidentalies***. This stage last from 9 to16 days with an average of 13 days. After completing the nymphal life, the fifth instars nymph moults intoimago. For this process, the fifth instars first tightly holds the leaves of host plant by powerful claws and then slowly a split appears mid dorsally in the skin of the instar through ecdysial tine. The split begins from mid cranial sulcus up to the metathorax. Now, after rupturation, the split gets wide and through this imago first protrudes out its head, then, thorax, rostrum and antennae. At last, folded wings from wing buds, abdomen and legs are pulled out. The imago rests for a while on the host nearby to exuvium and dries its appendages and body. In the folded wings blood circulation in the veins occurs and the wings are unfolded, getsnormal position and structures on exposure to air. The entire process of moulting lasts from 20-75 minute with an average of 55minimum. The exuvium (moulted skins) is either left attached with the host plant or is blown away by air current. This exuvium is bluish green in colour and light in white

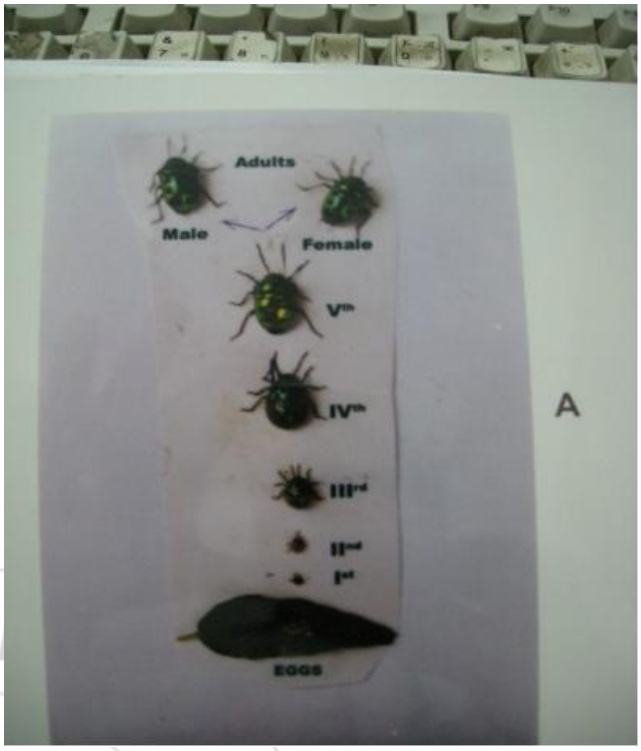


Table 1: Identification Charts for Various Nymphal instars of ***Chrysocois stolli***(in mm)

Particular	Ist	IInd	IIIrd	IVth	Vth
Head					
Length between the eyes (Av.)	1.2	1.6	2.0	2.4	3.3
Across the eyes-	1.5	2.0	2.5	3.3	4.0
Colours	Brown Black	Same	Same	Same	Same
Antennae					
Length	1.6	2.4	4.2	6.2	7.1
Colours	Light brown with black	Brown with black	Brown with black	Dark brown with black	Dark brown with black
Rostrum					
Length	1.2	2.3	3.9	5.2	5.9
Colours	Light brown with lack tip	Light brown with black tip	Light brown with black tip	Light brown with black tip	Light brown with black
Pronotum					
Length	0.6	1.9	2.2	2.9	3.2
Colours	Green metallic + red line and black spots	Red line and green + black spot spots	Green + yellow metallic black spots	Green metallic black spots	Green yellow metallic black spots
Mesothorax	Green yellow	Green yellow	Green yellow	Green yellow	Green with black spots yellow colour
Metathorax	Green + red line	Green + yellow	Green yellow black spots	Green yellow black line	Green with black spots yellow

Wing buds colours			Rudimentary black	Conspicuous black	Prominent black
Scutellum colours	-	-	-	-	Conspicuous green yellow + black spots
Scent glands	Opening conspicuous	Opening visible	-	-	-
Sensory setae	Brown black	Brown black	Brown black	Brown black	Brown black
Length of prothoracic leg	3.0	3.6	6.2	8.1	10.2
Abdomen Colour	Red+green	Red with black line	Red with green + black spots	Green yellow + black spots	Green yellow with black spots
Total body Length	2.3	3.5	7.1	9.8	11.4
Body colours	Black head body red	Green black head green body	Green yellow black spots with wing pade	green yellow black spots buds metallic	Green yellow black spots metallic

Average has been taken of 100 observations

Table 2: Body measurement (in mm) of Various Nymphal Instars and adults of ***Chrysocoris stolli***.

Particulars	Length			Width		
	Mini	Maxi	Av.	Mini	Maxi	Av.
I Nymphal instars	2.0	2.4	2.3	1.4	1.6	1.5
II Nymphal instars	3.3	3.6	3.5	2.3	2.4	2.2
III Nymphal instars	6.9	7.3	7.1	3.6	3.9	3.8
IV nymphal instars	9.7	9.9	9.8	5.7	5.9	5.8
V Nympla instars	11.0	11.7	11.4	6.4	6.9	6.7
Imago	11.3	11.9	11.8	7.6	7.9	7.5
Male	13.75	13.95	13.86	6.8	7.3	7.1
Female	14.20	14.55	14.26	6.9	7.6	7.4

Average has been taken of 100 observations.

Table 3: Average comparative length of antennal segment of various instars and adults ***C.stolli*** (in mm).

Particulars	Scape	Pedical + Flagellum I		Flagellum II	Flagellum III	Total Length
Ist Instar	0.1	0.4		0.6	0.5	1.6
IInd Instar	0.2	0.4		0.6	1.2	2.4
IIIrd Instar	1.0	0.8		1.1	1.3	4.2
IVth Instar	1.3	1.4		1.5	2.0	6.2
Vth Instar	1.3	1.4		1.9	2.5	7.1
Male	1.4	PD	$F.L_1$	$F.L_2$	$F.L_3$	Total length
		0.2	1.7	2.5	3.0	8.8
Female	1.4	0.2	1.7	2.7	3.0	9.0

Average has been taken of 100 observations.

Table 4: Comparative length (in mm) of Various Rostral Segments of Various instars and adults of ***C.stolli***.

Particular	I	II	III	IV	Total length
Ist instar	0.2	0.5	0.3	0.2	1.2
IInd instar	0.2	0.5	0.3	1.3	2.3
IIIrd instar	0.5	0.7	0.6	1.9	3.9
IVth instar	0.7	1.0	1.5	2.0	5.2
Vth instar	0.7	1.2	1.5	2.5	5.9
Male	1.0	1.3	1.8	2.8	6.9
Female	1.0	1.5	1.9	2.8	7.2

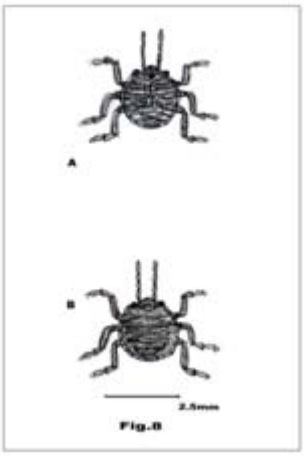
Average has been taken for 100 observations

Table 5: Comparative length of various Segment of Prothoracic lege of Different instars and adult ***C.stolli*** (in mm).

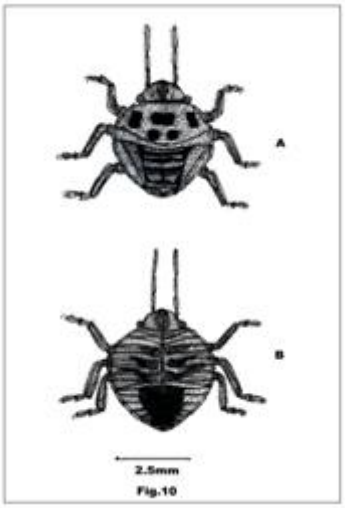
Instars and adults	Coxa	Segment	Tarsal segments	Total length

		Trochanter	Femur	Tibia	I	II	III	
Ist	0.1	0.2	1.2	1.1	0.2	0.2	-	3.0
IInd	0.2	0.2	1.4	1.2	0.3	0.3	-	3.6
IIIrd	0.5	0.7	2.1	1.9	0.4	0.6	-	6.2
IVth	0.9	1.0	2.6	2.1	0.7	0.8	-	8.1
Vth	1.2	1.5	3.2	2.6	0.8	0.9	-	10.2
Male	1.0	1.0	4.0	3.5	1.0	0.9	1.0	12.4
Female	1.0	1.1	4.2	3.6	1.0	0.9	1.0	12.8

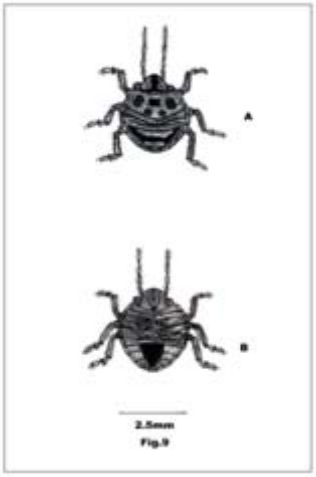
Average has been taken of 100 observations.



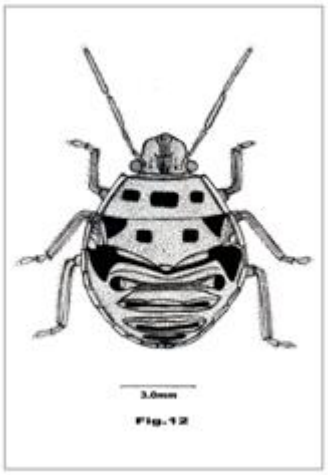
A. Dorsal view of Chrysocoris stolli first instars nymph.
B. Ventral view of Chrysocoris stolli first instar nymph



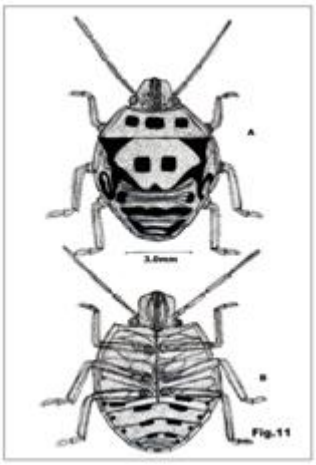
A. Dorsal view of Chrysocoris stolli third instar nymph
B. Ventral view of Chrysocoris stolli third instar nymph



A. Dorsal view of Chrysocoris stolli second instars nymph
B. Ventral view of Chrysocoris stolli second instars nymph



Dorsal view of Chrysocoris stolli Vth instar



A. Dorsal view of Chrysocoris stolli IVth instar nymph
B. Ventral view of Chrysocoris stolli IVth instar nymph

Ventral l view of Chrysocoris stolli Vth instar nymph

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