

TAXONOMIC STUDIES ON PREDATORY COCCINELLID BEETLES AND THEIR SPECIES COMPOSITION IN RICE ECOSYSTEM OF INDO-BANGLADESH BORDER

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KEYWORDS

Coccinellid
Rice ecosystem
Indo-Bangladesh border

Received on :
02.10.2014

Accepted on :
17.01.2015

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ABSTRACT

Ten genera under four tribes of the family Coccinellidae were collected and identified from Indo Bangladesh border in 2009-2010. They are *Brumoides suturalis* (Fabricius), *Chilocorus nigritus* (Fabricius), *Coccinella septempunctata* Linnaeus, *Coccinella transversalis* Fabricius, *Harmonia octomaculata* (Fabricius), *Illeis cincta* (Fabricius), *Micraspis crocea* (Fabricius), *Propylea sp. nr. japonica* (Thunberg), *Cryptolaemus montrouzieri* Mulsant and *Scymnus (Scymnus) nubilus* Mulsant. Result also revealed that out of ten coccinellid *Harmonia octomaculata* (Fabricius) (22.9%), *Micraspis crocea* (Fabricius) (18.5%), *Brumoides suturalis* (Fabricius) (12.36%) and *Chilocorus nigritus* (Fabricius) (9.06%) were major predatory coccinellids beetles in rice ecosystems of Indo- Bangladesh border.

INTRODUCTION

Indo-Bangladesh border mainly comprises with Tripura, Assam, Mizoram, Meghalaya and West Bengal. This research mainly focuses in Tripura and some part of Assam. Main staple food of this region is rice and more or less around 80 insect has attack in growth stage . The most commonly used method of controlling rice insect pests is the application of insecticides which cause several problems such as development of insecticide resistance to the pest insects, environmental pollution and undesirable effects on the non-target organisms including the natural enemies of the target pests (Kiritani, 2000). Some insecticides have disrupted natural enemy complexes and induced resurgence of the target pests and outbreak of secondary pests (Hashmi, 1994). Natural enemies are often important biological agents of various insect pests of rice ecosystem (Devi. M. T *et al.*, 2013). In this rice ecosystem more or less 20 predators were found. Coccinellids belong to the family Coccinellidae of the order coleoptera and are commonly called as ladybird beetles. These are oval to hemispherical in shape with clavate antennae, securiform maxillary palpi and pseudotrimerous tarsi and often brightly coloured with red, orange or yellow elytra frequently spotted black or yellow striped. The Coccinellids are extremely diverse

in their feeding habits. Food habit of the coccinellid species are predaceous and beneficial from the view point of biological control of pests, feeding during both larval and adult stages upon aphids, scale insects, psyllids, mites and egg of lepidoptera insect etc. Members of a relatively small sub-family Epilachninae are herbivorous and occur as serious pests of agricultural crops. Coccinellids are key predators that are conserved and augmented in agricultural ecosystems, to achieve biological control of pests. Actual quantification of field predation has not been attempted for many of the beneficial coccinellids (Mahendiran. G *et al.*, 2013). Numerous reports show coccinellids as opportunistic, feeding on a variety of food material in addition to their preferred prey. *Micraspis discolor* is the most abundant species of coccinellid in rice ecosystems and touted as a biocontrol option for brown planthopper (BPH), *Nilaparvata lugens* (Stal), a key pest of rice. (Shanker *et al.*, 2011, Parveen, S. *et al.*, 2014). No information about the taxonomic identification, population dynamics and functional role of coccinellid in agricultural fields of Indo-Bangladesh region is available. To fill this gap, the present study was planned. The main objective of this study was to characterize coccinellid fauna occurring in the rice fields of Indo-Bangladesh region. Eight rice fields located in four different districts of Indo-Bangladesh region were

compared to assess whether faunal differences occur between rice fields in terms of coccinellid diversity, species composition and guild structure. Phenological patterns of the agrobiont species were also studied to determine their relationships with phenology of crop. This study will provide baseline data about the coccinellid fauna of rice fields and also helpful to establish and evaluate future management practices for rice fields in this area.

MATERIALS AND METHODS

Study area

Collection has been in 2010-11 from four different states of Indo-Bangladesh Region. Locations were Agartala, Sonamura, Khoai, Dharmanagar, Kumarghat, Koilashahar, Panisagar, Bilonia, Udaipur, Santir bazar, Sabroom, Ambasa, Manu, Kachar, Lunglei, Mamit, Kolasib and Shillong.

Species collection

The coccinellids collections were made by net sweepings mostly from 2-5 months old rice crop during 2009-2011. The coccinellids collected in the net were aspirated in glass vials and were killed with ethyl acetate cotton swab. The killed specimens were dried in a hot air oven at 45-50°C for 4-6 hours. The dried specimens were stored in small glass vials and labeled. The oven dried coccinellids were mounted singly on white thick cardboard triangular points which were prepared by using punching machine. The coccinellid specimens were glued on the ventral side of thoracic region on the triangular points which are pinned with entomological pins so as to facilitate the study of head, wings, legs and abdomen from all the desired angles. The printed label with the information regarding locality, date of collection, host plant and name of the collector, was transfixed separately to the entomological pin containing the coccinellid specimen. The sex of the coccinellid was determined by observing under microscope and indicated on the right hand side of the label by using standard notations 'B &' for male and '@ &' for female specimens.

Preparation of both male and female genitalia, the coccinellid specimens were gently supported on a China clay block on its back, and the abdomen was detached from the thoracic region under the binocular microscope with the help of sharp micro needles by pressing at the junction of thorax and abdomen. The detached abdomen was then transferred with the help of camel hair brush carefully to the cavity block containing a few milliliters of freshly prepared 10 per cent KOH and kept them overnight at room temperature to facilitate digestion of soft tissues. The period varied depending upon the specimen whether freshly collected or old. If necessary the specimens were kept in a hot air oven at 50-60°C for 10-15 minutes for digestion. The abdomen was removed from KOH solution and transferred to a glass cavity dish containing distilled water and gently with the help of blunt needles the digested soft tissues were pressed out. After repeated washings in distilled water, the abdomen was transferred to a glass slide containing one or two drops of glycerine for genitalia dissection, which was made under Stereo zoom Binocular Microscope. The above said treatment facilitates the entire abdomen to become completely transparent and permitted to study the genitalia.

The mouth parts were also similarly prepared for the study after dissecting those carefully using fine needles and forceps under a Stereo zoom Binocular Microscope. (Knight, 1965).

The drawings were made with the help of drawing attachment under Trinocular Research Microscope at 40X and 100X depending on the size of the specimen and these were redrawn on tracing paper with the help of rotaring variant pen. The specimens were identified based on the male and female genitalia structures, besides morphological characters like antennae, mouth parts and elytra. After completion of studies, the dissected parts were finally stored in genitalia vials (microvials) with a drop of glycerin. The vial was Stoppard and transfixed to the corresponding specimen under the label. For making illustrations, the mouth parts, antennae, pronotum, hind leg and genitalia parts were kept in position by applying a small pinch of fevistick gum at the bottom of a cavity slide before placing a drop of glycerin on it. The dissected parts were kept immersed completely by gently pressing and after arranging them in desired orientation. The dissected structures were further studied in detail with the help of Olympus Trinocular Research Microscope and Illustrations were also made with the same microscope using drawing attachment. The scales of magnification were indicated on the right hand side of the specimen.

Measurements of structures were taken with the help of ocular micrometer placed in one eye piece of the Stereoscopic Trinocular Microscope and this ocular micrometer was calibrated with stage micrometer in millimeters (mm). Five specimens of each of the species were used for taking measurements unless fewer specimens were available. The length of the body from the anterior to the posterior end and also the maximum width were measured.

Taxonomic key for identification of species

Taxonomic studies on the description of many genuine species to the family coccinellidae associated with rice crop ecosystem is limited. coccinellids associate with rice crop ecosystem of Indo-Bangladesh border has done first time. Present investigation was taken under the studied 'Studies on predatory coccinellid beetle as regard to taxonomy and species composition in rice ecosystems of -Bangladesh border' provided taxonomic key for their accurate identification. In this investigation, ten coccinellids species were reported. Taxonomic key of newly reported species are given below.

Clypeus strongly expanded laterally ; anterior margin of pronotum deeply, trapezoidally concave, lateral portions strongly descending below; elytral base distinctly broader than pronotal base; elytral epipleura broad or its inner carina reaching elytral apex; tibiae angulate externally..... 2 (Tribe Chilocorini)

Clypeus not strongly expanded laterally, pronotum not as above; elytral base slightly broader than pronotal base; elytral epipleura narrow, inner carina not reaching elytral apex 3

Body elongate, oval; each elytron with a sutural and discal broad longitudinal black stripe; elytra without reflexed margin; elytral epipleura not foveolate (Plate 1:1).....*Brumoides suturalis* (Fabricius).

Body rounded, subglobose; antennae 8 segmented, elytra

black, lateral expansions of pronotum reddish brown; elytra without spots; spermatheca sac-like with finger like projection anteriorly (Plate I:2; Fig. 2: a and j) *Chilocorus nigritus* (Fabricius).

Eyes usually moderate in size with or without a moderately deep or shallow post antennal emargination; antennae eight to eleven segmented and usually relatively short, at most shorter than two-thirds the head width. Labrum rather short; coxite of female usually elongate, rarely transverse(Tribe Scymnini) 4.

Eyes covered anteriorly by the expanded head capsule; antennae nine-segmented and very short, less than one-fourth the head width; elytral epipluera very narrow with distinct foveae; trochanters elongate, femora broadly expanded concealing the compressed tibiae, tarsi true trimerous; abdomen composed of six segments, of which first convex posteriorly in an arc; dorsum pubescent and body medium to small(Tribe Coccinellini) 5.

Prosternum produced anteriorly to cover mouth parts; antennae 10 segmented; head, thorax and apices of elytra reddish and rest black (Plate V:11) *Cryptolaemus montrouzieri* Mulsant.

Pronotum with brown markings; elytra with caudally tapering brown stripe along the commissural line, brown stripe broad at anterior, narrow at posterior looks like 'V' shape (Plate V: 12).....*Scymnus (Scymnus) nubilis* Mulsant.

Anterior margin of mesosternum weakly emarginate at middle; each elytron with three transverse rows of black spots and an apical spot on a reddish yellow background, the spots frequently coalescing; apex of siphon spoon shaped with membranous projection (Fig. 5: a and j; Plate III: 5)*Harmonia octomaculata* (Fabricius).

..... Anterior margin of meso sternum flat8.

Each elytron with 3 + ½ roundish spots, spermatheca strongly hooked, nodulus and ramus clearly demarcated (Fig.3A : i; Fig. 3B:h; Plate I: 3B)*Coccinella septempunctata* Linnaeus.

each elytron without those round spots 9

Each elytron with a large trilobed humeral spots (sometimes lacking); elytra with transverse band at apical 0.33, a second usually incomplete band just before apex and black (Fig.4A, B, C and D; Plate II: A, B, C and D).....*Coccinella transversalis* Fabricius.

Elytra without such black stripes 10

Siphon curved at basal, apically straight, apex of siphon spatula shaped with hooked process; spermatheca curved and C shaped (Fig.7B: i; 7A:j; Plate III:7) *Micraspis discolor* (Fabricius).

Apex of siphon spatula shaped without hooked process and corrugated at tip11

Pronotum with a pair of rounded black spots at posterior end; prosternum anteriorly expanded to cover the mouth parts (Plate III:6)*Illeis cincta* (Fabricius).

Pronotum with black markings at posterior end; hemisternite elongated triangular, nearly round, spermatheca strongly curved, short, stout and C shaped (Fig. 9: i and j; Plate V: 9)

..... *Propylea sp. nr. japonica* (Thunberg).

RESULTS

Description of different coccinellid predators

Subfamily : Chilocorinae

Tribe : Chilocorini

Brumoides suturalis : (Fabricius)

Coccinella suturalis Fabricius, 1798: 78 (ZMC)

Brumus suturalis: Mulsant, 1850: 494.-Korschefsky, 1932:267-Kapur, 1942:56 (Boil. early stage fig.).

Brumoides suturalis : Chapin, 1965a:237.

Colour

Head, antennae and pronotum brown; elytra yellowish brown with two longitudinal black stripes on each elytron, legs brown in colour. The ventral side brown to dark brown and varying with age. (Plate 1)

External morphology

Body is oval, glabrous, moderately convex above. Head with a prominent pair of eyes which, when the head is retracted, are slightly covered by the pronotum. Mouthparts as shown in. The antennae 9 segmented with small sensory hairs all over. Frons widened posteriorly, antennal insertions covered by the expanded clypeal margin. The pronotum with a pair of notches in front of the eyes, scutellum triangular. A median longitudinal black stripe which extends from the scutellum to the apex of the elytra; coxal line complete and legs with a pair of simple claws at the terminal tarsal joint. (Fig. 1b)

Male genitalia

Tegmen with median lobe as long as lateral lobes; lateral lobes sparsely having setae and parallel sided. Apophysis of ninth segment broad at base and caudally bifid. Siphon strongly curved with a T-shaped basal part, broadened apically; siphonal capsule long, quadrate with slender inner process. (Fig. 1a and 1c)

Measurements (mm)

Body 3.0 (2.8 – 3.3) long; 2.44 (2.06 – 2.81) wide.

Specimens examined

2 males, 1 female Fotikrai, North Tripura, rice, 19-VIII-2010, Samik chowdhury; 1 male, 1 female, Padmapur, North Tripura, rice, 18-VIII-2010, Samik chowdhury; 1 male, Krishnapur, South Tripura, rice, 22-VIII-2010, Samik chowdhury; 1 male, 1 female, Arundhutinagar, West Tripura, rice, 12-VIII-2010, Samik chowdhury.

Distribution

Worldwide

Sri Lanka. Pakistan. Nepal. Myanmar. Malaysia. Chagos Archipelago. Indonesia. Madagascar. Reunion. Mauritius. Seychelles. Togo. Ghana. East Africa. Kenya. Tanzania. South Africa. Brazil. (Samways *et al.*, 1999).

India

Widely distributed (Andhra Pradesh; Assam; Goa; Karnataka; Kerala; Maharashtra; Orissa; Punjab; Tamil Nadu; Uttar Pradesh. (Bielawski, R. 1961)

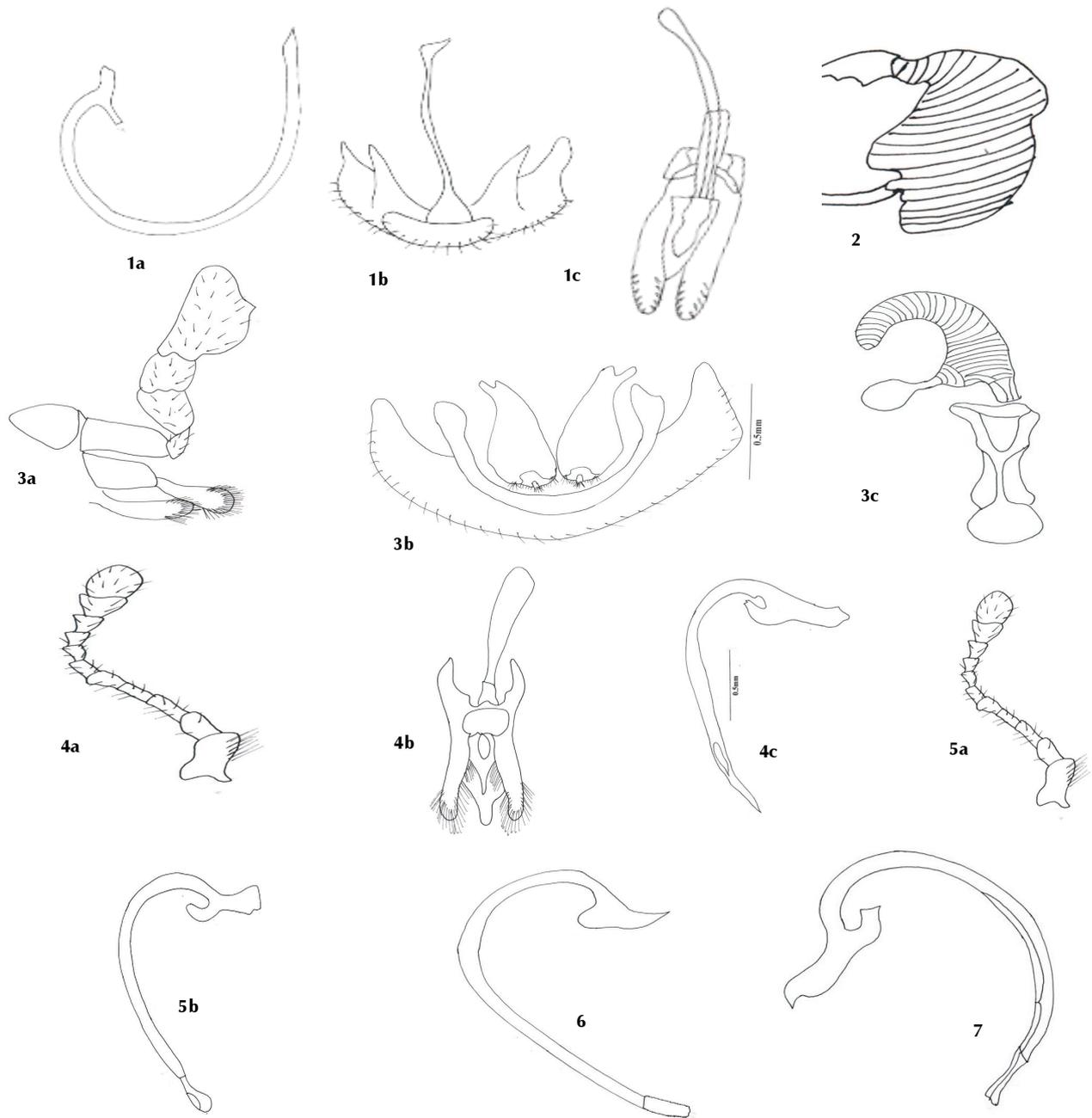


Figure 1: *Brumoides suturalis* (Fabricius): (a) Siphon; (b) Ninth abdominal segment of male; (c) Male tegmen, ventral view. 2. *Chilocorus nigratus* (Fabricius): Spermatheca of female. 3. *Coccinella septempunctata* Linnaeus: (a) Maxilla, (b) Spermatheca of female; (c) Hemisternite of female. 4. *Coccinella transversalis* Fabricius: (a) Antenna; (b) Male tegmen, ventral view; (c) Siphon. 5. *Harmonia octomaculata* (Fabricius): (a) Antenna; (b) Siphon. 6. *Illeis cincta* (Fabricius): Siphon. 7. *Micraspis discolor* (Fabricius) : Hemisternite of female

Local

Agartala, Sonamura, Khoai, Dharmanagar, Kumarghat, Koilashahar, Panisagar, Bilonia, Udaipur, Santir bazar, Sabroom, Ambasa, Manu, Kachar, Lunglei, Mamit, Kolasib and Shillong. (Majumder J., 2013)

***Chilocorus nigratus* (Fabricius)**

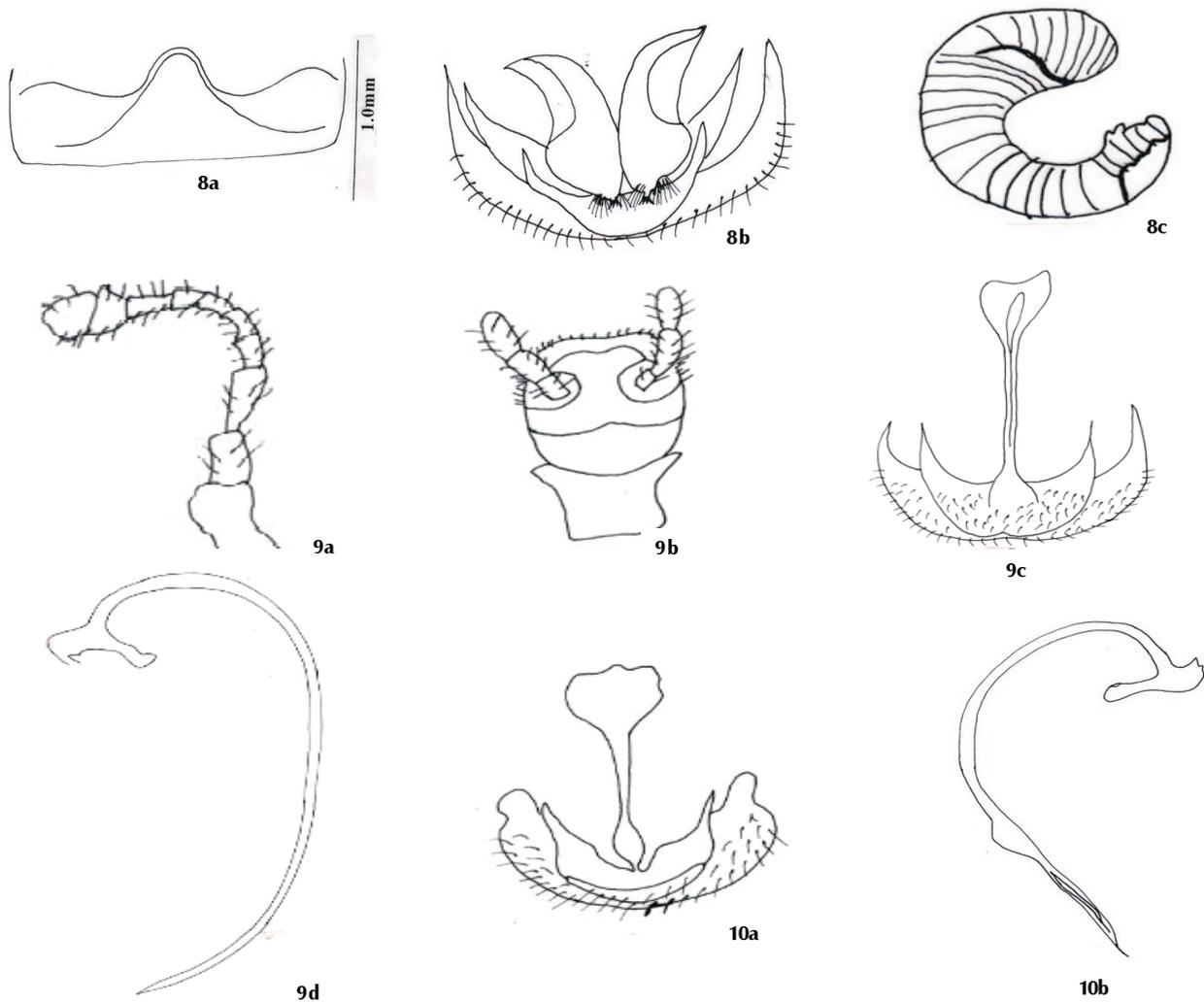
Coccinella nigrata Fabricius, 1798 : 79 (Type material lost-Booth, 1998).

Chilocorus nigratus : Mulsant, 1850: 463-Crotch, 1874:184-Korschefskey, 1932 : 240.-Nagaraja and Hussainy, 1967:252 (rev.).

Chilocorus nigrita: Bielawski, 1957 :86 (B and genitalia figs.).-Samways, 1989:345 (world dist.). Booth, 1998:362 (rev.).

Colour

The body bright black colour, head ochreous brown, eyes black; pronotum black with brown lateral expansions; mouth



Contd.....8. *Propylea sp.nr. japonica* (Thunberg): (a) First abdominal sternite; (b) Hemisternite of female; (C) Spermatheca of female. 9. *Cryptolaemus montrouzieri* Mulsant : (a) Antenna; (b) Labium (c)Ninth abdominal segment of male; (d) Siphus. 10. *Scymnus (Scymnus) nubilus* Mulsant (a) First abdominal sternite; (b) Siphus;

parts dark brown; scutellum and elytron black, venter of thorax and legs brown, abdominal terga dark brown, underside uniformly ochreous brown, hind wings grey and claws deep brown (Plate 2).

External morphology

Body is subglobose, rounded, highly convex, widest in the middle of the body. Head finely punctate with short and yellowish pubescence; genae narrower, frons coarsely punctate and clypeus concave at anterior margin. Antennae 8 segmented with small sensory hairs, slightly clavate. Pronotum strongly arched, narrower anteriorly with deep emargination; punctuations sparse all over and close, with pubescence at expansions; scutellum triangular with base slightly shorter than side; elytron widest near the middle. Coxal line shallowly curved and reached anterior margin; femoral line gently curved, extends almost to the lateral margin. Ventral side uniformly punctate and pubescent all over the legs with a pair

of claws.

Female genitalia

Hemisternite short, oval and broad and rounded, bears stylus with sparsely pubescent. Spermatheca sac like with a finger like projection anteriorly. (Fig. 2)

Measurements (mm)

Body 4.21 (3.61 – 4.51) long; 4.55 (4.18-4.58) wide.

Specimens examined

1 male, Chailanta, Ambasa district, rice, 17-VIII-2009, Samik chowdhury; 1 male, Padmapur, North Tripura, rice, 16-VIII-2010, Samik chowdhury; 2 males, Betaga, West Tripura, rice, 22-VIII-2010, Samik chowdhury.

Distribution

Worldwide

Sri Lanka, Pakistan, Nepal, Myanmar, Malaysia, Chagos

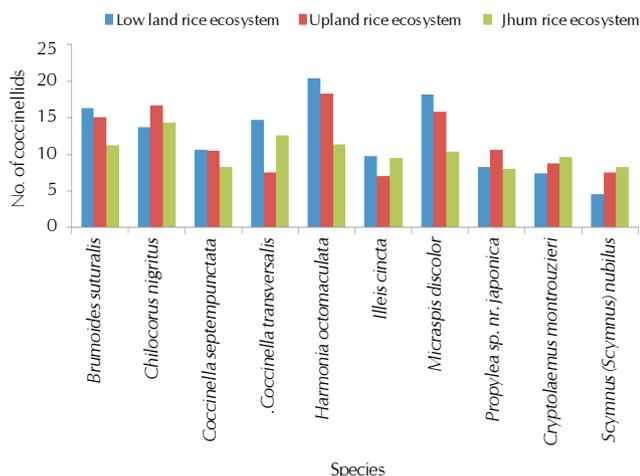


Figure 2: Distribution of different coccinellids in different rice ecosystems of Indo-Bangladesh border

Archipelago, Indonesia, Madagascar, Reunion, Mauritius. Seychelles, Togo, Ghana, East Africa, Kenya, Tanzania, South Africa, Brazil, North Africa, North America Southeast Asia, China. (Samways *et al.*, 1999)

India

Andaman and Nicobar Islands, Andhra Pradesh, Bihar, Delhi, Haryana, Himachal Pradesh, Karnataka, Kerala, Maharashtra, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, West Bengal and North-East. (Bielawski, R. 1961, Poorani, J. 2002)

Local

Agartala, Sonamura, Khoai, Dharmanagar, Kumarghat, Koilashahar, Panisagar, Bilonia, Udaipur, Santir bazar, Sabroom, Ambasa, Manu, Kachar, Lunglei, Mamit, Kolasib and Shillong. (Majumder J., 2013)

Subfamily : **Coccinellinae**

Tribe : **Coccinellini**

***Coccinella septempunctata* Linnaeus**

Coccinella 7-punctata Linnaeus, 1758: 365 (LSL).

Coccinella septempunctata: Korschefsky, 1932: 486 (cat.)-Schaefer and Semyanov, 1992: 125-134 (world parasite list and bibliography).

Coccinella divaricata Olivier, 1808: 1001 (lectotype; UCCC).-Korschefsky, 1932: 457 (cat.)-Mader, 1936: 375 (syn.)-Sudha Rao, 1962: 1341 (status).Gordon, 1987: 13 (lectotype design.).

Coccinella confusa Wiedemann, 1823: n.-Mulsant, 1850: 112 (as a var. of *divaricata*).-Sudha Rao, 1962: 1341 (status rev., morphs figd.).

Cocciliella bruckii Mulsant, 1866: 90.-Crotch, 1874: 46.

Coccinella septempunctata bruckii: Korschefsky, 1932: 491.

Colour

Head black, eyes brown, two yellowish spots present near the margin of eyes; mouth parts brown, antennae dark brown in colour, pronotum black with two yellow spots laterally; elytra orange in colour, black spots are present on elytra, these spots are connected to one another and form a broad black maculae on each elytron in some species. Ventral side and legs are

black. (Plate 3)

External morphology

Body medium sized, oval to round in shape, dorsum highly convex, glabrous. Antennae 11 segmented, last three segments gradually enlarged with setae sparsely. Mouth parts; maxillary palpi is usually large and hatchet shaped. Frons punctate, pronotum very densely punctate, scutellum triangular. Elytra sparsely punctate. The black pigmented area on elytra extended upto the first spot, leaving only the posterior structural margin of the elytra orange coloured. The middle orange areas reduced to a crescent shape due to the spreading of black pigment from the side of the original third and second spot and from the side of the fourth spot towards the middle of the elytra. The basal orange coloured area elliptical in shape whose posterior margin emarginated and contiguous upto the narrow apical margin through an elongate costal margin. Coxal line gently curved, femoral line angulate legs simple, tarsi pseudotrimerous (or) cryptotetramerous, last tarsal segment elongate and ends with a pair of claws. (Fig. 3a)

Female genitalia

Hemisternite bears a stylus. The shape of hemisternite elongate, transverse oval, anterior portion of hemisternite bifid and the basal part of hemisternite sparsely hairy. Spermetheca strongly hooked, nodulus and ramus clearly demarcated and the infundibulum elongated. (Fig. 3b and 3c)

Measurements (mm)

Body 7.12 (6.78 – 7.63) long; 5.64 (5.28 – 6.46) wide.

Specimens examined

11 males, 5 female, Chailanta, Ambasa district, rice, 17-VIII-2009, Samik chowdhury; 6 males, 1 female, 82 mile, Ambasa district, rice, 17-VIII-2009, Samik chowdhury; 10 males, 1 female Fotikrai, North Tripura, rice, 19-VIII-2010, Samik chowdhury; 8 males, 1 female, Jalebasa, North Tripura, rice, 19-VIII-2010, Samik chowdhury.

Distribution

Worldwide

One of the most common coccinellids of the region, found almost throughout India. Nepal. Sri Lanka. Myanmar. South-East Asia. China. Asia Pacific. Australia. New Zealand. (Kapur A.P 1962)

India

Andaman and Nicobar Islands, Andhra Pradesh, Bihar, Delhi, Haryana, Himachal Pradesh, Karnataka, Kerala, Maharashtra, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, West Bengal and North-East. (Bielawski, R. 1961)

Local

Agartala, Sonamura, Khoai, Dharmanagar, Kumarghat, Koilashahar, Panisagar, Bilonia, Udaipur, Santir bazar, Sabroom. (Majumder J., 2013)

***Coccinella transversalis* Fabricius**

Coccinella transversalis Fabricius, 1781: 97 (lectotype @& BMNH).-Mulsant, 1850: 126, 1022.-Timberlake, 1943: 14.-lablokoff-Khnzorian, 1979: 68; 1982: 391.-Pope, 1989: 652 (rev.).

Coccinella repanda Thunberg, 1781: 18 (lectotype @& UU).

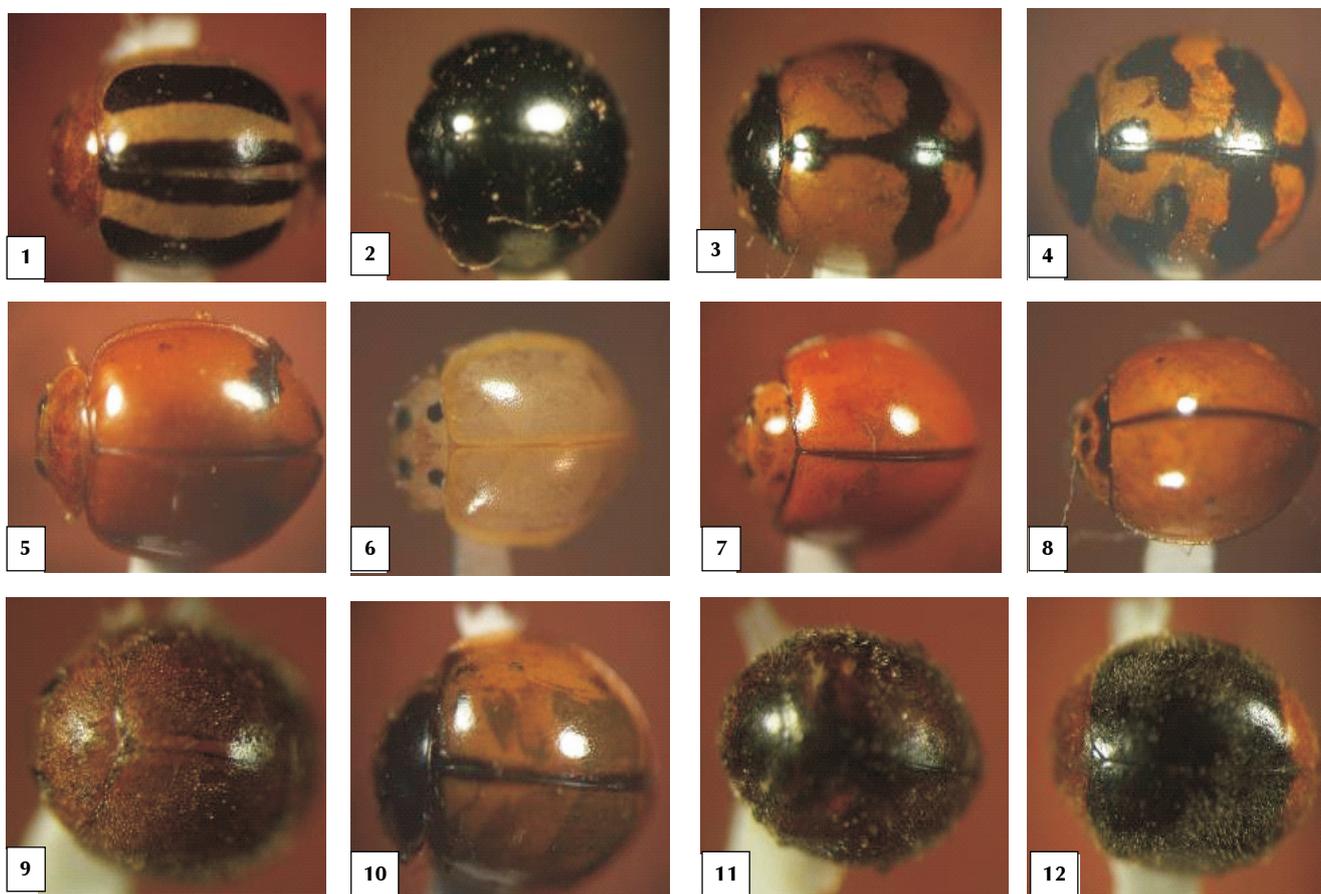


Plate.1. *Brumoides suturalis* (Fabricius) (male), **Plate. 2.** *Chilocorus nigrinus* (Fabricius)(female), **Plate.3 .** *Coccinella transversalis* Fabricius (male) **Plate.4.** *Coccinella transversalis* Fabricius (female) **Plate.5.** *Harmonia octomaculata* (Fabricius) (male) **Plate.6.** *Illeis cincta* (Fabricius) (male) **Plate.7.** *Micraspis discolor* (Fabricius) (female) **Plate.8.** *Micraspis discolor* (Fabricius) (male) **Plate.9.** *Propylea sp. nr. japonica* (Thunberg) (female) **Plate.10.** *Propylea sp. nr. japonica* (Thunberg) (Male) **Plate.11.** *Cryptolaemus montrouzieri* Mulsant **Plate.12.** *Scymnus* (*Scymnus*) *nubilus* Mulsant

-Mulsant, 1850: 1022 (syn.).-Crotch, 1871: 3; 1874: 117.-Korschefsky, 1932: 483 (cat.).-Pope, 1987: 62 (rev., lectotype design.).

Colour

Colouration variable : dark yellow creamy orange (Plate 4) and pale yellow (Fig. 4a, 4b and 4C) and brick red colour. Head black with yellow spot, mouthparts black to dark brown, antennae dark brown; eyes black; pronotum black with anterior lateral areas orange to yellow; scutellum black, elytra colouration variable. Elytra with black markings, commissural line black, ventral side and legs fully black (Abhishek. S. et al., 2014).

External morphology

Body larger in females than males. Body oval in shape, strongly convex dorsally. Head wider with a pair of prominent compound eyes. Frons punctate, clypeus straight. Antenna 11 segmented, last segment enlarged and rounded. The scape broad, long twice than pedicel. Mouthparts as shown in (Fig. 4a). Pronotum broad and finely punctate. Elytra sparsely punctate, epipleuron well developed. Coxal line curved and complete femoral line angulate. Legs pseudotrimerous end with a pair of claws.

Male genitalia

Tegmen with Y shaped medium lobe long as lateral lobes. Siphon short and curved at base and pointed at apex. Siphonal capsule having inner processes hooked and bifid and external processes broad. Apophysis of ninth abdominal segment caudally bifid, broad and rounded at tip.

Female genitalia

Hemisternite transverse oval to rounded and having stylus with sparsely setaceous. Spermatheca strongly curved and having infundibulum. Nodulus, ramus cannot be differentiated.

Measurements (mm)

Body 5.86 (5.25 – 6.35) long; 4.54 (4.48 – 4.78) wide.

Specimens examined

5 males, 10 females, Chailanta, Ambasa district, rice, 17-VIII-2009, Samik chowdhury; 3 females, Karamchara, Ambasa district, rice, 21-I-2010, Samik chowdhury; 4 males, 4 females, Padmapur, North Tripura, rice, 16-I-2010, Samik chowdhury.

Distribution

Worldwide

Sri Lanka, Pakistan, Nepal, Myanmar, Malaysia, Chagos

Table 1: Distribution of Coccinellid fauna in different districts of Indo-Bangladesh Border

Sl. no	Name of the species	West Tripura		North Tripura	South Tripura		Dhalai			Up	Am	Ma		
		Ag	Kho		Sm	Km	Ps	Ks	Bil				Sab	Sb
1	<i>Brumoides suturalis</i> (Fabricius)	34	42	28	44	34	51	27	35	42	31	48	48	32
2	<i>Chilocorus nigritus</i> (Fabricius)	28	27	22	34	28	30	5	25	28	18	30	31	38
3	<i>Coccinella septempunctata</i> Linnaeus	38	45	29	28	37	24	28	15	21	13	10	84	65
4	<i>Coccinella transversalis</i> Fabricius	21	20	10	35	28	23	23	21	28	30	15	53	74
5	<i>Harmonia octomaculata</i> (Fabricius)	31	58	38	61	43	28	45	51	48	39	47	35	42
6	<i>Illeis cincta</i> (Fabricius)	22	28	25	38	48	16	28	9	15	14	18	32	15
7	<i>Micraspis discolor</i> (Fabricius)	26	54	34	58	42	32	49	32	38	29	42	52	38
8	<i>Propylea sp. nr. japonica</i> (Thunberg)	29	35	28	25	35	15	22	18	21	23	15	27	32
9	<i>Cryptolaemus montrouzieri</i> Mulsant	25	34	27	24	28	35	18	24	13	23	15	21	35
10	<i>Scymnus (Scymnus) nubilus</i> Mulsant	19	12	27	12	18	10	14	10	9	10	8	42	15
Total		273	355	268	359	341	264	259	240	263	230	248	425	368
		896			1223			981				811		

AG: AGARTALA; KHO: KHOAI; SM: SONAMURA; DM: DHARMANAGAR; KM: KUMARGHAT; PS: PANISAGA; KS: KOILASHAHAR; BIL: BILONIA; SAB: SABROOM; SB: SANTIR BAZAR; UP: UDAIPUR; AM: AMBASA; MA: MANU

Archipelago, Indonesia, Madagascar, Reunion, Mauritius. Seychelles, Togo, Ghana, East Africa, Kenya, Tanzania, South Africa, Brazil, North Africa, North America Southeast Asia, China. (Kapur A.P 1962, Booth and Pope, 1989)

India

Andhra Pradesh; Goa; Haryana; Karnataka; Kerala; Maharashtra; Tamil Nadu. Widely distributed in India, but more common in peninsular India. (Bielawski, R. 1961, Poorani, J. 2002)

Local: Agartala, Sonamura, Bilonia, Udaipur, Santir bazar, Sabroom, Ambasa, Manu, Kachar, Lunglei, Mamit, Kolasib and Shillong. (Majumder J., 2013)

Harmonia octomaculata (Fabricius)

Coccinella octomaculata Fabricius, 1781 : 97 (not Thunberg, 1781:13) (Lectotype @&; BMNH).

Coccinella arcuata Fabricius, 1787:55 (ZMC).-Crotch, 1874: 110.-Korschefskey 1932: 440 (cat.)

Harmonia arcuata var. *octomaculata*: Mulsant, 1850: 80.

Harmonia arcuata: Mulsant, 1850: 177; 1866: 59.-Crotch, 1871: 3.-Timberlake 1943: 18.-Miyatake, 1965: 60.

Harmonia octomaculata: Mader, 1932: 215.-Bielawski, 1957: 93 (male genitalia figd.); 1961c: 6; 1962: 204; 1964: 5 (rev.).-Sasaji, 1971; 280 (desc.); 1977: 14 (larval desc.).-Iablokoff-Khnzorian, 1979: 71; 1982: 475.-Pope, 1989: 685 (rev.).

Harmonia octomaculata var. *arcuata*: Mader, 1932: 217.

Coeinella arcuata var. *octomaculata*: Korschefskey, 1932: 441.

Ptyehanatis octomaculata: Kamiya, 1965: 59.

Colour

Head orange to pale brown with black, eyes; antennae and mouth parts reddish brown in colour. Pronotum reddish brown; elytra reddish brown to brown in colour with black maculae on posterior end of elytra. The commissural line of elytra brown in colour. Ventral side dark brown and the legs reddish brown in colour. Epipleuron also reddish brown and scutellum dark brown. (Plate 5)

External morphology

Body is oval, longer than broad, dorsally convex and widen at the middle of the body or middle of elytra. Head broad with a

pair of prominent compound eyes; frons punctate, intraocular margin divergent apically. Antenna 11 segmented, the last segment bulged, mouth parts as shown in Fig. 5a. Pronotum strongly and trapezoidally excavated, surface punctate; scutellum triangular and basal margin longer than lateral margin. Elytra sparsely punctate and the epipleuron with an inner carina that may reach the elytral apex or well developed epipleuron. The post coxal line strongly curved and almost reached the anterior margin. Femoral line angulate, legs simple with 4 segmented tarsi ending with a pair of claws.

Male genitalia

Tegmen with short and broad lateral lobes with hairs at apex, median lobe shorter than lateral lobes, shape of median lobe characteristic. Sipro strongly curved at base and straight apically and apex of sipro spoon shaped with membranous projection; siphonal capsule inner processes hooked and outer processes broadened. Apophysis of ninth abdominal segment broad at caudally, rounded oval tip anteriorly. (Fig. 5b)

Measurements (mm)

Body 6.25 (5.46 - 6.38) long; 4.51 (3.68 - 5.05) wide.

Specimens examined

3 males, Arundhutinagar, West Tripura, rice, 12-VIII-2010, Samik chowdhury.

Distribution

Worldwide

Sri Lanka, Pakistan, Nepal, Myanmar, Malaysia, Chagos Archipelago, Indonesia, Madagascar, Reunion, Mauritius. Seychelles, Togo, Ghana, East Africa, Kenya, Tanzania, South Africa, Brazil, North Africa, North America Southeast Asia, China. (Sudha, R. *et al.*, 1962, Samways *et al.*, 1999, Kapur A.P 1962, Booth and Pope, 1989; Canepari, 2003)

India

Andaman and Nicobar Islands, Andhra Pradesh, Bihar, Delhi, Haryana, Himachal Pradesh, Karnataka, Kerala, Maharashtra, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, West Bengal and North-East. (Bielawski, R. 1961, Poorani, J. 2002)

Local

Agartala, Sonamura, Khoai, Dharmanagar, Kumarghat, Koilashahar, Panisagar, Bilonia, Udaipur, Santir bazar, Sabroom, Ambasa, Manu, Kachar, Lunglei, Mamit, Kolasib

and Shillong. (Majumder J., 2013)

***Illeis cincta* (Fabricius)**

Coccinella cincta Fabricius, 1798: 77 (ZMC)

Psyllobora cincta Mulsant, 1850: 167; 1866 :127.

Thea cincta : Crotch, 1874:135.

Illeis cincta : Korschefsky, 1932: 558 (cat.).-Bielwaski, 1957:95 (male genitalia figd.); 1961:356 (rev.).

Colour

Head yellowish; eyes black, antennae pale yellowish, mouth parts yellowish to brown; pronotum transparent yellow and scutellum yellowish. Pronotum with a pair of black round spots at posterior end. Elytra greyish yellow to pale yellow and shiny. Sometimes elytra light orange in colour and shiny. Elytral commissural line yellowish. Ventral side brown and legs yellowish to brown. (Plate 6)

External morphology

Body elongate oval, dorsally convex, wider at middle of elytra. Head with a pair of prominent black eyes. Eyes mostly covered by the pronotum. Head densely punctate and hairy. Frons flat. Antennae 11 segmented, elongated, last segment of antennae bulged. Mouthparts as shown in Fig.6 (b, c, d and e). Maxillary palpi characteristic, last segment of maxillary palpi enlarged, broad, axe-head shaped. Pronotum strongly excavated, straight, broader than longer and finely punctate. Scutellum triangular. Prosternum anteriorly extended to cover mouthparts. Mesosternum broad and short. Elytra densely punctate than pronotum, apices of elytra rounded. Post coxal line straight not reaching the anterior margin. Femoral line slightly curved and reaching the posterior margin. Legs densely hairy, tarsus 4 segmented and ending with a pair of claws.

Male genitalia

Tegmen with elongated lateral robes and densely hairy at apex, median lobe longer than lateral lobes. Siphon strongly curved basally and apically. Apex of siphon spatula like and inner processes of siphonal capsule short and round, outer processes pointed. Apophysis of ninth abdominal segment elongated and bifid caudally. (Fig. 6)

Measurements (mm)

Body 4.54 (4.41 – 5.12) long; 3.78 (3.36 – 4.19) wide.

Specimens examined

3 males, 1 female, Padmapur, North Tripura, rice, 18-VIII-2010, Samik chowdhury; 1 male, 2 females, Karamchara, Ambasa district, rice, 17-VIII-2010, Samik chowdhury.

Distribution

Worldwide

Sri Lanka, Pakistan, Nepal, Myanmar, Malaysia, Chagos Archipelago, Indonesia, Madagascar, South Africa, Brazil, North Africa, North America Southeast Asia, China. (Kapur A. P 1962, Booth and Pope, 1989; Canepari, 2003)

India

Andaman and Nicobar Islands, Andhra Pradesh, Bihar, Delhi, Haryana, Himachal Pradesh, Karnataka, Kerala, Maharashtra, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, West Bengal and North-East. (Bielawski, R. 1961, Poonomi)

Local: Agartala, Sonamura, Khoai, Dharmanagar, Kumarghat, Koilashahar, Panisagar, Bilonia, Udaipur, Santir bazar, Sabroom, Ambasa, Manu, Kachar, Lunglei, Mamit, Kolasib and Shillong. (Majumder J., 2013)

***Micraspis discolor* (Fabricius)**

Coccinella discolor Fabricius, 1798: 77 (Type depository unknown).

Verania discolor: Mulsant, 1850 369-Korschefsky, 1932: 308.-Bielawski, 1957: 92 (B& genitalia figd.).

Micraspis discolor: Kamiya, 1965a: 60.-Sasaji, 1968: 128.-Sasaji & Tsubokawa, 1983: 47 (larval desc.).-Jiang & Su, 1985: 115 (food habits & syst.).

Coccinella simplex Thunberg, 1820: 363 (lectotype @& UU).-Korschefsky, 1932: 582 (as species incerta sedis).-Synonymised and lectotype designated by Pope, 1987: 64.

Colour

Head yellow, compound eyes black, mouth parts and antennae brown; pronotum pale yellow to yellowish white in colour with black spots or patches towards proximal end. Scutellum black, elytra orange in colour with black commissural line. The ventral side yellowish brown, fore legs brownish yellow and hindlegs dark brown. Females bright orange in colour and highly convex dorsally. Males pale yellowish to orange in colour, pronotum having half moon shaped black marking at posterior end. (Plate 7 and 8)

External morphology

Body oval, convex dorsally and glabrous. Head with a pair of compound eyes. Eyes sparsely pubescent with very short, erect hairs. Antennae 11 segmented, last 3 segments formed club and enlarged. In male the last antennal segment beak shaped. Elytra slightly pubescent. The post coxal line straight and complete. Femoral line straight but incomplete. The elytral epipleuron continuation upto the underside or epipleuron is well developed. Legs simple, pseudotrimerous or cryptotetramerous tarsi with apically bifid claw.

Male genitalia

Tegmen having elongated long lateral lobes with densely hairy, median lobe shorter than lateral lobes and the apex of median lobe is pointed. Apophysis of ninth abdominal segment rounded at anterior end. Siphon strongly curved at base, straight at apex; siphonal capsule well developed, apex of siphon with hooked processes (Fig. 7).

Female genitalia

Spermatheca curved and C shaped, the spermatheca attached to the inverted Y shaped infundibulum. Hemisternite transverse, oval in shape and stylus absent.

Measurements (mm)

Body 4.18 (3.59 - 4.32) long; 3.51 (3.38 - 3.68) wide.

Specimens examined

1 male, Jalebasa, North Tripura, rice, 19-VIII-2009, Samik chowdhury; 1 female, Padmapur, North Tripura, rice, 18-VIII-2010, Samik chowdhury; 1 male, Karamchara, Ambasa district, rice, 17-VIII-2010, Samik chowdhury; 3 males, 5 females Arundhutinagar, West Tripura, Rice, 12-VIII-2010, Samik chowdhury.

Distribution**Worldwide**

Sri Lanka, Pakistan, Nepal, Myanmar, Malaysia, Chagos Archipelago, Indonesia, Madagascar, Reunion, Mauritius, Seychelles, Togo, Ghana, East Africa, Kenya, Tanzania, South Africa, Brazil, North Africa, North America Southeast Asia, China.

India

Andaman and Nicobar Islands, Andhra Pradesh, Bihar, Delhi, Haryana, Himachal Pradesh, Karnataka, Kerala, Maharashtra, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, West Bengal and North-East. (Bielawski, R. 1961, Poorani, J. 2002)

Local: Agartala, Sonamura, Khoai, Dharmanagar, Kumarghat, Koilashahar, Panisagar, Bilonia, Udaipur, Santir bazar, Sabroom, Ambasa, Manu, Kachar, Lunglei, Mamit, Kolasib and Shillong. (Majumder J., 2013)

***Propylea sp. nr. japonica* (Thunberg)**

(*Coccinella japonica* Thunberg, 1781: 12 (lectotype B&; UU).-Pope, 1987: 58 (lectotype design.).

Coccinella tetraspilota Hope, 1843: 64 (not Hope, 1831) (Lectotype; B:MNH). Synonymised and lectotype designated by Booth & Pope, 1989: 366.

Propylea japonica: Lewis, 1896: 30.

Propylaea japonica: Mader, 1933: 262-263.-Kamiya, 1965: 44-46.

Propylea quatuordecimpullctata japonica: Timberlake, 1943: 28.

Colour

Head brown, eyes black, antennae and mouthparts dark brown; pronotum golden yellowish with markings, scutellum black; elytra pale yellow to light orange in colour with black commissural lines, ventral side dark brown with dark brown, legs. (Plate 9 and 10)

External morphology

Body short, oval, glabrous, dorsally strongly convex. Head broader than long with a pair of prominent eyes and finely punctate. Frons weakly convex. Antennae 11 segmented, last 3 segments gradually enlarged, scape twice larger than pedicel and sparsely setaceous all over the antennae. Mouthparts as shown in Fig.8a and 8b). Pronotum finely punctate broader than long, trapezoidally excavated; scutellum smaller, triangular in shape. Elytra densely punctate than pronotum and elytral epipleuron very well developed. Post coxal line slightly curved, incomplete. Femoral line curved and reaching the posterior margin.

Female genitalia

Hemisternite elongated triangular, nearly round. Stylus present, finely setaceous. Spermatheca strongly curved, short, stout, C shaped and characteristic in this species. (Fig. 8c)

Measurements (mm)

Body 3.66 (3.28 - 4.01) long; 2.75 (2.23 - 3.15) wide.

Specimens examined

1 male, Padmapur, North Tripura, rice, 18-VIII-2010, Samik chowdhury; 1 male, Jalebasa, North Tripura, rice, 19-VIII-2010,

Samik chowdhury.

Distribution**Worldwide**

Sri Lanka, Pakistan, Nepal, Myanmar, Malaysia, Chagos Archipelago, Indonesia, Madagascar, Reunion, Mauritius, Seychelles, Togo, Ghana, East Africa, Kenya, Tanzania, South Africa, Brazil, North Africa, North America Southeast Asia, China.

India

Andaman and Nicobar Islands, Andhra Pradesh, Bihar, Delhi, Haryana, Himachal Pradesh, Karnataka, Kerala, Maharashtra, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, West Bengal and North-East. (Bielawski, R. 1961, Poorani, J. 2002)

Local

Agartala, Sonamura, Khoai, Dharmanagar, Kumarghat, Koilashahar, Panisagar, Bilonia, Udaipur, Santir bazar, Sabroom, Ambasa, Manu, Kachar, Lunglei, Mamit, Kolasib and Shillong. (Majumder J., 2013)

Tribe : Scymnini *Cryptolaemus montrouzieri* Mulsant

Cryptolaemus montrouzieri Mulsant, 1853a: 268 (lectotype; PM).

Cryptolaemus montrouzieri : Crotch, 1874: 204 (emend.).-Korschefsky, 1931: 169 (cat.).-Puttarudriah *et al.*, 1952: 377 (introduction into India).

Cryptolaemus montrouzieri montrouzieri: Booth & Pope, 1986: 706 (rev. and lectotype design.).

Colour

Head, antennae reddish yellow, eyes black; mouth parts yellowish brown; scutellum black; elytra shining black with apices reddish yellow; prosternum yellowish brown, meso and metasternum slightly black in colour, ventral side yellowish brown to dark brown and legs dark brown in colour with pale tarsi. (Plate 11)

External morphology

Body strongly oval in shape, convex with strongly setaceous. Head finely punctate relatively large, deep and close punctures, half of their diameter or less nearer to eyes and clypeus. Punctures finer on vertex behind eyes. Antennae 10 segmented with last 3 segments forming a club. Mouth parts as shown in Fig. 9. Pronotum pubescent more at side margins. Scutellum closely punctured. Prosternum has semicircular lobe anteriorly. Elytra more pubescent than pronotum and forming shaggy appearance to elytra, elytra more pubescent but less punctured. Post coxal lines shallowly curved and rounded, reached to anterior margin and femoral line strongly curved. Legs with 4 tarsal segments and end with a pair of claws.

Male genitalia

Apophysis of 9th abdominal segment expanded anteriorly in M shape and caudally bifid. Siphon strongly curved with developed siphonal capsule and apex of siphon truncated. Tegmen with ruminant median lobe shorter than lateral lobes and lateral lobes hairy. (Fig. 9d)

Measurements (mm)

Body 3.75 (3.58 - 4.35) long; 2.58 (2.25 - 3.09) wide.

Specimens examined

1 male, Fotikrai, North Tripura, rice, 19-VIII-2010, Samik chowdhury; 1 female, Padmapur, North Tripura, rice, 18-VIII-2010, Samik chowdhury; 1 female, Satchand, South Tripura, rice, 21-VIII-2010, Samik chowdhury;

Distribution

Worldwide

Sri Lanka, Pakistan, Nepal, Myanmar, Malaysia, Chagos Archipelago, Indonesia, Madagascar, Reunion, Mauritius, Seychelles, Togo, Ghana, East Africa, Kenya, Tanzania, South Africa, Brazil, North Africa, North America Southeast Asia, China.

India

Andaman and Nicobar Islands, Andhra Pradesh, Bihar, Delhi, Haryana, Himachal Pradesh, Karnataka, Kerala, Maharashtra, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, West Bengal and North-East. (Bielawski, R. 1961, Poorani, J. 2002)

Local

Agartala, Sonamura, Khoai, Dharmanagar, Kumarghat, Koilashahar, Panisagar, Bilonia, Udaipur, Santir bazar, Sabroom, Ambasa, Manu, Kachar, Lunglei, Mamit, Kolasib and Shillong. (Majumder J., 2013)

10. *Scymnus (Scymnus) nubilus* Mulsant

Scymnus nubilus Mulsant, 1850: 972 (lectotype; BEC, OU).-Bielawski, 1972: 293 (B& genit. figd.).-Booth and Pope, 1989: 359 (lectotype design.).

Scymnus (Scymnus) nubilus: Korschefsky, 1931: 143 (cat).

Scymnus curtisii Mulsant, 1850: 973 (original syntype lost).-Synonymised by Booth and Pope, 1989: 351.

Scymnus suturalis Motschulsky, 1858: 120.-Crotch, 1874: 253.-Korschefsky, 1931: 144.-Iablokoff-Khuzorian, 1972: 166.

Scymnus stabilis Motschulsky, 1866: 426 (Holotype; UM).-Crotch, 1874: 257. Weise, 1900: 439.-Korschefsky, 1931: 144 (cat).

Scymnus lateralis Sicard, 1913: 502 (Holotype @&; BMNH)-Korschefsky, 1931: 143 (cat).-Pang and Gordon, 1984: 133 (redesc.).-Synonymised by Booth and Pope, 1989: 360.

Colour

Very small beetles. Head dark brown, eyes black, mouth parts antennae brown in colour; pronotum dark brown with small spot or patch, scutellum black; elytra dark brown to brown in colour having the black line or patch along with commissural line of elytra broad at anterior and narrow posteriorly and it forms V shaped patch; ventral side dark brown to black in colour with brown legs. (Plate 12)

External morphology

Small sized body oval, elongated and highly pubescent. Head densely punctate with a pair of compound eyes. Antennae 9 segmented, last 2 segments are enlarged gradually and scale elongated twice than pedicel. Mouth parts as shown in Fig. 12 (b, c, d, e and f). Antennal scape elongated twice than pedicel. Pronotum densely punctate and pubescent; posterior margin of pronotum is W shaped and broad; scutellum triangular, elytra heavily pubescent with yellowish hairs, epipleuron not well developed. Coxal line curved, complete and femoral line straightly curved. (Fig. 19a)

Male genitalia

Tegmen with short median lobe, lateral lobes elongate, slender and sparsely hairy. Apophysis of the 9th abdominal segment expanded broadly at distal end. Siphon strongly curved at base with pointed apex and thread like; the inner processes of siphonal capsule narrow and longer and outer processes broad and short. (Fig. 10b)

Measurement (mm)

Body 1.91 (1.64 – 2.08) long; 1.51 (1.15 – 1.32) wide.

Specimen examined

1 male, 82 mile, Ambasa district, rice, 19-VIII-2009.

Distribution:

Worldwide

Sri Lanka, Pakistan, Nepal, Myanmar, Malaysia, Chagos Archipelago, Indonesia, Madagascar, Reunion, Mauritius, Seychelles, Togo, Ghana, East Africa, Kenya, Tanzania, South Africa, Brazil, North Africa, North America Southeast Asia, China.

India

Commonly distributed throughout the country (Karnataka; Kerala; Goa; Haryana; Maharashtra; Orissa; Punjab; Rajasthan; Tamil Nadu; Uttar Pradesh; West Bengal). Nepal. Pakistan. Bangladesh. Myanmar. Japan. Micronesia. Asia Minor. Mediterranean region. Africa (Booth & Pope, 1989; Canepari, 2003, Poorani, J. 2002)

Local: Agartala, Sonamura, Khoai, Dharmanagar, Kumarghat, Koilashahar, Panisagar, Bilonia, Udaipur, Santir bazar, Sabroom, Ambasa, Manu, Kachar, Lunglei, Mamit, Kolasib and Shillong. (Majumder J., 2013)

Climate change is one of the major issues in North-East region. Due to this climate change minor pest become major pest. May to this minor pest will turn to major pest after some decades. Insecticides have disrupted natural enemy complexes and induced resurgence of the target pests and outbreak of secondary pests (Heinrichs, 1994). In conclusion, the populations of coccinellid in rice fields should be conserved and enhanced through the maintenance of a rich weed flora during the fallow period, management of weed communities on the bunds through partial slashing, and by minimal use of biocides when needed, to avoid economic damage by specific insect pests. Natural biological control which maintains the diversity and integrity of this man made agro-ecosystem should be given prime importance in deciding environmentally safe and effective IPM strategies. The role of biodiversity in the dynamics and management of the insect pests of rice highlighted by Way and Heong (1994) is further substantiated by the present study (Bambaradeniya *et al.*, 2008).

Among these 10 species of Coccinellids, *Harmonia octomaculata* (Fabricius) (32%) and *Micraspis discolor* (Fabricius) (22%) are the most abundant species in and around rice ecosystem of followed by *Brumoides suturalis* (Fabricius) (18%) and *Chilocorus nigritus* (Fabricius). Five species viz., *Coccinella septempunctata* Linnaeus; *Coccinella transversalis* Fabricius; *Illeis cincta* (Fabricius) *Propylea sp. nr. japonica* (Thunberg) and *Scymnus (Scymnus) nubilus* Mulsant were minor in rice ecosystem of Indo-Bangladesh border. Among

these species *Harmonia octomaculata* (Fabricius) is abundant recording 32% of population followed by *Micraspis discolor* (Fabricius) recording 22% of population.

Among these coccinellids species, *Harmonia octomaculata* (Fabricius) and *Micraspis discolor* (Fabricius) were mostly abundant in lowland rice ecosystem (C. Shanker *et al.*, 2013). *Brumoides suturalis* (Fabricius) and *Micraspis discolor* (Fabricius) were major coccinellid beetle in upland rice ecosystem (B. Vinothkumar, 2012). *Harmonia octomaculata* (Fabricius), *Coccinella transversalis* Fabricius and *Chilocorus nigritus* (Fabricius) were high in jhum land rice ecosystem. (from Fig. 2)

Distribution of Coccinellid fauna in different districts of Indo-Bangladesh Border

The distribution pattern of coccinellids associated with rice crop ecosystems of Indo-Bangladesh border were presented in Table 1. 3911 no of coccinellid were collected from Indo-Bangladesh border. Out of that, maximum no of species collected from Northern border region 1155 followed by Southern border region then Western border and Eastern border of Indo-Bangladesh border. A perusal of data from the table revealed that the coccinellids viz., *Harmonia octomaculata* (Fabricius), *Micraspis discolor* (Fabricius), *Brumoides suturalis* (Fabricius), *Chilocorus nigritus* (Fabricius) and *Coccinella septempunctata* Linnaeus Were widely distributed in all the four regions of Indo-Bangladesh border.

DISCUSSION

Coccinellid species belonging to ten genera, under four tribes of the family Coccinellidae were collected and identified in this study. They were *Brumoides suturalis* (Fabricius), *Chilocorus nigritus* (Fabricius), *Coccinella septempunctata* Linnaeus, *Coccinella transversalis* Fabricius, *Harmonia octomaculata* (Fabricius), *Illeis cincta* (Fabricius), *Micraspis crocea* (Fabricius), *Propylea sp. nr. japonica* (Thunberg), *Cryptolaemus montrouzieri* Mulsant and *Scymnus (Scymnus) nubilus* Mulsant. Result also revealed that out of ten coccinellid *Harmonia octomaculata* (Fabricius) (22.9%), *Micraspis crocea* (Fabricius) (18.5%), *Brumoides suturalis* (Fabricius) (12.36%) and *Chilocorus nigritus* (Fabricius) (9.06%) were major predatory coccinellids beetles in rice ecosystems of Indo-Bangladesh border. Study also revealed that population of *Harmonia octomaculata* (Fabricius) and *Micraspis crocea* (Fabricius) was higher in lowland rice ecosystem, *Brumoides suturalis* (Fabricius) and *Micraspis crocea* (Fabricius) was higher in upland ecosystem of rice and *Chilocorus nigritus* (Fabricius), *Coccinella transversalis* Fabricius and *Harmonia octomaculata* (Fabricius) were higher in jhum ecosystem of rice in Indo-Bangladesh border.

These coccinellid beetles are mainly act as a predator in different rice ecosystem which act as is a big component of biological control. These coccinellids mainly feed nymph of leafhoppers, plant hoppers and thrips. These coccinellids also heavy feeder of egg and larvae of different insect. Under natural field conditions, GLH is one of the important preys for *H. octomaculata* adults and grubs (Lydia. *et al.*, 2008). *Cheilomena sexmaculatus*, *Coccinella transversalis*, *Brumoides suturalis*, *Harmonia octomaculata* and *Microspia*

discolour were predominant during crop season in upland rice and they have significant positive correlation with the population of brown plant hopper and green leaf hopper (Vinothkumar, 2012). *Micraspis discolor* is the most abundant species of coccinellid in rice ecosystems and touted as a biocontrol option for brown plant hopper (BPH), *Nilaparvata lugens* (Stal), a key pest of rice (Shanker *et al.*, 2013).

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