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Rojeet Thangjam

College of Horticulture, CAU
(Imphal), Thenzawl, Mizoram,
India

Veronica Kadam

College of PG Studies in
Agricultural Sciences, CAU
(Imphal), Umiam, Meghalaya,
India

Kennedy Ningthoujam

College of PG Studies in
Agricultural Sciences, CAU
(Imphal), Umiam, Meghalaya,
India

RK Borah

Department of Entomology,
Assam Agricultural University,
Jorhat, Assam, India

DK Saikia

Department of Entomology,
Assam Agricultural University,
Jorhat, Assam, India

Corresponding Author:

Rojeet Thangjam

College of Horticulture, CAU
(Imphal), Thenzawl, Mizoram,
India

Diversity and abundance of predatory coccinellid beetles (Coleoptera: coccinellidae) of king chilli (*Capsicum chinense* Jacq.) in Assam, India

Rojeet Thangjam, Veronica Kadam, Kennedy Ningthoujam, RK Borah and DK Saikia

Abstract

A total of 205 individual coccinellids were observed during the investigation out of which 19 species belonging to 11 genera were found to predate on sucking pests of king chilli. Among the coccinellids, *Coccinella transversalis* was observed in highest number (40 nos.) followed by *Menochilus sexmaculatus* (38 nos.) and *Micraspis discolor* (34 nos.) and *Platynaspis* sp. recorded lowest (1 nos.). The highest relative abundance was recorded in *Coccinella transversalis* (19.51%) followed by *Menochilus sexmaculatus* (18.54%), *Micraspis discolor* (16.59%), *Brumoides suturalis* (7.32%), *Coelophora bissellata* (5.85%) and *Coccinella septempunctata* (4.88%). However, *Platynaspis* sp. recorded the lowest (0.49%) followed by *Jauravia quadripunctata* and *Propylea* sp. with the relative abundance of 0.98 percent each. One hymenopteran parasitoid *Oomyzus* sp. was also observed during the study and this may be the first time reporting this parasitoid from Assam parasitizing coccinellids.

Keywords: Predatory, coccinellids, diversity, relative abundance, king chilli, Assam

Introduction

Northeast India is one of the important hot spot for biodiversity with diverse flora and fauna due to sub-tropical climate, influenced by southwest and northeast monsoons. The “King chilli (*Capsicum chinense* Jacquin)” a unique chilli grown in this region is a special gift of nature, which is one of the hottest chilli in the world with a pleasant and tempting aroma. In 2007, Guinness World Records certified that this chilli was the world's hottest chilli about 400 times hotter than Tabasco sauce^[1]. The chilli is extensively grown in North Eastern region of India, predominantly in the states of Assam, Manipur and Nagaland. The king chilli belongs to the family Solanaceae with chromosome number 2n=24. The chilli is called by different names in different regions. In Assam, it is widely called Bhut Jolokia, Bih Jolokia or Naga Jolokia; U-Morok or OO-Morok in Manipur and Raja Mircha or Raja Mirchi in Nagaland and Ghost pepper or Naga king chilli by the western media^[2]. In the last few decades, this chilli is catching the attention of many growers due to its high demand. The fresh king chilli costs around 300-350 Rs/kg and more than 1500-2000 Rs/kg in dried chilli at local market. Local entrepreneurs are exporting this chilli to Australia, USA, UK and Israel^[3]. This chilli also has high cost benefit ratio per hectare and in Assam, it reach upto 1:11.85^[4]. In Assam, king chilli was found to be infested by pests like *Aphis gossypii*, *Myzus persicae*, *Bemisia tabaci*, *Bactrocera latifrons*, *Scirtothrips dorsalis* and *Polyphagotarsonemus latus*^[5, 6, 7] and this chilli is also highly susceptible to viral diseases which are transmitted by aphids, whitefly and thrips hampering the productivity of the crop^[8, 9]. Since little work has been done on predatory coccinellid beetles in king chilli ecosystem, the present investigation was taken up to understand the diversity and relative abundance of coccinellids associated with the pests of king chilli.

Materials and Methods

The present investigation was carried out for two years from 2014 to 2016 during *rabi* season at the Experimental farm, Department of Horticulture, Assam Agricultural University, Jorhat, Assam. The geographical location of the experimental field is situated at 26°47' North latitude and 94°12' East longitude at an altitude of 86.6 meters above the mean sea level with mostly alluvial and sandy loam soil.

Preparation of the field and raising of the crop was done by following package and practices for horticultural crops of Assam. Recommended doses of manures and fertilizers were applied before transplanting to the field at the rate of 5 tonnes cow dung manure per hectare with N:P:K @ 120:60:60/ha. A spacing of 75×75 cm was maintained in 100 m² and the activity of coccinellids was observed after the appearance of sucking pests in the crop at weekly interval without insecticides application. The coccinellid beetles were photographed (grubs, pupae and adults) with DSLR camera (Nikon D3300) and collected by using brush and test tube. The immature stages were collected and reared them in the laboratory for adult emergence. The adult specimens were then killed by using chloroform and preserved them in 80 percent ethanol in small vials and pinning was also done for dry preservation. The samples were then sent to Dr. Poorani Janakiraman, NRCB, Trichy and National Bureau of Agricultural Insects Resources (NBAIR), Bangalore for identification. The relative abundance was calculated by counting total number of coccinellids collected during the study and the number of individual coccinellids and expressed in percentage.

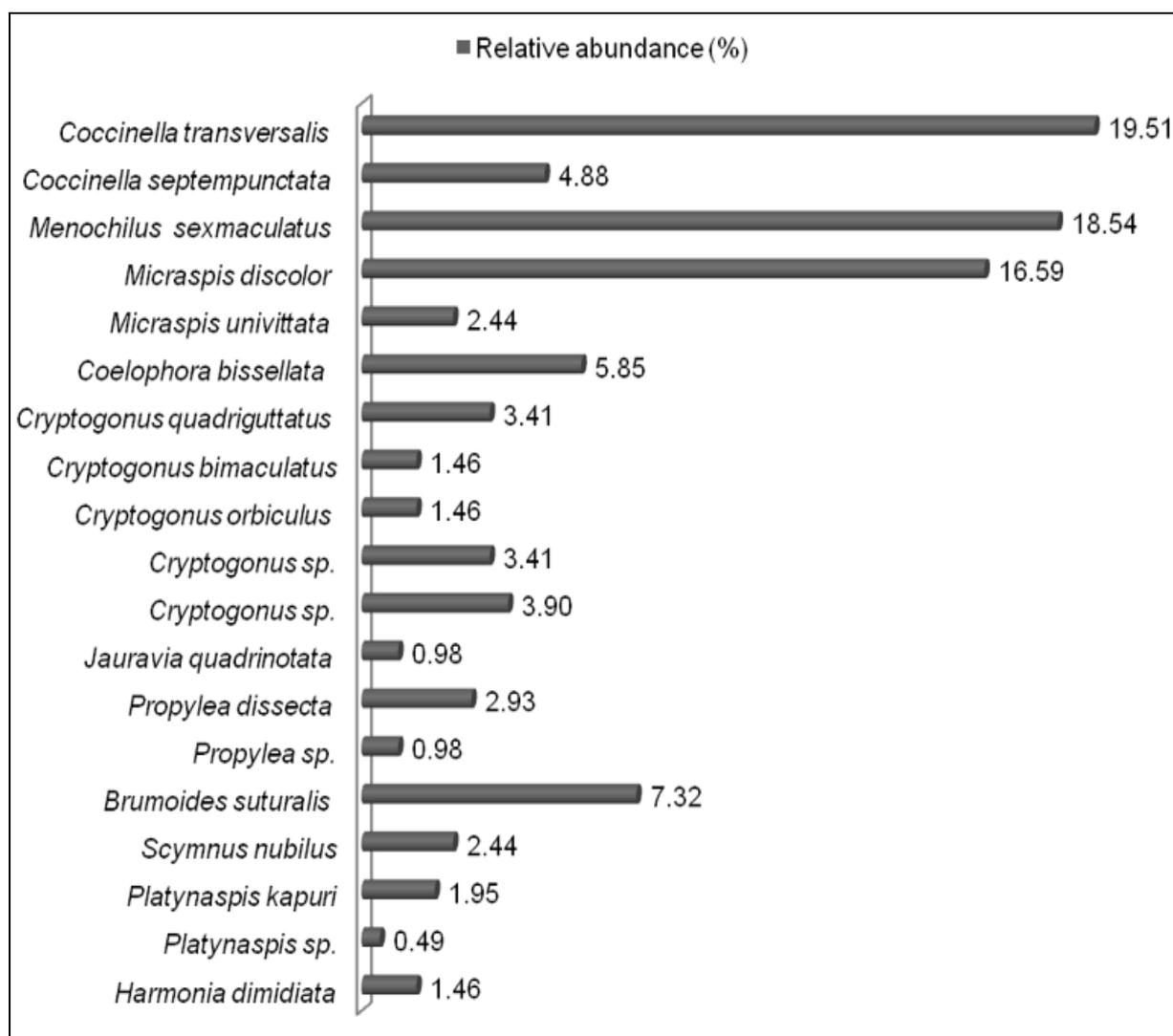
Results and Discussion

A total of 205 individual coccinellids were observed during the investigation out of which 19 species belonging to 11 genera were found to predate on sucking pests (*Aphis gossypii*, *Myzus persicae* and *Bemisia tabaci*) of king chilli (Table 1). The observed predatory coccinellid beetles were *Coccinella transversalis*, *Coccinella septempunctata*, *Menochilus sexmaculatus*, *Micraspis discolor*, *Micraspis univittata*, *Coelophora bissellata*, *Cryptogonus quadriguttatus*, *Cryptogonus bimaculatus*, *Cryptogonus orbiculus*, *Cryptogonus* sp., *Cryptogonus* sp., *Jauravia quadrinotata*, *Propylea dissecta*, *Propylea* sp., *Brumoides suturalis*, *Scymnus nubilus*, *Platynaspis kapuri*, *Platynaspis* sp. and *Harmonia dimidiata*. Among the coccinellids, *Coccinella transversalis* was observed in highest number (40 nos.) followed by *Menochilus sexmaculatus* (38 nos.) and *Micraspis discolor* (34 nos.) and *Platynaspis* sp. recorded lowest, only 1 individual throughout the investigation followed by *Jauravia quadrinotata* and *Propylea* sp. (2 nos. each). The highest relative abundance was recorded in *Coccinella transversalis* (19.51%) followed by *Menochilus sexmaculatus* (18.54%), *Micraspis discolor* (16.59%), *Brumoides suturalis* (7.32%), *Coelophora bissellata* (5.85%) and *Coccinella septempunctata* (4.88%). However, *Platynaspis* sp. recorded the lowest of 0.49 percent followed by *Jauravia quadrinotata* and *Propylea* sp. with the relative abundance of 0.98 percent each (Table 1). *Cryptogonus* sp., *Cryptogonus quadriguttatus*, *Cryptogonus* sp., *Propylea dissecta*, *Micraspis univittata*, *Scymnus nubilus*, *Platynaspis kapuri*, *Cryptogonus bimaculatus*, *Cryptogonus orbiculus* and *Harmonia dimidiata* recorded with the relative abundance of 3.90, 3.41, 3.41, 2.93, 2.44, 2.44, 1.95, 1.46, 1.46 and 1.46 percent respectively during the investigation (Figure 1). The photographs of the observed coccinellid beetles are shown in Figure 2, 3 and 4. One hymenopteran larval-pupal parasitoid of coccinellid beetle *Oomyzus* sp. belong to family Eulophidae was also observed during the study and this may be the first time reporting this parasitoid

from Assam (Figure 5). Begam *et al.* 2016^[5] Buragohain *et al.* 2017^[7] and Kalita *et al.* 1998^[10] also reported *Coccinella transversalis*, *C. septempunctata*, *Cheilomenes sexmaculata*, *Brumoides suturalis*, *Micraspis discolor* and *Harmonia dimidiata* associated with the pests of king chilli and brinjal in Assam. In Malaysia, 5 coccinellids *viz.*, *Menochilus sexmaculatus*, *C. transversalis*, *Harmonia octomaculata*, *Coelophora inaequalis* and *C. bissellata* were found to be associated with sucking pest of chilli^[11]. Firake *et al.* 2013^[12] also reported 6 species of coccinellids (*C. transversalis*, *C. septempunctata*, *C. sexmaculata*, *M. discolor*, *Oenopia sexarata* and *Oenopia kirbyi*) predated on aphids like *Liphaphis erysimi*, *Brevicoryne brassicae* and *M. persicae* in Brassicaceous crop in Meghalaya. Megha *et al.* 2015^[13] also observed 2 species of coccinellids *Cheilomenes sexmaculata* (Fabricius) and *Illeis cincta* (Fabricius) from chilli in Dharwad area out of 18 different species collected from different ecosystem. In Punjab, *Coccinella transversalis*, *Menochilus sexmaculatus* (Fabricius) and *Brumoides suturalis* were observed in chilli ecosystem predated on sucking insects like aphids and whitefly^[14]. Gurung *et al.* 2019^[15] also observed 8 coccinellids *viz.*, *Anegleis cardoni* (Weise), *Cheilomenes sexmaculata* (Fabricius), *Coccinella septempunctata* (Linnaeus), *Coccinella transversalis* (Fabricius), *Illeis indica* (Fabricius), *Micraspis discolor* (Fabricius), *Micraspis yasumatsui* (Sasaji) and *Propylea dissecta* (Mulsant) in chilli ecosystem feeding on *Aphis gossypii* (Glover), *Myzus persicae* (Sulzer) and *Bemisia tabaci* (Gennadius) in West Bengal. Majumder *et al.* 2013^[16] reported 24 species of coccinellids under 17 genera from different agro and forest habitats of Tripura state and their relative abundance showed that *Micraspis discolor* (F.), *Cheilomenes sexmacula* and *Coccinella transversalis* showed maximum population with a relative abundance of 24.52%, 18.13% and 11.99%, respectively. Ramya and Thangjam^[17] also reported 12 species of coccinellid beetles *viz.*, *Coccinella transversalis* (Fabricius), *Coelophora bowringii* (Crotch), *Coelophora saucia* (Mulsant), *Cryptogonus bimaculatus* (Kapur), *Cryptogonus* spp., *Cryptolaemus montrouzieri* (Mulsant), *Harmonia globata* (Linnaeus), *Harmonia dimidiata* (Fabricius), *Illeis confusa* (Timberlake), *Propylea* spp., *Platynaspis kapuri* (Chakraborty and Biswas) and *Scymnus* spp. predated on various sucking pests. Among them, *Coccinella transversalis* was recorded in maximum number (9.0 per tree) followed by *Harmonia dimidiata* (8.4 per tree) with a relative abundance of 17.79 and 16.60 percent respectively while *Cryptogonus* spp. was recorded lowest (0.9 per plant) with relative abundance of 1.79% in Assam. Ceryngier and Hodek^[18] reported that *Oomyzus scaposus* (Thomson) is widely distributed gregarious parasitoid of coccinellids and have a wide host range that includes Coccinellinae, Chilocorinae and Scymninae. Ali *et al.* 2013^[19] also reported that *Oomyzus scaposus* (Hymenoptera: Eulophidae), was found to parasitized the pupae and adult of *C. septempunctata*, *C. transversalis* and *M. sexmaculatus*, with highest infestation in *C. septempunctata* in Uttar Pradesh. Honek *et al.* 2019^[20] also reported that *Phalacrotophora fasciata* (Fallen), *Phalacrotophora berlinensis* (Schmitz) and *Oomyzus scaposus* (Thomson) were the parasitoids of two predatory coccinellid species *Coccinella septempunctata* and *Harmonia axyridis* in Poland.

Table 1: List of predatory coccinellid beetles found in king chilli ecosystem in Assam

S. No.	Scientific name	rabi 2014-15 (Nos.)	rabi 2015-16 (Nos.)	Frequency (Nos.)	Relative abundance (%)
1	<i>Coccinella transversalis</i> (Fabricius, 1781)	18	22	40	19.51
2	<i>Coccinella septempunctata</i> (Linnaeus, 1758)	10	0	10	4.88
3	<i>Menochilus sexmaculatus</i> (Fabricius, 1781)	17	21	38	18.54
4	<i>Micraspis discolor</i> (Fabricius, 1798)	15	19	34	16.59
5	<i>Micraspis univittata</i> (Hope, 1831)	0	5	5	2.44
6	<i>Coelophora bissellata</i> (Mulsant, 1850)	5	7	12	5.85
7	<i>Cryptogonus quadriguttatus</i> (Weise, 1895)	0	7	7	3.41
8	<i>Cryptogonus bimaculatus</i> (Kapur, 1948)	3	0	3	1.46
9	<i>Cryptogonus orbiculus</i> (Gyllenhal, 1808)	1	2	3	1.46
10	<i>Cryptogonus</i> sp.	2	5	7	3.41
11	<i>Cryptogonus</i> sp.	5	3	8	3.90
12	<i>Jauravia quadrinotata</i> (Kapur, 1946)	0	2	2	0.98
13	<i>Propylea dissecta</i> (Mulsant, 1850)	0	6	6	2.93
14	<i>Propylea</i> sp.	0	2	2	0.98
15	<i>Brumoides suturalis</i> (Fabricius, 1789)	7	8	15	7.32
16	<i>Scymnus nubilus</i> (Mulsant, 1850)	2	3	5	2.44
17	<i>Platynaspis kapuri</i> (Chakraborty & Biswas, 2000)	0	4	4	1.95
18	<i>Platynaspis</i> sp.	0	1	1	0.49
19	<i>Harmonia dimidiata</i> (Fabricius, 1781)	3	0	3	1.46
Total				205	100.00

**Fig 1:** Relative abundance of different coccinellid beetles in king chilli ecosystem

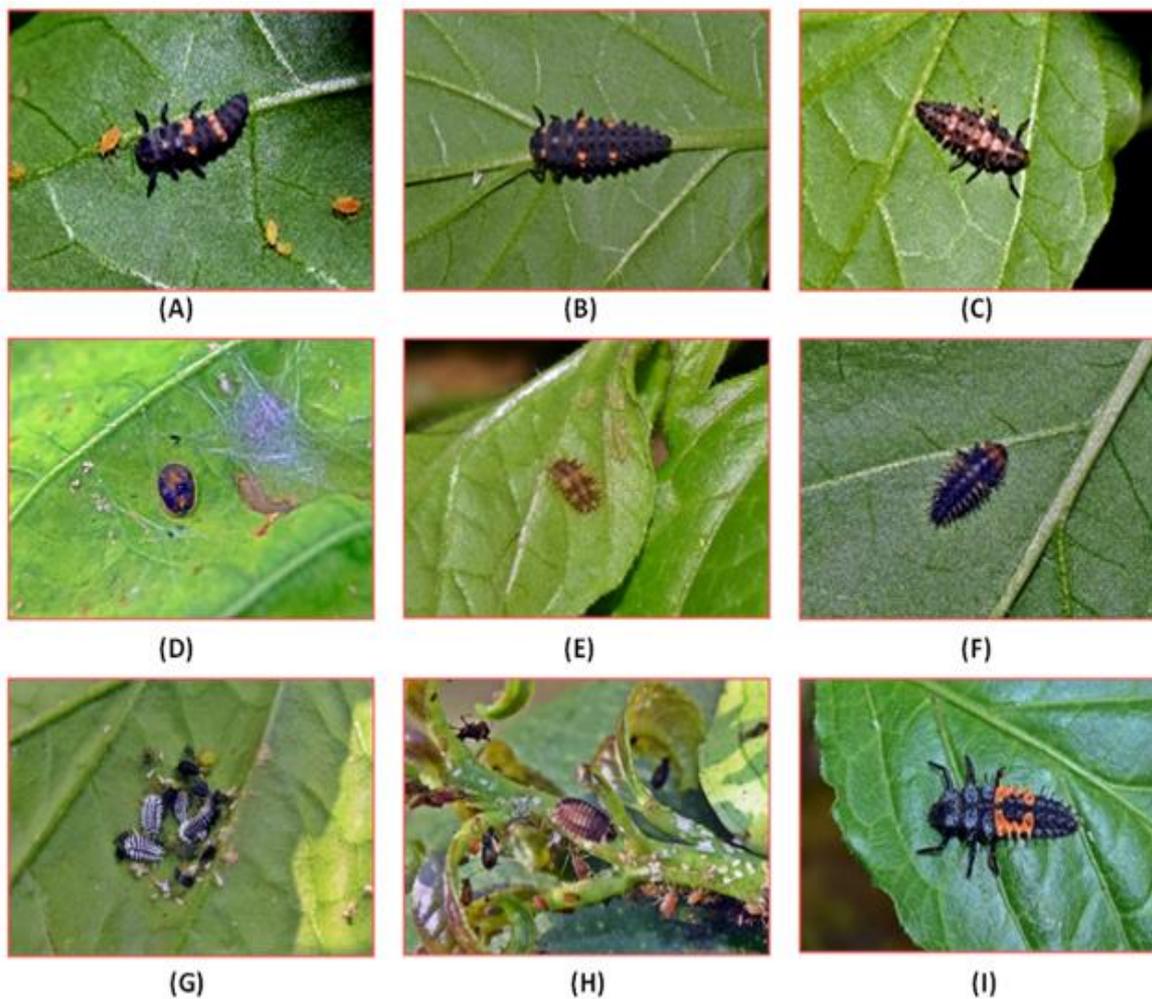


Fig 2: Grubs of different coccinellid beetle. (A) *Coccinella transversalis* (B) *Coccinella septempunctata* (C) *Menochilus sexmaculatus* (D) *Cryptogonus* sp. (E) *Jauravia quadrinotata* (F) *Brumoides suturalis* (G) *Scymnus nubilus* (H) *Platynaspis kapuri* (I) *Harmonia dimidiata*

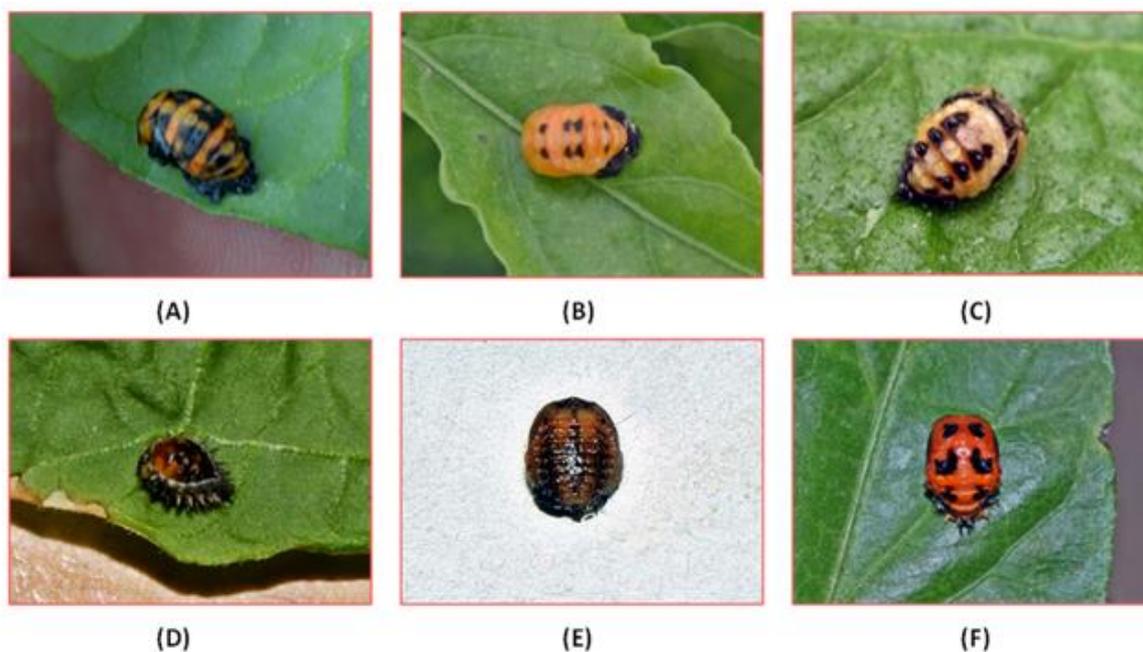


Fig 3: Pupae of different coccinellid beetles. (A) *Coccinella transversalis* (B) *Coccinella septempunctata* (C) *Menochilus sexmaculatus* (D) *Brumoides suturalis* (E) *Platynaspis kapuri* (F) *Harmonia dimidiata*.

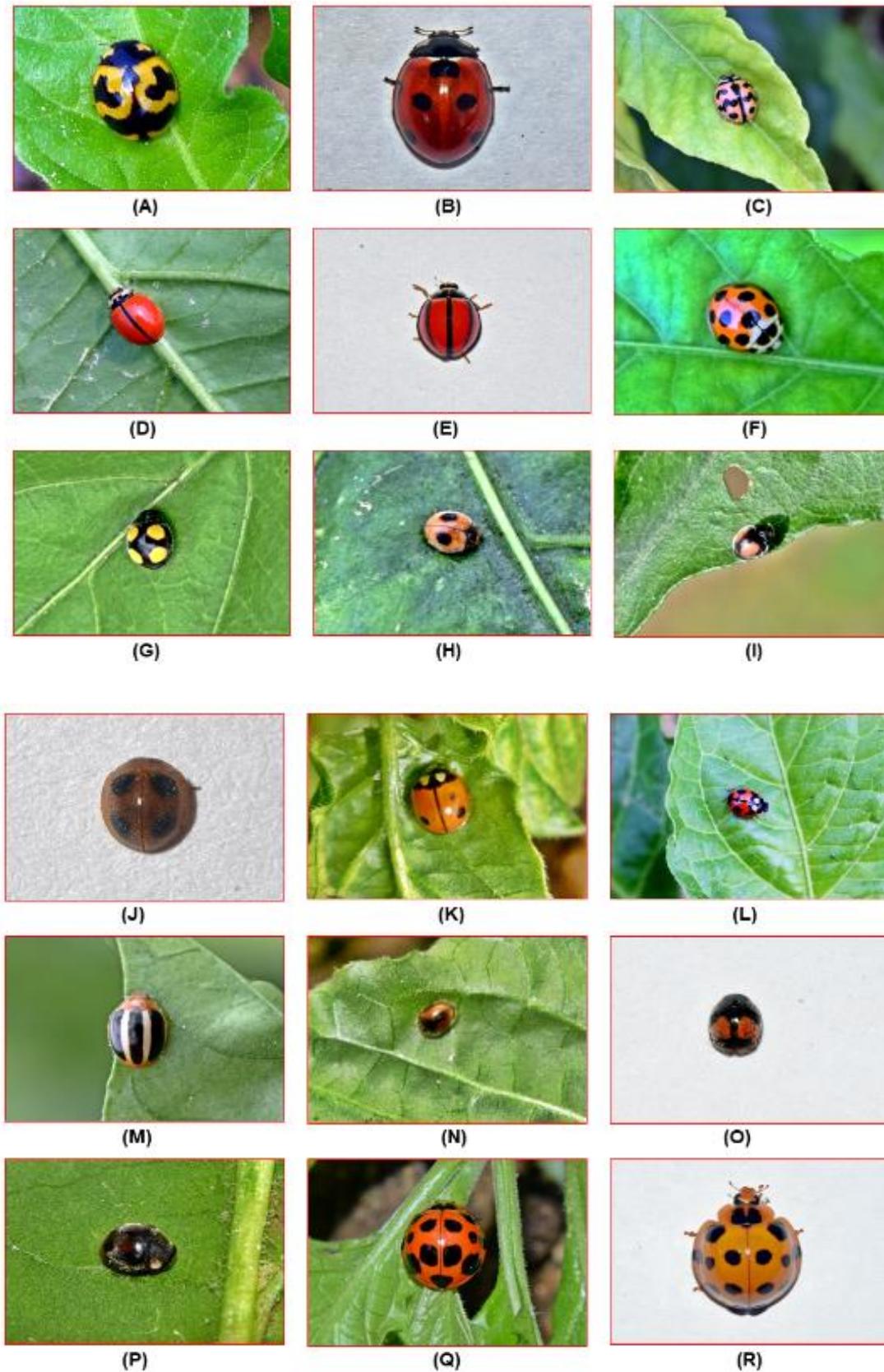


Fig 4: Adults of different coccinellid beetle. (A) *Coccinella transversalis* (B) *Coccinella septempunctata* (C) *Menochilus sexmaculatus* (D) *Micraspis discolor* (E) *Micraspis univittata* (F) *Coelophora bissellata* (G) *Cryptogonus quadriguttatus* (H) *Cryptogonus bimaculatus* (I) *Cryptogonus orbiculus* (J) *Jauravia quadrinotata* (K) *Propylea dissecta* (L) *Propylea* sp. (M) *Brumoides suturalis* (N) *Scymnus nubilus* (O) *Platynaspis kapuri* (P) *Platynaspis* sp. (Q and R) *Harmonia dimidiata*



Fig 5: Larval-pupal parasitoid of coccinellid beetle. (A) Adult *Oomyzus* sp. (B) *Oomyzus* sp. parasitizing grub of *C. transversalis*

Conclusion

Many coccinellid beetles are seen predated on sucking pests (aphids and whitefly) and therefore utilizing these predatory coccinellid beetles as a biological tool has a great potential in this region. These will also reduce the use of chemical pesticides and helps in conserving the natural enemy fauna in king chilli ecosystem.

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