



E-ISSN: 2320-7078

P-ISSN: 2349-6800

www.entomoljournal.com

JEZS 2020; 8(4): 1313-1319

© 2020 JEZS

Received: 16-05-2020

Accepted: 18-06-2020

T Vasista

Acharya N.G. Ranga
Agricultural University, Dept. of
Entomology, S. V. Agricultural
College, Tirupati, Chittoor,
Andhra Pradesh, India

MSV Chalam

Associate Professor, Acharya
N.G. Ranga Agricultural
University, Dept. of
Entomology, S. V. Agricultural
College, Tirupati, Chittoor,
Andhra Pradesh, India

KV Hariprasad

Acharya N.G. Ranga
Agricultural University, Dept. of
Entomology, S. V. Agricultural
College, Tirupati, Chittoor,
Andhra Pradesh, India

G Mohan Naidu

Acharya N.G. Ranga
Agricultural University, Dept. of
Entomology, S. V. Agricultural
College, Tirupati, Chittoor,
Andhra Pradesh, India

Corresponding Author:**MSV Chalam**

Associate Professor, Acharya
N.G. Ranga Agricultural
University, Dept. of
Entomology, S. V. Agricultural
College, Tirupati, Chittoor,
Andhra Pradesh, India

Bio diversity of coccinellid fauna associated with groundnut crop-ecosystem from Rayalaseema region of Andhra Pradesh

T Vasista, MSV Chalam, KV Hariprasad and G Mohan Naidu

Abstract

Studies were conducted to know the bio diversity of predatory coccinellid fauna associated groundnut crop ecosystems from Rayalaseema Region of Andhra Pradesh. Coccinellid beetles were collected by handpicking and sweep netting techniques. Male and Female genitalia, colouration, characters of elytra, mandibles and antenna were studied for accurate identification of the species present. Nine species of coccinellids viz., *Cheliomenes sexmaculata* (Fabricius), *Coccinella transversalis* Fabricius, *Aneglies cardoni* (Weise), *Illeis cincta* (Fabricius), *Harmonia octomaculata* (Fabricius), *Brumoides suturalis* (Fabricius), *Micraspis discolor* (Fabricius), *Scymnus nubulis* Mulsant and *Chilocorus nigritus* (Fabricius) were reported from groundnut crop ecosystems in Rayalaseema region of Andhra Pradesh. The above species were identified, described and the species composition was worked out. Among the nine predatory coccinellid species recorded, *C. sexmaculata* (45.75% of the total Coccinellids) ranked the first in abundance followed by *C. transversalis* (27.42% of the total Coccinellids), whereas *A. cardoni* ranked least in abundance (0.30% of the total Coccinellids). An illustrated key along with diagnostic taxonomic characters were provided for easy identification of the coccinellids associated with groundnut crop ecosystems from Rayalaseema region of Andhra Pradesh.

Keywords: Coccinellids, groundnut, bio diversity, composition of coccinellids

Introduction

Coccinellids belong to family Coccinellidae of order Coleoptera and are commonly called as ladybird beetles. These are oval to hemispherical in shape with clavate antennae, securiform maxillary palpi, pseudotrimerous tarsi and are often brightly coloured with red, orange (or) yellow shades. Coccinellids belong to family Coccinellidae, superfamily Cucujoidea, suborder Polyphaga and order Coleoptera comprising about 490 genera and more than 6000 species worldwide ^[1]. Family Coccinellidae consists of six subfamilies viz., Chilocorinae, Coccinellinae, Coccidulinae, Skymninae, Sticholotidinae and Epilachininae, of these one subfamily Epilachininae is phytophagous and the rest are predaceous in nature ^[2]. Ladybird beetles have been known worldwide as predators on number of insects and were distributed in many Asiatic countries including India ^[3]. Coccinellids are of high economic importance due to their predatory activity against soft bodied insects viz., aphids, leafhoppers, psyllids, whiteflies, scales and injurious to agricultural and forest plantations. Generally, coccinellids are voracious feeders and are beneficial from the view point of biological control of pests. Coccinellid fauna constitute key predatory fauna that are conserved and augmented in agricultural crop ecosystems to achieve desired biological control of the pests ^[4]. The predaceous coccinellids have been successfully utilized in various biocontrol programs with spectacular success rates. Some of the examples include *Rodolia cardinalis* (Mulsant) against *Iceria purchasi* Maskell, *Cryptolaemus montrouzieri* Mulsant against *Maconellisococcus hirsutus* (Green) and *Planococcus citri* (Risso) etc. ^[5]. Less famous but just as important are the naturally occurring Coccinellids, for without these species in our crop ecosystems pest problems would have been far more intense. Composition of predatory coccinellids varies widely among various crop ecosystems and so is their predatory potential on various hosts. Coccinellid groups has been studied by several workers ^[6, 7, 8] in India but all these studies pertains to a broad treatment of Indian Coccinellidae as a whole rather than giving importance to Coccinellid fauna occurring crop ecosystem wise. However, taxonomic studies were not carried out in Rayalseema region of Andhra Pradesh to know the predatory/beneficial coccinellid fauna occurring in groundnut crop ecosystems.

Up to date key for identification of commonly available species of coccinellids in groundnut crop ecosystems of Chittoor district are also not available. Hence, the present study was conducted to identify the biodiversity of coccinellid fauna in groundnut crop ecosystems of Chittoor district and also to know the species composition of the coccinellid fauna. The present study helps scientists, extension workers and farmers to identify the coccinellid fauna of groundnut crop ecosystems and to know the species composition, as well as most abundant coccinellid species.

Materials and Methods

Coccinellid specimens were collected from groundnut crop ecosystems in Chittoor district of Rayalaseema region, Andhra Pradesh. Coccinellid beetles were collected by sweep netting and hand picking. The collected beetles were killed with the help of cotton swab dipped in ethyl acetate. The dead specimens were dried in a hot air oven at 45-50 °C for 5-6 hours and the dried specimens were stored in screw capped glass vials with pertinent labels. The labeling to the screw capped vials was given as per the crop on which collection was made and date of collection. The oven dried coccinellid specimens were mounted singly on white thick cardboard triangular points. The mounting facilitates study of characters of head, thorax, abdomen, antenna, mouthparts *etc* from all the desired angles, which will be very useful for taxonomic identification and description of coccinellids. The abdomen of male and female beetles was detached, digested with 10 percent KOH for overnight and the genitalia (Male and Female) were dissected as per the standard procedure [9]. The dissected genital parts (male and female), were studied with a trinocular research microscope for identification and drawings of genital parts. In addition to the genital parts, colouration, characters of elytra, mandibles, antenna *etc* were also studied for quick and accurate identification.

Results and Discussion

During the present studies nine coccinellid species *viz.*, *Cheilomenes sexmaculata* (Fabricius), *Coccinella transversalis* Fabricius, *Scymnus nubulis* Mulsant, *Chilocorus nigritus* (Fabricius), *Aneglies cardoni* (Weise), *Micraspis discolor* (Fabricius), *Illeis cincta* (Fabricius), *Brumoides suturalis* (Fabricius) and *Harmonia octomaculata* (Fabricius) were collected and identified from Groundnut crop ecosystems. The most important taxonomic and morphological characters of the identified species were provided here under for easy identification.

***Cheilomenes sexmaculata* (Fabricius) (Fig. 1-4 and Plate 1 A):** Colour variable, creamy orange to bright orange. Head pale yellow to yellowish, sometimes with a triangular black marking at middle of frons. Pronotum colour also variable, yellow to orange with black markings. Scutellum black, elytra having black zigzag markings. The commissural line of elytra black. Body large to medium sized. Females larger than males. Elongated oval beetles. Antennae 11 segmented, clavate. Elytra sparsely punctate. Legs having pseudotrimerous tarsi and tarsal segments densely hairy, end with a pair of claws. Sipho strongly curved at base and thread like apically. The siphonal capsule well developed, inner processes rounded and outer processes pointed. Tegmen with broad long median lobe. Spermatheca is short, stout and curved; in ventral view spermatheca is kidney shaped.

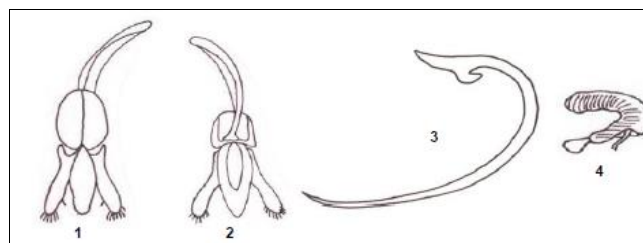


Fig 1-4: *Cheilomenes sexmaculata*; 1. Dorsal view of male tegmen, 2. Ventral view of male tegmen, 3. Siphon, 4. Spermatheca



Plate 1A: *Cheilomenes sexmaculata*

***Coccinella transversalis* Fabricius (Fig. 5-8 and Plate 1 B):** Colouration variable; dark yellow, creamy orange, pale yellow or brick red. Head black with yellow spots, antennae dark brown; eyes black; pronotum black with lateral areas orange to yellow; scutellum black. Elytra with black markings, commissural line black, ventral side and legs black. Body larger in females than in males, oval in shape, strongly convex dorsally. Antenna 11 segmented, last segment enlarged and rounded. Elytra sparsely punctate. Legs trimerous, end with a pair of claws. Tegmen with a Y shaped median lobe which is as long as lateral lobes. Siphon short and curved at base and pointed at apex. Siphonal capsule having inner processes hooked, bifid and external processes broad. Hemisternite oval to rounded and having stylus which is sparsely setaceous. Spermatheca strongly curved and having infundibulum.

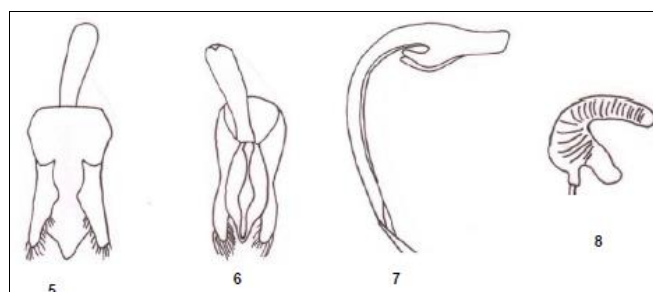


Fig 5-8: *Coccinella transversalis*; 5. Dorsal view of male tegmen, 6. Ventral view of male tegmen, 7. Siphon, 8. Spermatheca



Plate 1B: *Coccinella transversalis*

***Scymnus nubilus* Mulsant (Fig.9-10 and Plate 1 C):** 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 commissural line of elytra. Small sized body, oval, elongated and highly pubescent. Elytra is heavily pubescent with yellowish hairs. Tegmen is 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. Spermatheca curved and finger shaped.

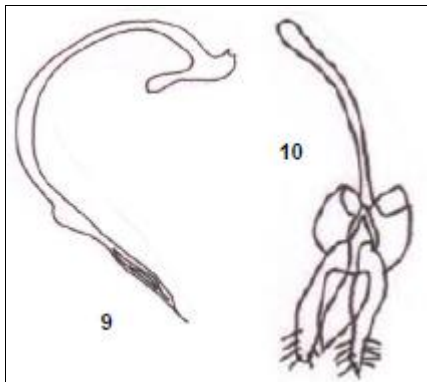


Fig 9-10: *Scymnus nubilus*; 9. Siphon, 10. Ventral view of male tegmen



Plate 1C: *Scymnus nubilus*

***Chilocorus nigritus* (Fabricius) (Fig. 11-12 and Plate 1 D):** Body bright black in colour, head ochreous brown, eyes black; pronotum black with brown lateral expansions; scutellum and elytra black. Body subglobose, rounded, highly convex and widest in the middle. Head finely punctuate, with short and yellowish pubescence. Siphon rather long, thin and moderately curved. Siphonal capsule with a distinct outer process and an inner protuberance; apex of siphon expanded. Tegmen relatively broad, lateral lobe shorter than the median lobe and narrower, parallel sided. Hemisternite short, oval, broad and rounded; bears stylus with sparse pubescence. Spermatheca is sac like with a finger like projection.

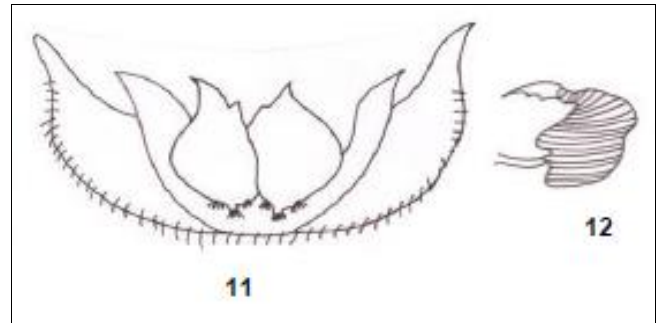


Fig 11-12: *Chilocorus nigritus*, 11. Hemisternite of Female, 12. Spermatheca



Plate 1D: *Chilocorus nigritus*

***Aneides cardoni* (Weise) (Fig. 13 -16 and Plate 1 E):** Head yellowish brown; compound eyes black; pronotum orange yellowish with two median discal spots and posterior marginal transverse band black; scutellum orange yellow with black margins; elytra orange yellow with black commissural line and two black, J-shaped stripes. Body round, dorsally convex, glabrous and medium sized. Antennae eleven segmented. Elytra finely, sparsely punctate. Siphon slightly curved in anterior view; siphonal capsule well developed; inner process slightly curved inwards, apex of siphon with bilobed membranous structure. Lateral lobes of tegmen longer than the median lobe, median lobe flattened, much broadened apically. Spermatheca broad basally and apically narrow, finger-like.

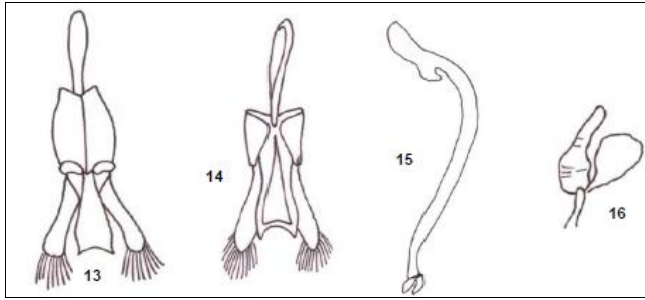


Fig 13-16: *Anegleis cardoni*; 13. Dorsal view of male tegmen, 14. Ventral view of male tegmen, 15. Siphon, 16. Spermatheca



Plate 1E: *Anegleis cardoni*



Plate 1F: *Micraspis discolor*

***Illeis cincta* (Fabricius) (Fig.21-23 and Plate 1 G):** 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 grayish yellow to pale yellow and shiny. Elytral commissural line yellowish. Body elongate, oval, dorsally convex, wider at middle of elytra. Maxillary palpi characteristic, last segment of maxillary palpi enlarged, broad, axe-head shaped. Legs densely hairy, tarsus four segmented and ending with a pair of claws. Tegmen with elongated and densely hairy at apex, median lobe longer than lateral lobes. Siphon strongly curved basally and apically straight. 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. Spermatheca considerably long, strongly curved and “C” shaped.

***Micraspis discolor* (Fabricius) (Fig. 17-20 and Plate 1 F):** Head yellow, compound eyes black; dorsum orange brown; frons sometimes with a black spot. Pronotum pale yellow to yellowish white in colour with black spots or patches towards proximal end. Scutellum black, elytra orange in colour and with black commissural line. Females are bright orange in colour and convex dorsally. Males pale yellowish to orange in colour. Pronotum having half moon shaped black marking at posterior end. Body oval, convex dorsally and glabrous. Antennae eleven segmented, last three segments club shaped and enlarged. In male the last antennal segment is beak shaped. Legs simple, pseudotrimerous or cryptotetramerous tarsi with apically bifid claw. Tegmen having elongated lateral lobes with a short densely hairy median lobe and the apex of median lobe is pointed. Siphon strongly curved at base, straight at apex. Siphonal capsule well developed, apex of siphon with hooked processes. Spermatheca curved and “C” shaped and attached to the inverted Y shaped infundibulum.

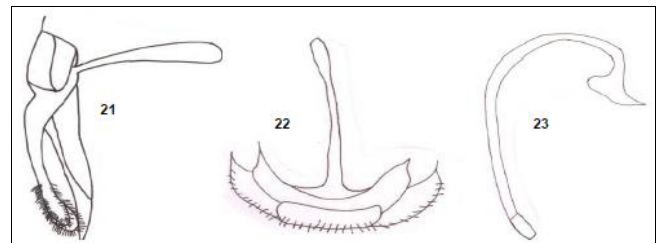


Fig 21-23: *Illeis cincta*; 21. dorsal view of male tegmen, 22. Ninth abdominal segment of male, 23. Siphon

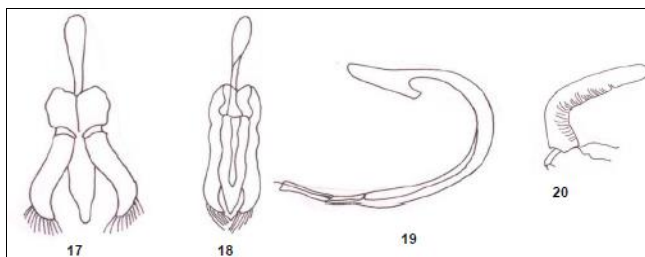


Fig 17-20: *Micraspis discolor*; 17. Dorsal view of male tegmen, 18. Ventral view of male tegmen, 19. Siphon, 20. Spermatheca



Plate 1G: *Illeis cincta*

***Brumoides suturalis* (Fabricius) (Fig. 24-28 and Plate 1 H):** Head, antennae, pronotum and thorax reddish brown, eyes black; elytra yellowish brown with two longitudinal black stripes on each elytra, legs brown in colour. A median longitudinal black stripe is present which extends from the scutellum to the apex of the elytra. 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. Spermatheca strongly curved, robust with a W-shaped inner margin.

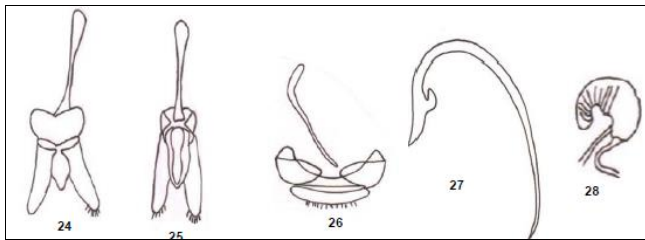


Fig 24-28: *Brumoides suturalis*; 24. Dorsal view of male tegmen, 25. Ventral view of male tegmen, 26. Ninth abdominal segment of male, 27. Siphon, 28. Spermatheca



Plate 1H: *Brumoides suturalis*

***Harmonia octomaculata* (Fabricius) (Fig. 29-32 and Plate 1 D):** 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. Whitish spots present on the mesosternum and on the anterior lateral corner of the abdomen. Body oval, longer than broad, dorsally convex and wider at the middle. Antenna eleven segmented, the last segment bulged. Elytra is sparsely punctate. Legs simple with four segmented tarsi ending with a pair of claws. Tegmen with short and broad lateral lobes with hairs at apex; median lobe shorter than lateral lobes. Siphon strongly curved at base and straight apically and apex of siphon spoon shaped with membranous projection. Siphonal capsule inner processes hooked and outer processes broadened. Spermatheca broadly V-shaped and of uniform width.

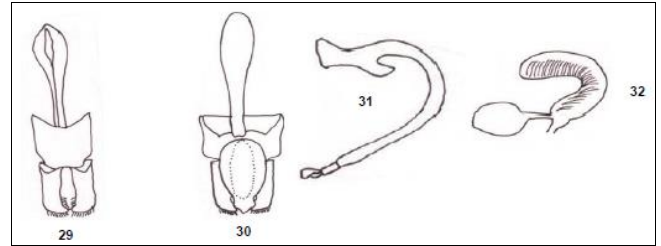


Fig 29-32: *Harmonia octomaculata*; 29. Dorsal view of male tegmen, 30. Ventral view of male tegmen, 31. Siphon, 32. Spermatheca



Plate 1I: *Harmonia octomaculata*

Taxonomic key for identification of Coccinellid predators in groundnut crop ecosystem

1. 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 elytra apex; tibiae angulate externally (Sub-family Chilocorinae, tribe Chilocorini)2
2. 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
3. Body elongate, oval; antennae nine segmented, elytra yellowish brown with two longitudinal black stripes on each elytra. Spermatheca strongly curved, robust with a W-shaped inner margin. Siphon strongly curved with a T-shaped basal part, broadened apically; siphonal capsule long, quadrate with slender inner process (Fig. 24-28 and Plate 1 H).....*Brumoides suturalis* (Fabricius)
4. Body rounded, subglobose; antennae eight segmented, elytra black, lateral expansions of pronotum reddish brown; elytra without spots. Pronotum black with brown lateral expansions. Spermatheca sac-like with finger like projection anteriorly. Siphon rather long, thin and moderately curved, siphonal capsule with a distinct outer process and an inner protuberance (Fig. 11-12 and Plate 1 D).....*Chilocorus nigritus* (Fabricius)
5. Coxites of female genitalia oval or transverse; antennae eleven segmented. Mandibles always with a bifid tip. Scutellum reddish brown or white in colour, elytra without pubescence (Sub family Coccinellinae tribe Coccinellini).....4
6. Very small beetles. Head dark brown. Mandibles without a bifid tip. Scutellum black in colour, elytra dark brown to brown in colour having the black line or patch along

- commissural line of elytra. 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. Spermatheca curved and finger shaped (Fig.9-10 and Plate 1 C) (Subfamily Scymninae Tribe Scymnini).....*Scymnus nubulis* Mulsant
7. Head yellowish brown; pronotum orange yellowish with two median discal spots and black posterior marginal transverse band. Stripes on elytra J- shaped. Siphon slightly curved in anterior; siphonal capsule well developed; inner process slightly curved inwards, apex of siphon with bilobed membranous structure. Spermatheca broad basally and apically narrow, finger-like (Fig. 13 - 16 and Plate 1 E).....*Aneglies cardoni* (Weise)
 8. Stripes on elytra not J- shaped, siphonal tip without a bilobed membranous structure, spermatheca not finger shaped.....5
 9. Colour pale yellow or brick red. Elytra having black zigzag markings, two on each elytra, black spot at posterior end of elytra. Siphon strongly curved at base and thread like apically; the siphonal capsule well developed, the inner processes rounded and external processes pointed. Spermatheca short, stout and curved; in ventral view spermatheca kidney shaped (Fig. 1-4 and Plate 1 A).....*Cheilomenes sexmaculata* (Fabricius)
 10. Basal segment of antennae elongate and normal; lateral side of elytra margined; inner carina of elytral epipleuron strongly convergent apically or not reaching the apex.....6
 11. Anterior margin of mesosternum flat. Orange to pale brown coloured beetles. Strong curvature observable in Siphon.....7
 12. Head orange to pale brown with black eyes. Pronotum reddish brown; elytra reddish brown to brown in colour with black maculae. Each elytra with three transverse rows of black spots and an apical spot on a reddish yellow background. Siphon strongly curved at base and apex spoon shaped with membranous projection. Spermatheca broadly V-shaped (Fig. 29-32 and Plate

- 11).....*Harmonia octomaculata* (Fabricius)
13. Colouration variable; dark yellow, creamy orange, pale yellow or brick red. Pronotum black with lateral areas orange to yellow. Elytra with black markings, large trilobed humeral spots and transverse black stripes. Siphon short and curved at base and pointed at apex. Spermatheca strongly curved and having infundibulum (Fig. 5-8 and Plate 1 B).....*Coccinella transversalis* Fabricius
14. Elytra without black stripes and is uniformly coloured.....8
15. Head yellowish; antennae pale yellowish. Elytra yellowish and shiny. Pronotum with a pair of black spots at posterior end. Apex of siphon spatula like and inner processes of siphonal capsule short and round, outer processes pointed. Spermatheca long, strongly curved and “C” shaped. (Fig.21-23 and Plate 1G).....*Ilies cincta* (Fabricius)
16. Elytra orange in colour with a black commissural line. Head yellow, compound eyes black. Pronotum pale yellow with black spots or patches towards proximal end. Siphon strongly curved at base, straight at apex; apex of siphon with hooked processes. Spermatheca curved and “C” shaped, the spermatheca is attached to the inverted Y shaped infundibulum (Fig. 17-20 and Plate 1 F).....*Micraspis discolor* (Fabricius)

Species composition of Coccinellids in groundnut crop ecosystem

A total of nine Coccinellid species viz., *C. sexmaculata*, *C. transversalis*, *I. cincta*, *H. octomaculata*, *B. suturalis*, *M. discolor*, *S. nubulis*, *A. cardoni*, *C. nigrinus* were collected from groundnut crop ecosystems. Among the nine predatory Coccinellid species recorded *C. sexmacualta* (45.75% of the total Coccinellids) ranked the first in abundance followed by *C. transversalis* (27.42% of the total Coccinellids), whereas *A. Cardoni* ranked last in abundance (0.30% of the total Coccinellids).

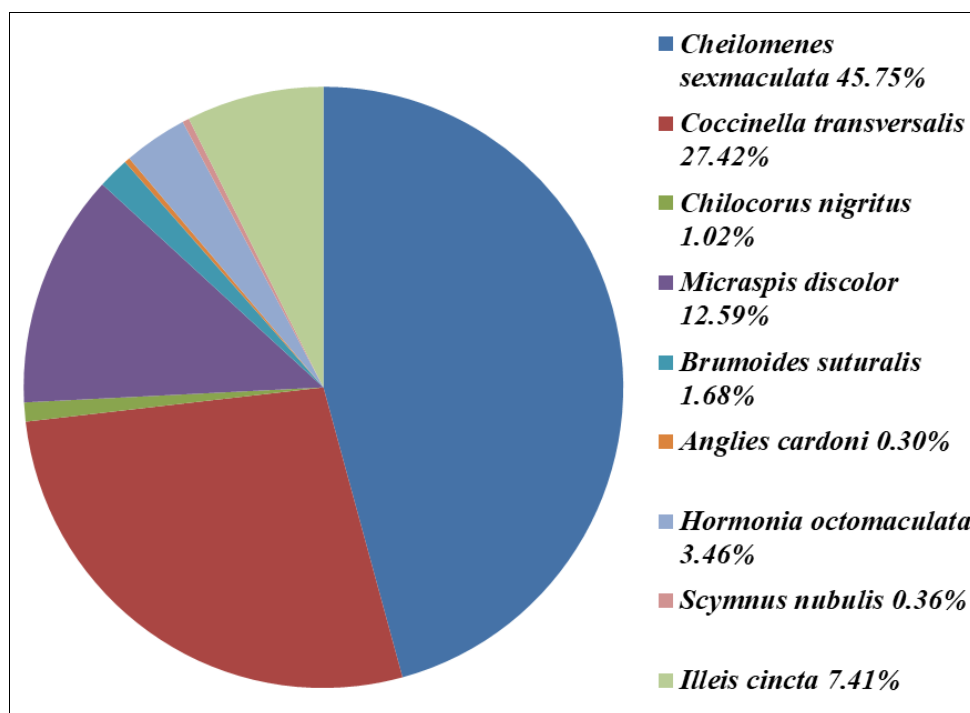


Fig 33: Species Composition of Coccinellids in Groundnut Crop Ecosystem

In the present studies nine coccinellid species viz., *C. sexmaculata*, *C. transversalis*, *S. nubilis*, *C. nigritus*, *A. cardoni*, *M. discolor*, *I. cincta*, *B. suturalis* and *H. octomaculata* were collected and identified from Groundnut crop ecosystems. These native coccinellids species play an important role in suppression of insect pests in groundnut crop ecosystems. Five species of Coccinellids from groundnut crop eco systems of Karnataka viz., *Coccinella septempunctata* Linnaeus, *Coccinella transversalis* Fabricius, *Harmonia octomaculata* (Fabricius), *Micraspis discolor* (Fabricius) and *Cheilomenes sexmaculata* (Fabricius) predating on aphid species were reported [10, 11, 12]. *Anegleis cardoni* was reported feeding on *Aphis gossypii* from Pakistan [3]. *Brumus suturalis* feeding on *Aphis craccivora* Koch and *Aphis gossypii* Glover in pulse crop ecosystems were documented [14]. Five Coccinellid species viz., *Coccinella septempunctata* Linnaeus, *Coccinella transversalis* Fabricius, *Harmonia octomaculata* (Fabricius), *Micraspis discolor* (Fabricius) and *Cheilomenes sexmaculata* (Fabricius) in groundnut crop ecosystem feeding on aphid, *Aphis craccivora* and leafhopper, *Empoasca (Empoasca) motti* Pruthi were reported [15]. The survey conducted during rabi and summer seasons revealed that *Cheilomenes sexmaculata* was the predominant species in pulse ecosystem from Khammam district of Telangana [16]. Importance of *Chilomenes sexmaculata* as a predator from rice and cowpea crop ecosystems of West Bengal is reported [17]. In the present studies nine coccinellid species were identified from groundnut eco systems and the species composition is worked out.

Conclusion

Present studies were conducted to know the biodiversity of coccinellid fauna in groundnut crop ecosystems of Rayalaseema region of Andhra Pradesh. During the present investigations, nine species of Coccinellids viz., *Cheilomenes sexmaculata* (Fabricius), *Coccinella transversalis* Fabricius, *Anegleis cardoni* (Weise), *Illeis cincta* (Fabricius), *Harmonia octomaculata* (Fabricius), *Brumoides suturalis* (Fabricius), *Micraspis discolor* (Fabricius), *Scymnus nubilis* Mulsant and *Chilocorus nigritus* (Fabricius) were identified, described and the species composition of these coccinellids was reported. Among the nine predatory Coccinellid species, *C. sexmaculata* (45.75% of the total Coccinellids) ranked the first in abundance followed by *C. transversalis* (27.42% of the total Coccinellids), while *A. cardoni* ranked least in abundance (0.30% of the total Coccinellids). An illustrated key along with diagnostic taxonomic characters, colour photographs of these Coccinellids were provided for easy identification of the Coccinellids. These Coccinellid species acts as main predators in different crop ecosystems and studies on species composition and identification of Coccinellid species occurring in any crop ecosystem is highly essential in order to utilize these Coccinellids in any biological control programme.

Acknowledgements

The senior author greatly acknowledges the financial support provided by Acharya N. G. Ranga Agricultural University in the form of Stipend.

References

1. Slipinski A, Tomaszewska W. Revision of the Oriental Coccinellidae (Coleoptera). Australian Journal of

- Entomology. 2005; 44(1):369-384.
2. Vandenberg NJ. Coccinellidae Latreille. In: Arnett RH, Thomas, MC and Skelley PE, (editors) American Beetles, Polyphaga: Scarabaeoidea through Curculionoidea. 2000; 2:371-389.
3. Singh J, Brar KS. Mass production and biological control potential of coccinellids in India. In: Sahayaraj K. (editor). Indian insect predators in biological control. Daya Publishing House, Delhi, India, 2004, 204-260.
4. Majumder J, Bhattacharjee PP, Agarwala BK. Diversity, distribution and habitat preference of predacious coccinellids (Coleoptera: Coccinellidae) in agro- and forest habitats of Tripura, Northeast India. International Journal of Current Research. 2013; (5):1060-1064.
5. Kundoo AA, Khan AA. Coccinellids as biological control agents of soft bodied insects: A review. Journal of Entomology and Zoology Studies. 2017; 5(5):1362-1373.
6. Joshi PC, Khamashon L, Kaushal BRL, Kumar K. New Additions of Coccinellid Beetles (Coleoptera: Coccinellidae) to the already reported Species from India. Nature and Science. 2012; 10(6):26-30.
7. Swaminathan R, Meena A, Meena BM. Diversity and predation potential of major aphidophagous predators in maize. Applied ecology and environmental Research. 2016; 13(4):1069-1084
8. Thakkar B, Parikh PH. A Study on diversity and abundance of coleopterans in Gujarat, India. Journal of Entomology and Zoology Studies. 2016; 4(5):1082-1089.
9. Poorani J. An annotated checklist of the Coccinellidae (Coleoptera) (excluding Epilachninae) of the Indian sub-region. Oriental Insects. 2002; 36:307-383.
10. Puttarudraiah M, Channabasavanna GP. Beneficial Coccinellids of Mysore I. Indian Journal of Entomology. 1953; 15:87-96.
11. Puttarudraiah M, Channabasavanna GP. Beneficial Coccinellids of Mysore II. Indian Journal of Entomology. 1955; 17:1-5.
12. Puttarudraiah M, Channabasavanna GP. Some Beneficial Coccinellids of Mysore III. Journal of Bombay National History Society. 1956; 54:156-159.
13. Irshad M. Distribution, hosts, ecology and biotic potentials of Coccinellids of Pakistan. Pakistan journal of Biological Sciences. 2001; 4(10):1259-1263.
14. Khan MR, Irshad M, Rafi MA. Insect fauna of Azad Jammu and Kashmir. MK Traders, Islamabad, 2008, 143.
15. Chanmaml G. Taxonomic studies on predacious coccinellidae, Order: Coleoptera. M.sc (Ag.) Thesis. Acharya N G Ranga Agricultural University, Tirupathi (Andhra Pradesh) India, 2009, 175.
16. Rani CH, Rao GR, Chalam, MSV, Kumar PA, Rao VS. Summer season survey for incidence of *Maruca vitrata* (G.) (Pyralidae: Lepidoptera) and its natural enemies on green gram and other alternative hosts in main pulse growing tracts of Khammam district. Journal of research, ANGRAU. 2013; 41(3):16-20.
17. Ponnuswamy N. Taxonomical and Bio-ecological studies on predaceous coccinellid beetles associated with various crop ecosystems. M.Sc. (Ag.) Thesis. Uttara Bangla Krishi Vidyalaya, 2018, 145.