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Diversity of natural enemies associated with insect pest of cowpea in Southern Rajasthan

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Abstract
The intensive surveys were conducted to record the diversity of major natural enemies population associated with the insect pests of cowpea [*Vigna unguiculata* (L.) Walp.] during the summer and monsoon season of 2019 and 2020. Diversity of natural enemies were recorded from the 5 different locations in five districts *viz*., Udaipur, Bhilwara, Banswara, Chittorgarh and Pratapgarh. The recorded natural enemies comprises of 07families (Carabidae, Chrysopidae, Coccinellidae, Geocoridae, Pentatomidae, Reduviidaeand Syrphidae) belonging to 4 insect orders (Hemiptera, Neuroptera, Coleoptera and Diptera). At all the locations, coccinellids was observed to be the maximum among all the natural enemies (30-40 per cent) followed by the population of predatory bugs including Geocorid, Pentatomid and Reduviid bugs, syrphid flies and spiders with the minimum relative density during both year. The mean population of natural enemies was recorded to be maximum for Udaipur (1.78, 2.31) followed by Banswara (1.78, 2.02), Bhilwara (1.54, 1.97), Chittorgarh (1.39, 1.5) and Pratapgarh (1.46, 1.7) during summer and monsoon seasons of 2019, respectively. The mean population of natural ememies was observed to be maximum at Udaipur district followed by Banswara in summer, while, Banswara had more population in monsoon season during 2020.

Keywords: predators, coccinellids, mean diversity and relative density

Introduction
Pulse crops are known as an important dietary source of proteins for a major part of the vegetarian population across the globe; especially in India. Legume crops help restoration of soil fertility through symbiotic nitrogen fixation. Cowpea [*Vigna unguiculata* (L.) Walp.] is one of the principal pulse crops of the tropics and is commonly known as crowdel pea, *chala*, *chola* or *choli*, *chavli*, *lobia*, southern pea and black eyed bean. Being, an annual herbaceous legume it is a widely adapted and cultivated crop in tropical Africa, Asia, North and South America mostly for its edible seeds as a grain; besides, as a vegetable and the whole plant as fodder having high levels of proteins ensuring tolerance against several stresses. It is one of the oldest farmed crops cultivated on 12.5 million hectares, having a worldwide production of 3 million tons. In India *lobia* is grown on an area of approximately 3.9 million hectares with a production of 2.21 million tons having a national productivity of 683 kg per hectare (Kaushik, 2016) [2].

Both grubs and adults of aphidophagous coccinellids, voraciously feed primarily on aphids and other soft bodied insects, which in turn makes them important key in suppressing the aphid population in field. From India, 57 genera comprising of 261 species of predaceous coccinellids have been catalogued (Omkar and Pervez, 2004) [4]; out of which 12 genera of aphidophagouscoccinellids have been reported from Southern Rajasthan (Jat *et al*., 2008) [1]. *Coccinellaseptempunctata* Linnaeus and *Cheilomenessexmaculata* Fabricius were the relatively more dominant in the different cropping patterns in Udaipur region of Southern Rajasthan (Swaminathan *et al*., 2016) [5].

Cowpea is known to harbor many natural enemies of pestiferous insects, which exert a significant role in their suppression, so introduction of cowpea crop under different cropping system can result into enhanced population of natural enemies.

Materials and Methods

With a view to estimate the comparative diversity of natural enemies associated with insect pests of cowpea during *Zaid* and *Kharif* were recorded from the 5 different locations in three districts *viz*., Udaipur, Bhilwara, Banswara, Chittorgarh and Pratapgarh. Observations for both pestiferous insects and their natural enemies were taken from 10 randomly selected plants of cowpea by the visual-count-technique at 15 days interval using standard sampling methodology. The associated natural enemies like coccinellids, predatory bugs, syrphid flies and spiders were recorded by the visual count technique from the same plants randomly, during their peak activity.

The following mathematical analyses have been done

a) Mean density

Mean density = $\sum Xi/N$

Where,
Xi = No. of insects or natural enemies in i^{th} sample
N = Total No. of plants sampled

b) Relative density

$$\text{Relative density (RD \%)} = \frac{\text{Number of individual species}}{\text{Total number of individual of all specipes}} \times 100$$

Results and Discussion

The biodiversity of natural enemies associated with insect pests of cowpea was observed from different locations of southern Rajasthan (Udaipur, Bhilwara, Banswara, Chittorgarh and Pratapgarh). The recorded natural enemies comprises of 07 families (Carabidae, Chrysopidae, Coccinellidae, Geocoridae, Pentatomidae, Reduviidaeand Syrphidae) belonging to 4 insect orders (Hemiptera, Neuroptera, Coleoptera and Diptera) It was observed that overall species richness was more during the monsoon season as compared to that during the summer. [Table 1 and 2]

At all the locations, coccinellids was observed to be the maximum among all the natural enemies followed by the population of predatory bugs including Geocorid and reduviid bugs, syrphid flies and spiders with the minimum relative density during both the year 2019 and 2020. The mean population of coccinellids ranged from 0.40 to 0.61 in different locations during the summer, 2019 as compared to 0.37 to 0.67 during the monsoon, 2019. The maximum population of coccinellids were found in Banswara (0.61) during summer, 2019 whereas, it was maximum in Udaipur (0.67) and Banswara (0.67) during monsoon, 2019.

Similarly, the mean population of coccinellids ranged from 0.46 to 0.63 in different locations during the summer, 2020 as compared to 0.49 to 0.67 during the monsoon, 2020. The maximum population of coccinellids were found in Banswara (0.63) during summer, 2019 whereas, it was maximum in Udaipur (0.67) during monsoon, 2019. In summer, mean population of predatory bugs ranged from 0.34 to 0.47 in 2019 and 0.36 to 00.51 in 2020. In monsoon, mean population of predatory bugs ranged from 0.38 to 0.53 in 2019 and 0.36 to 0.56 in 2020.

Similar results were reported by Sardan and Verma (1986) observed the activity of *Coccinellids septempunctata* to be the maximum during pod formation stage in summer cowpea. The present finds are in line with findings of Kumar and Kumar (2015) [3], who observed maximum population of coccinellids among different associated natural enemies. Similarly, Zahra *et al*. (2019) [6] recorded 19 insect species from 05 orders and 10 families to infest cowpea crop.

Table 1: Diversity of natural enemies associated with cowpea insect pest at different locations during 2019

S. No.	Arthropods	Mean natural enemies per plant									
		Summer					Monsoon				
		Udaipur	Bhilwara	Banswara	Chittorgarh	Pratapgarh	Udaipur	Bhilwara	Banswara	Chittorgarh	Pratapgarh
1.	Coccinellids	0.56 (32.37)	0.45 (29.22)	0.61 (34.27)	0.43 (30.94)	0.4 (27.40)	0.67 (29.00)	0.57 (28.93)	0.67 (33.17)	0.37 (24.67)	0.46 (27.06)
2.	Predatory Bugs	0.47 (27.17)	0.37 (24.03)	0.41 (23.03)	0.41 (29.50)	0.34 (23.29)	0.53 (22.94)	0.38 (19.29)	0.53 (26.24)	0.45 (30.00)	0.41 (24.12)
3.	Syrphid Fly	0.34 (19.65)	0.38 (24.68)	0.26 (14.61)	0.29 (20.86)	0.37 (25.34)	0.45 (19.48)	0.41 (20.81)	0.37 (18.32)	0.32 (21.33)	0.28 (16.47)
4.	Spiders	0.18 (10.40)	0.11 (7.14)	0.23 (12.92)	0.14 (10.07)	0.16 (10.96)	0.34 (14.72)	0.26 (13.20)	0.18 (8.91)	0.21 (14.00)	0.24 (14.12)
5.	Others	0.23 (13.29)	0.23 (14.94)	0.27 (15.17)	0.12 (8.63)	0.19 (13.01)	0.32 (13.85)	0.35 (17.77)	0.27 (13.37)	0.15 (10.00)	0.31 (18.24)
Total		1.78	1.54	1.78	1.39	1.46	2.31	1.97	2.02	1.5	1.7

Others: natural enemies which have no particular crop pest association *viz.* preying mantids, chrysopids, dragonflies and damselflies
*Values outside parenthesis are mean density (no. / plants)
**Values in parenthesis are relative density (%)

Table 2: Diversity of natural enemies associated with cowpea insect pest at different locations during 2020

S. No.	Arthropods	Mean natural enemies per plant									
		Summer					Monsoon				
		Udaipur	Bhilwara	Banswara	Chittorgarh	Pratapgarh	Udaipur	Bhilwara	Banswara	Chittorgarh	Pratapgarh
1.	Coccinellids	0.58 (30.05)	0.63 (36.63)	0.59 (31.38)	0.46 (25.84)	0.47 (26.11)	0.67 (33.67)	0.58 (31.69)	0.53 (26.37)	0.49 (25.39)	0.51 (29.48)
2.	Predatory Bugs	0.43 (22.28)	0.36 (20.93)	0.51 (27.13)	0.39 (21.91)	0.43 (23.89)	0.45 (22.61)	0.41 (22.40)	0.56 (27.86)	0.41 (21.24)	0.36 (20.81)
3.	Syrphid Fly	0.37 (19.17)	0.31 (18.02)	0.35 (18.62)	0.38 (21.35)	0.31 (17.22)	0.35 (17.59)	0.34 (18.58)	0.39 (19.40)	0.34 (17.62)	0.28 (16.18)
4.	Spiders	0.26 (13.47)	0.23 (13.37)	0.26 (13.83)	0.26 (14.61)	0.21 (11.67)	0.23 (11.56)	0.19 (10.38)	0.32 (15.92)	0.35 (18.13)	0.31 (17.92)
5.	Others	0.29 (15.03)	0.19 (11.05)	0.17 (9.04)	0.29 (16.29)	0.38 (21.11)	0.29 (14.57)	0.31 (16.94)	0.21 (10.45)	0.34 (17.62)	0.27 (15.61)
Total		1.93	1.72	1.88	1.78	1.8	1.99	1.83	2.01	1.93	1.73

Others: natural enemies which have no particular crop pest association *viz.* preying mantids, chrysopids, dragonflies and damselflies
*Values outside parenthesis are mean density (no. / plants)
**Values in parenthesis are relative density (%)

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