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Assemblage and Functional Guild of Galerucinae Beetles (Chrysomelidae: Coleoptera) in different Agroeco Systems of Tamil Nadu

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ABSTRACT: Increasing population growth raise the demand for food requirement which directly forces the agriculture sector to maximise its production. Such intensive cultivation practices will result in deterioration of local flora and fauna. A detailed information on the current status of faunal community in agrarian lands is required to keep check on extinction of local fauna. With this view, the current study on Galerucinae assemblage and their functional guild in different agro ecosystems of Tamil Nadu was undertaken. Galerucinae beetles of Tamil Nadu region comprised of 11 genera and 17 species. *Aulacophora, Monolepta Chaetocnema* and *Madurasia* were the dominant genera of Galerucinae beetles recorded in the study locations while *A. foveicollis* (14.80%) was the most abundant species. Among the different places of collection relative abundance of Galerucinae was highest in plains of Western Ghats. Species richness (Margalef species Richness Index: 2.02), diversity (Shannon-Wiener Index: 2.31) and eveness (Peilou's Evenness Index: 0.852) was the highest in plains of the Western Ghats. Berger-Parker indices was also higher for plains of the Western Ghats (6.46). Plains were diversified with different crops than hills as monocropping is predominant in hills.

Keywords: Agro-ecosystem, Galerucinae fauna, diversity indices, relative abundance, cropping pattern.

INTRODUCTION

Galerucinae (Chrysomelidae) is one of the largest group of leaf beetles. Galerucinae (including Galerucini and Alticini) comprise approximately 14,500 species under 1,134 genera (Nadein and Bezděk, 2014). Galerucinae are highly specialized phytophagous insects. Mostly they are either mono or oligophagous. Some of the species are important pests of crop plants inflicting direct damage or indirect damage (transmitting viral diseases). Meanwhile they are also beneficial in biological control of weeds (Ayyar, 1963; Nair, 1986; Jolivet and Verma, 2002; Nie *et al*., 2012).

Modern cultivation methods alter food webs and functioning of ecosystems (Zytynska and Meyer, 2019; Follett *et al*., 2020). Crop production has intensified considerably in past decade because of growing demand for agricultural products due to increasing human population. This event has resulted in the conversion of complex natural habitat into simplified agricultural landscapes (Tscharntke *et al*., 2012). Agricultural intensification includes an increased use of agrochemicals, the conversion of semi-natural habitats into farming land, and monocropping over large area (Benton *et al.,* 2003; Rischen *et al.,* 2021). These activities pave way to the habitat loss which is the vital element in the conservation of biodiversity in farm land (Fahrig *et al.,* 2011). Consequently, agricultural intensification poses a major threat to the conservation of biodiversity and associated ecosystem services (Benton *et al.,* 2003). While biodiversity is under pressure at a global scale, farmland species have suffered particularly strong declines over recent decades (Seibold *et al*., 2019). Intensification of agricultural activities is one of the crucial element in the event of recent arthropod species loss. Agro ecosystems of Tamil Nadu are diverse in nature due to its varying geophysical conditions. The faunal diversity of agrarian lands of Tamil Nadu is impacted by the modern cultivation methods. In this intensively cultivated major crop production areas, knowledge gap on status of species richness in relation to agriculture management and cropping pattern is still prevailing. Hence, a detailed knowledge of insect diversity pattern is therefore important. Owing to fact that the phytophagous nature of Galerucinae and close association with crop plants and weeds, their diversity and abundance requires to be studied in agro-ecosystems. So the present study was undertaken to record the relative abundance and diversity of Galerucinae beetles from different agro-ecosystems of Tamil Nadu.

MATERIALS AND METHODS

Faunal diversity of Galerucinae was assessed in crop ecosystems in the plains and hilly areas of the Western Ghats and the Eastern Ghats of Tamil Nadu (Table 1). Based on the geographical conditions, Tamil Nadu had been divided into seven agro climatic zones. Ten locations representing different agro ecosystems were surveyed during 2018-2021. Locations in the present study fall under Western zone (Thondamuthur, Pollachi, Gobi and Bhavani), North Western zone (Attur, Thally and Hosur) and hilly zone (Kothagiri, Thadiyankuduai and Yercaud).

Insect collection was done in cropped areas and along the boundaries of the field. Frequency of survey to the particular area may vary but each locations were visited at least once during the survey period. Galerucinae beetles were collected directly from the host plants using mouth aspirators. Sweep netting was also done using sweep nets in some low lying crops. The collected beetles were killed using Ethyl acetate and mounted in triangular cards with fevicol. Specimens were examined using Leica 205A stereo zoom microscope mounted with Leica DMC2900 camera. Specimens were identified based on dichotomous keys provided by Maulik (1926, 1936) and Prathapan (2019).

Occurrence data of Galerucinae beetles were consolidated and their relative abundance percentage ((Number of individuals of one species/Number of individuals of all species) × 100) was calculated. Further the diversity indices *viz.*, Shannon-Wiener index of Diversity (H′), Margalef's index of Species Richness (α), Berger-Parker Dominance index and Peilou's Evenness index (Magurran, 2013) were calculated using Biodiversity Professional 2 software.

Table 1: Details of collections sites and their cropping pattern.

Location	Coordinates	MSL (m)	Agro climatic Zone	Mean Annual Rainfall (mm)	Mean maximum temperature °C	Mean minimum temperature °C
Plain regions near the Western Ghats						
Thondamuthur	11.0078N, 76.8019E	320	WZ	696	33	22
Pollachi	10.6603N, 76.9757E	293	WZ	802	31	21
Gobichettipalayam	11.4324N, 77.3573E	213	WZ	717	37.9	20
Bhavani	11.4548N, 77.6681E	193	WZ	667	32.5	21.6
Plain regions near the Eastern Ghats						
Attur	11.5893N, 78.5770E	282	NWZ	416.5	35.5	23.7
Hosur	12.6117N, 77.9449E	880	NWZ	809	29.4	18.6
Thally	12.5817N, 77.6671E	1000	NWZ	790	28.5	16.7
Hilly regions of Western Ghats						
Kotagiri	11.4609N, 76.8134E	1847	HZ	1900	25	11
Thadiayankudisai	10.2974N, 77.7091E	1100	HZ	1400	29	15.2
Hilly regions of Eastern Ghats						
Yercaud	11.7966N, 78.2117E	1623	HZ	1600-1800	26	13.5

WZ – Western Zone, NWZ – North Western Zone, HZ – Hilly Zone

RESULTS AND DISCUSSION

Species abundance. A total of 2,142 Galerucine beetles representing 11 genera, 17 species, two tribes and two functional guilds were recorded from different agro ecosystems of Tamil Nadu. Species composition and abundance varied between the study locations (Table 2 & Fig. 1). Tribe Alticini was found dominant in overall abundance (55.32%) and species richness (9 species) compare to Galerucini (44.68%). In different agroecosystems, agrarian lands in plains of the Western Ghats had higher species richness (15 species) and abundance (52.99%). But the agrarian lands in hills of Western Ghats had a lower richness (8 species) and abundance (8.03%).

Table 2: Species composition of Galerucinae beetles collected from different agro ecosystems of Tamil Nadu.

Species	Plains		Hilly areas		No. of individuals	Relative abundance (%)	Host plants recorded in the study	Functional role
	WG	EG	WG	EG				
Tribe: Galerucini								
Aulacophora cincta (Fabricius, 1775)	0	0	6	4	10	0.47	**Cucurbitaceae**: *Trichosanthes cucumerina*	MN
Aulacophora foveicollis (Lucas, 1849)	157	149	9	2	317	14.80	**Cucurbitaceae**: *Benincasa hispida, Cucurbita moschata, Cucumis sativus, Lagenaria siceraria* **Fabaceae:** *Medicago sativa, Vigna unguiculata* **Poaceae**: *Eleusine coracana, Pennisetum glaucum, Zea mays* **Solanaceae**: *Solanum melongena*	MJ
Aulacophora lewisii Baly, 1866	55	71	0	0	126	5.88	**Cucurbitaceae**: *C. moschata, Lagenaria siceraria* **Poaceae**: *Zea mays*	MN
Hymenesia tranquebarica (Fabricius, 1798)	2	5	0	0	7	0.33	Not recorded in this study	GH
Monolepta bifasticata (Hornstedt, 1788)	0	0	10	11	21	0.98	Not recorded in this study	
Monolepta orientalis Jacoby, 1889	123	34	22	11	190	8.87	**Poaceae**: *Triticum aestivum, Zea mays*	MN
Monolepta signata (Olivier, 1808)	9	1	52	14	76	3.55	**Amaranthaceae**: *Beta vulgaris* **Solanaceae**: *Solanum tuberosum*	MJ
Tribe: Alticini								
Altica cyanea (Weber, 1801)#	117	60	8	5	190	8.87	**Onagraceae**: *Ludwigia* sp.	GH
Chaetocnema concinnipennis Baly, 1877	90	122	25	18	255	11.90	**Poaceae**: *Oryza sativa*	MN
Chaetocnema gracilis Motschulsky, 1858	38	29	0	0	67	3.13	**Poaceae**: *E. coracana, Sorghum vulgare*	MN
Chaetocnema pusaensis Maulik, 1926	26	28	0	0	54	2.52	**Poaceae**: *E. coracana*	MN
Clitea indica (Jacoby, 1896)#	5	0	0	0	5	0.23	**Rutaceae**: *Aegle marmelos*	GH
Longitarsus birmanicus Jacoby, 1892	87	25	0	24	136	6.35	**Fabaceae**: *Crotalaria juncea*	MN
Madurasia undulatovittata (Motschulsky, 1866)	150	60	0	0	210	9.80	**Fabaceae:** *Lablab purpureus, V. mungo, V. radiate, V. unguiculata*	MJ
Phygasia silacea (Illiger, 1807)	114	36	0	0	150	7.00	**Apocynaceae**: *Calotropis gigantea*	GH
Phyllotreta chotanica Duvivier, 1892	29	27	40	29	125	5.84	**Brassicaceae**: *Brassica oleracea, Raphanus sativus*	MN
Sinocrepis obscurofasciata (Jacoby, 1892)	133	70	0	0	203	9.48	**Malvaceae**: *Abutilon indicum*	GH
No. of individuals	1135	717	172	118	2142			
Relative abundance (%)	52.99	33.47	8.03	5.51				
No. of species	15	14	8	9				

WG – Western Ghats, EG – Eastern Ghats, GH – General Herbivore, MJ – Major Crop Pest, MN – Minor Crop Pest, # - Grubs are above ground feeders, SOI – Species Occurrence Index.

Functional guild. Based on functional guild, Galerucinae beetles were divided into crop pests and general herbivore which feed on weed hosts. Crop pests were predominant group than general herbivore. *A. foveicollis* (14.80%) was the most abundant species tailed by *C. concinnipennis* (11.90%) and *M. undulatovittata* (9.80%). *S. obuscufasticata* (9.48%), A. *cyanea* (8.87%) and *P. silacea* (7%) were the abundant general herbivores recorded on weeds in the field boundaries during the study period. *Aulacophora, Monolepta and Chaetocnema, Hymenesia*, *Madurasia*, *Phyllotreta*, *Sinocrepis*, *Phygasia*, *Longitarsus*, *Altica* and *Clitea* were the genera of Galerucinae beetles recorded in the study locations during 2018-2020. *Chaetocnema, Aulacophora and Monolepta* were the most specioces genus in the current study which were represented by three species each.

Crop pests. *Aulacophora* was the dominant genus over other group of Galerucinae represented by three species *viz., A. foveicollis, A. lewisii and A. cincta*. *A. foveicollis* was a major pest in cucurbits. Damage symptom includes skeletonizing of leaves and in early stage of the crop severe damage was recorded.

Sometimes re-sowing had be taken to maintain the crop population. They also found to cause damage in millets, pulses, brinjal and lucerne (Nair, 1986). As they had a vast habitat suitability, they were found to occur in diverse agro ecosystems.

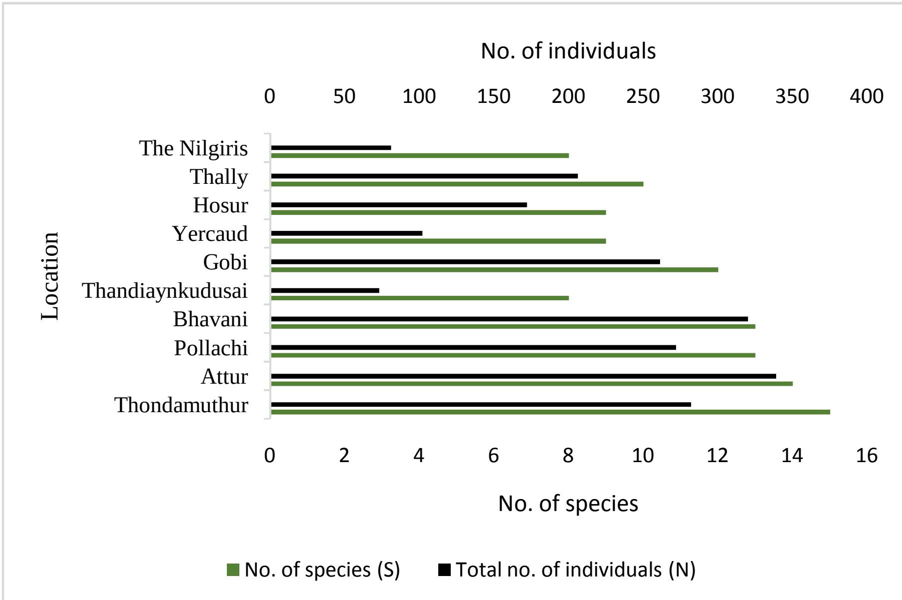


Fig. 1. Abundance of Galerucinae beetles in the study location.

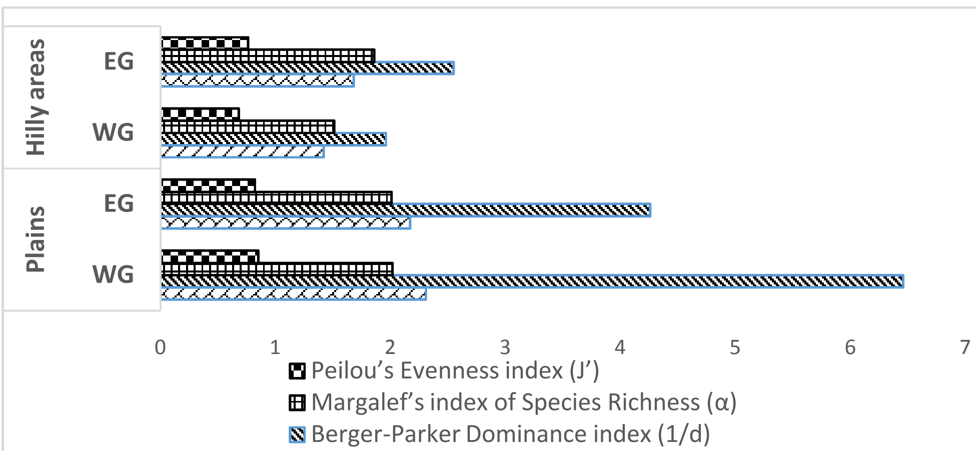
Chaetocnema was the second most abundant genus in the study locations. Three species of *Chaetocnema* were recorded during the study *viz., C. concinnipennis, C. pusaensis* and *C. gracilis*. *C. concinnipennis* was reported as minor pest of *Oryza sativa* (Nair, 1986). *C. pusaensis* and *C. gracilis* was reported as minor pest of *Eleusine coracana, Panicum miliaceum* and *Sorghum vulgare* (Prathapan, 2019). In minor millets, *Chaetocnema* cause significant loss in early stage of the crop where in later stage crop damage was not significant. *Monolepta* was the third most abundant genus in the current study. It contained *M. orientalis*, *M. signata* and *M. bifasticata. M. signata* was found occur more on hilly areas than plains. They were found to feed on beet root, cabbage, cauliflower and radish. Extensive damage in beet root by *M. signata* was observed in Kothagiri regions of The Nilgiris during the present study. They also found to attack potato, wheat, millets, pulses, cotton, sugarcane, colocasia and fodder crops (Nair, 1986). Whereas, *M. orientalis* recorded more in the plain regions in the present study. Occurrence of *M. orientalis* was high in wheat crop at TNAU, Coimbatore.

In pulse ecosystem, *M. undulatovittata* was reported to damage the crop from two leaf stage until flowering. They cause severe damage during initial stages of the crop. Adult beetles made holes in the leaves. Host plants of *M. undulatovittata* include *Vigna mungo, V. radiate, V. unguiculata, V. aconitifolia, V. umbellate, Lablab purpureus* and *Cajanus cajan* (Naresh and Thakkur, 1972; Saxena *et al*., 1971; Pareek *et al.*, 1983; Satyanarayana *et al.*, 1995a, b; Soundararajan and Chitra, 2012; Prathapan, 2016).

General herbivore. *S. obscurofasciata* was the dominant species of among the general herbivores recorded from the host *Abutilon indicum*. *A. indicum* is a common in barren lands and field borders. Their distribution is ranged upto 1200 MSL. Hence the occurrence of *S. obscurofasciata* restricted only in plains. *A. cyanea* was the second most abundant herbivore feed on *Ludwigia* sp. *Ludwigia* is aquatic or semi-aquatic weed mostly found in rice ecosystem and along banks of water bodies. They are found in both hilly and plain area. Grubs and adults feed on leaves of *Ludwigia* gregariously. So the dominance of *A. cyanea* was more in rice based cropping system as the semi aquatic condition is available throughout the season which favours persistence of *Ludwigia.* Adults of *P. silacea* feed on leaves of *Calotropis gigantea* and grubs feed on their roots *C. gigantea* is another weed common in barren land and field bunds with distribution up to 1000 MSL. It is also been used as green leaf manure in rice fields. So they were not removed on barren lands. Hence the occurrence of *P. silacea* is common in plains.

Feeding guild. Immature stages, *A. cyanea* and *C. indica* grubs were above ground feeders whereas remaining Galerucinae grubs were below ground feeders. With reference to feeding guild of Galerucinae beetles, adults were above ground feeders. Some of the flea beetles can feed on internal tissues of host plant (Prathapan, 2019). Species recorded in the present study were mostly below ground feeders in their immature stages except *C. indica* and *A. cyanea.* Their immature stages and adults feed on the leaves of the host plants *Aegle marmeols* and *Ludwigia* sp. respectively.

Species diversity. Diversity was more in plains of the Western Ghats (H' = 2.31) and Eastern Ghats (H' = 2.17) based on Shannon-Wiener index (Fig. 2). And also the plains dominated the hilly zones in species abundance as indicated by higher Berger-Parker dominance index value for plains of Western Ghats than Eastern Ghats (6.46 and 4.26 respectively). Species richness of a community was indicated based on Margalef's index and evenness. The values of both the index were higher for plains of Western Ghats (2.02, 0.852 respectively). When the H' value is high the population is considered to be diversified, while when one or more species dominate strongly the index stays low (Gobat *et al*., 2010; El Harche *et al*., 2021). Cultivation practices as a whole alter the functional ecosystem of a location. It affect both faunal and floral diversity directly. From the present study it was evident that plain regions of the Western Ghats and Eastern Ghats were abundant in Galerucinae fauna. On other hand hilly regions were recorded with less abundant. Such variation is possible as the plains were cropped with multiple crops in a year whereas in hilly regions it is mostly perennial crops (Tea or coffee). Usually the forest areas without anthropogenic activity will have rich faunstic diversity. But monocropping of plantations in large scale resulted in elimination of local flora in course of time which indirectly vanish faunal diversity also. Apart from exclusion of local fauna due to cultivation practises it also encourage dominance of a single species over other species and turn them into major pest of a particular crop (Seibold *et al*., 2019; Follett *et al*., 2020). It was evident in case on *M. signata* which has become a major pest of beetroot crop in hilly areas. Serrano *et al.* (2005) highlighted that agricultural practices can cause disturbances in beetle assemblages. The density of vegetation, the availability of habitats, and food resources in the area play a major role in these abundances (Barbosa *et al.*, 2002; Rischen *et al.*, 2021). Temperature is a vital factor in the distribution of beetles in a habitat. It remains one of the determining factors in the activity of these set of insects, which are heterothermic organisms However, their abundance is mainly determined by their life cycle because the periods of reproduction differ from species to species, manifested by emergences at specified periods (El Harche *et al*., 2021).



WG – Western Ghats, EG – Eastern Ghats

Fig. 2. Diversity indices of Galerucinae species in the study location.

CONCLUSION

Availability of host plants and diversified cropping pattern are the prime factor for the richness of insect species in an agro ecosystem. Due to many socio-economic constraints the cropping pattern has been changing nowadays. A shift from annual crops to plantation crops or fallowing of land has been witnessed nowadays. Such shift in cropping pattern will directly affect the insect community associated with crops. Galeruciane beetles occur in varied habitat with wide host range. They act as indicator for a habitat about its richness in floral community. Assessing the faunal diversity of Galerucinae beetles would be a tool for studying the attributes of an ecosystem.

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Conflict of interest. Nil.

REFERENCES

Ayyar, T. V. R. (1963). *Handbook of Economic Entomology for south India*. Government Press, Madras.

Barbosa, M. G., Fonseca, C. R., Hammond. P. M., & Stork, N. E. (2002). Diversity and similarity among habitats based on the serrapilheira of a land floresta in the Central Amazon. *Monografias Tercer Milenio. vol. 2, Sociedad Entomologica Aragonesa*, SEA, Zaragoza, 69-83.

Benton, T. G., Vickery, J. A., & Wilson, J. D. (2003). Farmland biodiversity: is habitat heterogeneity the key. *Trends in ecology & evolution*, *18*(4): 182-188.

El-Harche, H., Fegrouche, R., Chavanon, G., Ghailoule, D., Benhoussa, A., Arahou, M., & Fadli, M. (2021). Comparison of Terrestrial Beetles in Cultivated and

Natural Ecosystem of Semi-Arid Region of Morocco. *Indian Journal of Ecology*, *48*(4): 1184-1190.
Fahrig, L., Baudry, J., Brotons, L., Burel, F. G., Crist, T. O., Fuller, R. J., Sirami, C., Siriwardena, G. M., & Martin, J. L. (2011). Functional landscape heterogeneity and animal biodiversity in agricultural landscapes. *Ecology letters*, *14*(2): 101-112.
Follett, P. A., Bruin, J., & Desneux, N. (2020). Insects in agroecosystems–an introduction. *Entomologia Experimentalis et Applicata*, *168*(1): 3-6.
Gobat, J. M., Aragno, M., & Matthey, W. (2010). *The living soil: Basic pedology, soil biology*. 3rd revised and expanded edition. Presses Polytechniques et Universitaires Romandes, Lausanne.
Jolivet, P., & Verma, K. K. (2002). *Biology of Leaf Beetles*. Intercept Publisher, United Kingdom. pp.332.
Magurran, A. E. (2013). *Measuring biological diversity*. John Wiley & Sons.
Maulik, S. (1926). *Coleoptera Chrysomelidae (Chrysomelinae and Halticinae) The fauna of British India including Ceylon and Burma*.Taylor & Francis Group, London.
Maulik, S. (1936). *Coleoptera Chrysomelidae (Galerucinea) The fauna of British India including Ceylon and Burma*. Taylor & Francis Group, London.
Nadein, K., & Bezděk, J. (2014). Galerucinae Latreille, 1802. In Leschen R A B, Beutel R G (eds.). *Handbook of Zoology, Coleoptera, beetles, Morphology and systematics*. Volume 3, Walter de Gruyter, Berlin/Boston. pp.251–259.
Nair, M. R. G. K. (1986). *Insects and Mites of Crops in India*. Indian Council of Agricultural Research, New Delhi.
Naresh, J. S., & Thakur, R. P. (1972). Efficacy of systemic granular and spray insecticides for the control of insect pests of black-gram (*Phaseolus mungo* Roxb.). *Indian Journal of Agricultural Sciences 42*(8): 732–735.
Nayar, K. K., Ananthakrishnan, T. N., & David, B. V. (1976). *General and Applied Entomology*. Tata Mc Graw-Hill, New Delhi.
Nie, R. E., Xue, H. J., Hua, Y., Yang, X. K., & Vogler, A. P. (2012). Distinct species or colour polymorphism Life history, morphology and sequence data separate two species of elm leaf beetles (Coleoptera: Chrysomelidae). *Systematics and Biodiversity, 10*: 133–146.
Pareek, B. L., Sharma, R. C., & Yadav, C. P. S. 1983. Record of insect faunal complex on mothbean, *Vigna aconitifolia* (Jacq.) Marechel in semi arid zone of Rajasthan. *Bulletin of Entomology*, *24*(1): 44–45.
Prathapan, K, D. (2019). Flea Beetles of South India (Coleoptera: Chrysomelidae: Galerucinae: Alticini). In Ramani S, Mohanraj P, Yeshwanth H M (eds.). *Indian Insects: Diversity and Science*, CRC Press.
Prathapan, K. D. (2016). Revision of the legume-feeding leaf beetle genus *Madurasia* Jacoby, including a new species description (Coleoptera, Chrysomelidae, Galerucinae, Galerucini). *ZooKeys*, (597): 57 - 79.
Rischen, T., Frenzel, T., & Fischer, K. (2021). Biodiversity in agricultural landscapes: different non-crop habitats increase diversity of ground-dwelling beetles (Coleoptera) but support different communities. *Biodiversity and Conservation*, *30*(13): 3965-3981.
Satyanarayana, J, Singh, K. M., & Singh, R. N. (1995). Insect pest succession in rice bean. *Bulletin of Entomology*, *36*(1/2): 78–83.
Saxena, H. P., Kumar, S., & Prasad, S. K. (1971). Efficacy of some systemic granular insecticides against Galerucid beetle, *Madurasia obscurella* Jacoby infesting kharif pulses. *Indian Journal of Entomology*, *33*(4): 470–471.
Seibold, S., Gossner, M. M., Simons, N. K., Blüthgen, N., Müller, J., Ambarlı, D., Ammer, C., Bauhus, J., Fischer, M., Habel, J. C., & Linsenmair, K. E. (2019). Arthropod decline in grasslands and forests is associated with landscape-level drivers. *Nature*, *574*(7780): 671-674.
Serrano, J., Ruiz, C., Andujar, C., & Lencina, J. L. (2005). Land use and ground beetle assemblages in the National Park of Cabañeros, Central Spain (Coleoptera: Carabidae). In: Lövei, G., Toft, S. (Eds.) *European Carabidology*. Proceedings of the 11th European Carabidologists's Meeting. DIAS Report Plant Production, Danish Institute of Agricultural Sciences, *14*: 275- 289.
Soundararajan, R. P., & Chitra, N. (2012). Impact of intercrops on insect pests of black gram, *Vigna mungo* L. *Journal of Entomology*, *9*(4): 208–219.
Tscharntke, T., Clough, Y., Wanger, T. C., Jackson, L., Motzke, I., Perfecto, I., Vandermeer, J., & Whitbread, A. (2012). Global food security, biodiversity conservation and the future of agricultural intensification. *Biological conservation*, *151*(1): 53-59.
Zytynska, S. E., & Meyer, S. T. (2019). Effects of biodiversity in agricultural landscapes on the protective microbiome of insects – a review. *Entomologia Experimentalis et Applicata*, *167*: 2–13.

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