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COLLECTION, IDENTIFICATION AND CLASSIFICATION OF VARIOUS INSECT FAUNA UNDER AGRO-FORESTRY ECOSYSTEM OF IGKV, RAIPUR, CHHATTISGARH

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ABSTRACT

The investigation was conducted during October 2014 to April 2015 under agro-forestry ecosystem of IGKV. The collection, identification and classification of various insect fauna clearly indicates that maximum domination of lepidoptera (133) was observed in collections made by sweep net followed by diptera (125) and hemiptera (62). Light trap collections were dominated by hemiptera (81) followed by diptera (62) and Lepidoptera (43) while in case of collection by pit fall trap method, the maximum dominating order was hymenoptera (496) followed by diptera (220). In case of Berlese funnel also maximum collection belonged to order hymenoptera (123) followed by acarina (55). Maximum number of insects were collected in pit fall trap (1045) followed by sweep net (443), Berlese funnel (330) and light trap (213). The overall collection of insects population by different various methods at agro-forestry ecosystem which indicates that the total number of insects was belonged to order hymenoptera (639) followed by diptera (420). Whereas, the crawling insects dominated the fauna of agro-forestry and order diptera was significantly dominated towards on yellow pan among the various coloured pans/basins used in the pit fall trap.

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INTRODUCTION

Biological diversity means the variability among the living organisms from all sources including terrestrial, marine, and other aquatic ecosystems (Harper and Hawksworth, 1994). Koli *et al.,* 2009, the first time was carried out intensive survey and collection of short horned grasshopper from adjoining areas of Chandoli National Park, Maharashtra. A total of seventeen species and subspecies under twelve genera belonging to nine subfamilies were reported. Subfamily Oedipodinae was dominant followed by Acridinae, Cyrtacanthacridinae, Gomphocerinae, Truxalinae, Romaleinae, Hemiacridinae, Oxyinae and Catantopinae. This includes diversity within species, between species, and of ecosystems. Biological diversity refers to the entire body of organisms, their ecological complexity within the environment, and all the ecological processes in relation to these systems (Primack, 1993 and Liu, 1999). Presently, it has been observed that *Cajanus cajan* is infested by insect pests belonging to 6 orders and 16 families. Of the 6 orders recorded, pests belonging to Lepidoptera cause maximum damage followed by members of Coleoptera, Diptera, Hemiptera and Homoptera, in that order. *Helicoverpa armigera* was found to be the major pest with its predominant presence in all the 5 sites studied (Srilaxmi and Paul, 2010). Approximately 30 million species are found worldwide, of which about 1.4 million have been briefly described; of these, about 750,000 are insects. Insects now comprise >75% of all described animal species and exhibit not only a rich variety of form, color, and shape, but also a range of ecological adaptations unexcelled by any other group (Cheng, 1976). Leakey (1996) described that Agro-forestry is a dynamic ecologically based natural resource management system that, through the integration of trees/woody perennials in farm and rangelands, diversifies and sustains production for increased social, economic and environmental benefits. Studies on the bio-diversity of insect fauna of the agro-forestry ecosystem of IGKV, Raipur not under taken in detail earlier and except some work done by Soman *et al.,* 2006. The state of Chhattisgarh commonly known as the rice bowl of India which was formed in 2000, is very rich in biodiversity and has been declared as the herbal state. It has a forest canopy of 44% (Sandarbh Chhattisgarh, 2002). Thus, to have an idea of the insects dominations constituting the bio-diversity of the area mentioned above so that management strategies could be chalked out accordingly, the present studies were formulated.

MATERIALS AND METHODS

The present investigation was conducted during October 2014 to April 2015. The experiment was conducted at the experimental research farm, Department of Forestry, Indira Gandhi Krishi Vishwavidyalaya, Raipur, C.G. and in the laboratory of Department of Entomology. Collection of various available fauna of insects were done by sweep nets for collecting flying insects, by pit fall traps for crawling insects, by light trap for nocturnal flying insects and by Berlese funnel for leaf litter and soil dwelling insects. Light trap is an efficient method of trapping adults of nocturnal flying insects, as per earlier workers Vrieze (2008), Dadmal and Khadakkar (2014),

and various types of light sources have been tested and used. Collections were done at fortnightly intervals on 20 sweeps from 5 locations covering the experimental area of the agro-forestry field. Pit fall trap was placed in the agro-forestry field using four different colored plastic basin type of containers *viz.,* red, blue, green and yellow at five different locations (replications), filled with one fourth level of water. Pit fall traps have been used to collect ground dwelling insects (Sahra, 2006). Collections were done at fortnightly intervals. The traps were collected the next day and the insects collected in various plastic containers were counted and sorted out colour-wise, and analyzed using R.B.D. Light trap was installed for trapping nocturnal flying insects at proper location among the selected agro-forestry field. Berlese funnel (low cost and modified) using an ordinary study lamp was used to collect apterygote insects from leaf litter by placing over a sieve. The soil and leaf litter dwelling insects were collected in a plastic basin with some water kept under the sieve. The various species of insects thus collected were categorized order wise and tabulated to know their respective abundance in the Agro-forestry ecosystem. Analysis of data the various methods mentioned above were tabulated separately into various orders and were identified; and pooled analysis was also done. The insect biodiversity was calculated using the Shannon-Weaver diversity indices (Shannon and Weaver, 1949) along with various multivariate analysis which are described as Shannon-Weaver diversity index (H) was used to determine the sample which has more abundant species. A species diversity study takes into account the number of species (species richness) and the importance of individuals in species (evenness) (Vandermeer, 1981). The resulting product was summed across species, and multiplied by -1**.**

$$H \quad \sum_{i\ 1}^{s} p_i \ln p_i$$

H is a more reliable measure as sampling size increases.

RESULTS AND DISCUSSION

The collection of various available fauna of insects were done by different trapping methods viz. sweep net, pit fall trap, light trap and Berlese funnel at fort nightly intervals. Observations were carried out at the experimental area of agro-forestry field.

Sweep net

No collection of insects belonging to order collembola, protura, thysanura and diplura were seen by sweep net method. Among endopterygotes the maximum population was dominated by lepidoptera (133) followed by diptera (125) whereas, hymenopterans were recorded in minimum numbers (20) (Table 1). Among exopterygotes the highest population was of hemiptera (62) followed by odonata (40) whereas, the lowest population was exhibited by embioptera (5). Looking to the overall collection of insects by sweep net method as presented in Table 1, highest number of insects collected belonged to order Lepidoptera followed by diptera, hemiptera, coleoptera, odonata, orthoptera and embioptera. Mite (Acarina) population was not seen in the collections by sweep net method. The Shannon' diversity index for insects collected by sweep net was calculated by the formula $H = -\sum_{i-1}^{s} p_i \ln p_i$ and was estimated to be 1.74. (Table 1)

Pit fall trap

Pit fall trap was placed in the agro-forestry field using four different colored plastic basin type of containers *viz.,* red, blue, green and yellow at five different locations (replications). The traps were collected the next day and the insects collected in various plastic containers were counted and sorted out colour-wise, and analysed using R.B.D. No collection of insect population belonging to order collembola, protura, diplura and thysanura was noticed by pit fall method. As far as endopterygotes were concerned maximum insect population recorded was of hymenoptera (496) followed by diptera (220) whereas, the minimum population noticed was of coleoptera (120) (Table 2). In case of exopterygotes the highest insect population was observed of hemipterans (96) followed by orthoptera (94) while, the lowest population was exhibited by isoptera (6). No mite population was recorded in pit fall trap. The data presented in table 2b, revealed significantly higher population of dipteran insects towards yellow pit fall trap. No significant choice in other orders towards any particular colour was noticed.

The Shannon' diversity index of the various insects belonging to different orders collected by pit fall trap was found to be 1.45. (Table 2a)

Light trap

No collection of insects belonging to apterygotes *i.*e. collembola, protura, diplura and thysanura was seen in light trap. Among endopterygotes maximum population recorded

Table 1: Percent composition of insects in agro-forestry field by sweep net collection

S.N.	Insect order	Total population	Seasonal mean	Percent composition of insects
1	Lepidoptera	133	13.3	30.02
2	Diptera	125	12.5	28.22
3	Hemiptera	62	6.2	14.00
4	Orthoptera	15	1.5	3.39
5	Hymenoptera	20	2	4.51
6	Odonata	40	4	9.03
7	Coleoptera	43	4.3	9.71
8	Embioptera	5	0.5	1.13
Grand total		443		
Shannon' diversity index		1.74		

Table 2a: Percent composition of insects in agro-forestry field by pit fall trap

S. No.	Insect order	Total population	Seasonal mean	Percent composition of insects
1	Coleoptera	120	12	11.48
2	Hymenoptera	496	49.6	47.46
3	Hemiptera	96	9.6	9.19
4	Orthoptera	94	9.4	9.00
5	Isoptera	6	0.6	0.57
6	Dermaptera	13	1.3	1.24
7	Diptera	220	22	21.05
Grand total	1045			
Shannon' diversity index	1.45			

Table 2b: Collection of insects order on used different colours of pit fall trap

S. No.	Treatment	Coleoptera	Hymenoptera	Hemiptera	Orthoptera	Isoptera	Dermaptera	Diptera
1	Red	0.96	1.62	0.80	1.05	0.71	0.72	1.04
2	Blue	1.14	1.70	1.00	0.97	0.72	0.76	1.19
3	Green	1.09	1.87	1.11	0.98	0.73	0.75	1.36
4	Yellow	0.95	1.64	0.96	0.93	0.75	0.77	1.39
	C.D.	N/A	N/A	N/A	N/A	N/A	N/A	0.26
	SE(m)	0.08	0.12	0.10	0.04	0.02	0.02	0.08
	C.V.	17.75	15.04	22.63	8.61	5.19	6.23	14.92

Table 3: Percent composition of insects in agro-forestry field by light trap method

S.N.	Insect order	Total population	Seasonal mean	Percent composition of insects
1.	Lepidoptera	43	2.15	20.19
2.	Hemiptera	81	4.05	38.03
3.	Diptera	62	3.1	29.11
4.	Coleoptera	9	0.45	4.23
5.	Orthoptera	4	0.2	1.88
6.	Ephemeroptera	10	0.5	4.69
7.	Neuroptera	4	0.2	1.88
Grand total	213			
Shannon' diversity index	1.48			

Table 4: Percent composition of insects in agro-forestry field by berlese funnel method

S. No.	Insect order		Total population	Seasonal mean	Percent composition of insects	
1.	Isoptera	Worker Termite	19	6.33	5.76	(10)
		Soldier Termite	14	4.66	4.24	
2.	Protura		26	8.66	(7.88)	
3.	Diplura		15	5.00	(4.55)	
4.	Collembola		34	11.33	(10.30)	
5.	Hymenoptera	Saprophytic ants	92	30.66	27.88	(37.27)
		Red Ants	31	10.33	9.39	
6.	Diptera		13	4.33	(3.94)	
7.	Coleoptera		31	10.33	(9.39)	
8.	Acarina		55	18.33	(16.67)	
Grand total			330			
Shannon' diversity index			1.82			

was of diptera (62) followed by lepidoptera (43) whereas, minimum population was noticed in neuroptera (4) (Table 3). As far as exopterygotes were concerned highest insect population was dominated by order hemiptera (81) followed by ephemeroptera (10) while, lowest population was exhibited by orthoptera (4). Mite population was not observed in light trap. The Shannon' diversity index calculated for the various insects belonging to different orders collected by light trap was computed to be 1.48. Overall collection of insects by light trap as presented in table 3, revealed that it was dominated by order hemiptera (38.05%) followed by diptera (29.11%), Lepidoptera (20.19%) and coleoptera (4.23%) which is contradictory to the findings of Dadmal and Khadakkar (2014), who mentioned that coleoptera was the most dominant order in light trap collection.

Berlese funnel method

Berlese funnel is an efficient method for observing apterygote insects and in the present studies maximum population recorded belonged to order of collembola (34) followed by protura (26) whereas, the minimum population was noticed of diplura (15). No insects belonging to order thysanura was

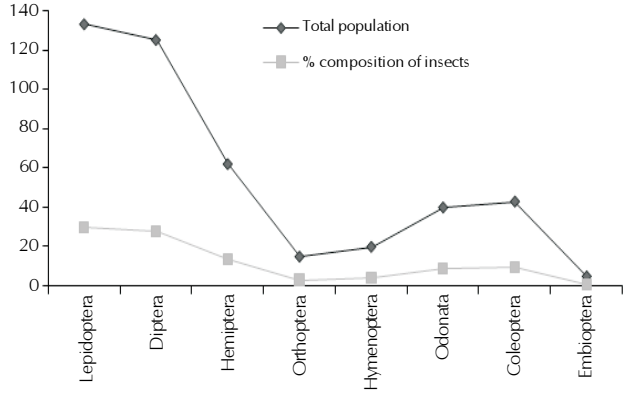

Figure 1: Overall and order wise graphical representation of percent composition of insects of agro-forestry field collected by sweep net collection

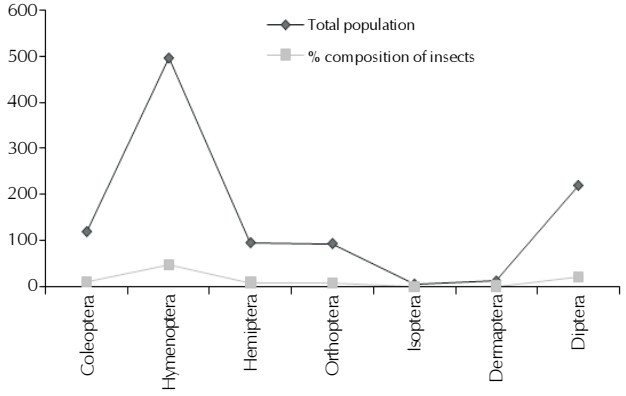

Figure 2: Overall and order wise graphical representation of percent composition of insects of agro-forestry field collected by pit fall trap

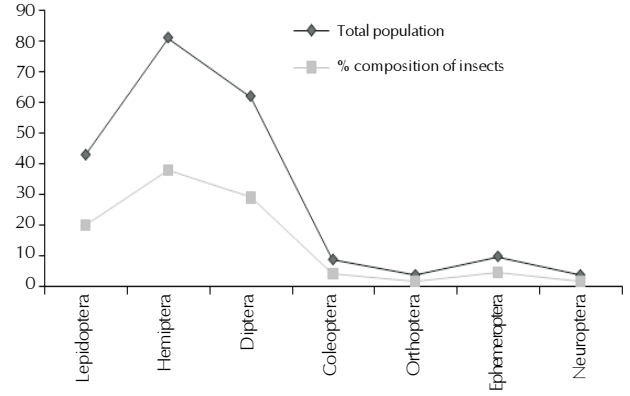

Figure 3: Overall and order wise graphical representation of percent composition of insects of agro-forestry field collected by light trap

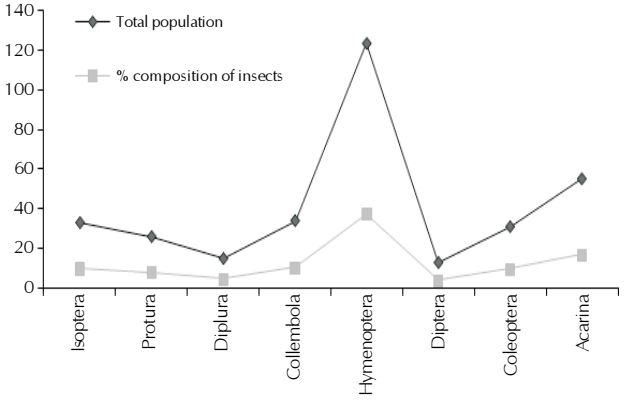

Figure 4: Overall and order wise graphical representation of percent composition of insects of agro-forestry field collected by Berlese funnel method

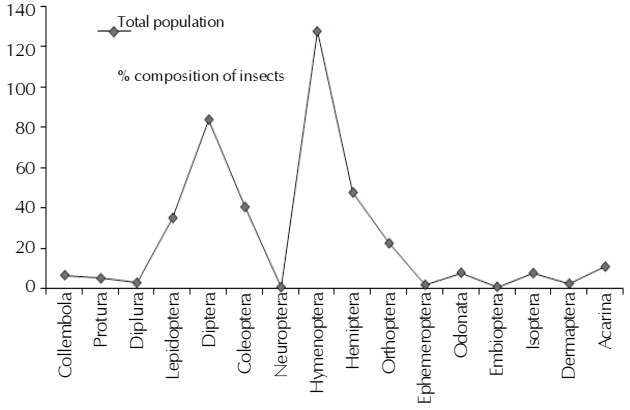

Figure 4: Overall and order wise graphical representation of percent composition of insects of agro-forestry field collected by Berlese funnel method

recorded. These findings are in agreement with Rocheforta *et al.,* 2005, who also mentioned that collembola were most abundant in the newly established site of the province Quebec. Among endopterygotes the maximum population recorded was of hymenoptera (123) followed by coleoptera (31) while lowest population was noticed of diptera (13). Among exopterygotes, the only insects recorded was of order isoptera with a population of 33 insects. Mite population (55) was also recorded by Berlese funnel (Table 4). The Shannon' diversity index computed for the collection of insects under different orders by Berlese funnel was estimated to be 1.82.

On the basis of overall collection of insects by various methods in the agro-forestry field ecosystem revealed maximum number of insects belonging to order hymenoptera (639) followed by diptera (420) while minimum population observed was of neuropterans (4). As far as collection of non-insects was concerned only mite population (55) was noticed. As far as percent composition of overall insects recorded by various methods was concerned maximum and minimum population recorded was of hymenoptera *i.e.* (31.46%) and neuroptera *i.e.* (0.20%), while percent composition of mites was 2.71% (Table 5). Hence, from the present studies it can be concluded that the insect biodiversity of the agro-forestry field of IGKV, Raipur was composed of representatives from fifteen orders namely; collembola, protura, diplura, lepidoptera, diptera, coleoptera, neuroptera, hymenoptera, hemiptera, orthoptera, ephemeroptera, odonata, embioptera, isoptera and dermaptera (fig: 5). No representation of insects from the order thysanura, plecoptera, grylloblattodea, phasmida, zoraptera, psocoptera, mallophaga, siphunculata, thysanoptera, mecoptera, trichoptera, siphonaptera, dictyoptera and

Table 5: Overall population of insects at the agro-forestry ecosystem collected by various methods.

Different trapping methods	Various insect and mites fauna present under agro-forestry ecosystem																
	Apterygota			Endopterygota					Exopterygota							Arachnida	Total
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	
Sweep net	0	0	0	133	125	43	0	20	62	15	0	40	5	0	0	0	443
Pit fall trap	0	0	0	0	220	120	0	496	96	94	0	0	0	6	13	0	1045
Light trap	0	0	0	43	62	9	4	0	81	4	10	0	0	0	0	0	213
Berlese funnel	34	26	15	0	13	31	0	123	0	0	0	0	0	33	0	55	330
Total population	34	26	15	176	420	203	4	639	239	113	10	40	5	39	13	55	(2031)
Percent Composition	1.67	1.28	0.74	8.67	20.68	10	0.2	31.46	11.77	5.56	0.49	1.97	0.25	1.92	0.64	2.71	
Shannon' diversity index				2.04													

Where; A= Collembola, B = Protura, C = Diplura, D = Lepidoptera, E = Diptera, F = Coleoptera, G = Neuroptera, H = Hymenoptera, I = Hemiptera, J = Orthoptera, K = Ephemeroptera, L = Odonata, M = Embioptera, N = Isoptera, O = Dermaptera, P = Acarina.

strepsiptera was observed.

Thus, looking to the overall collection of insects trapped by various methods as presented in table 5, clearly indicates that maximum number of insects were collected in pit fall trap (1045) followed by sweep net (443), Berlese funnel (330) and light trap (213). This indicates that crawling insects dominated the fauna of agro-forestry which may be due to the deposition of leaf litter from the various tree species and plantation crops comprising the agro-forestry ecosystem; and the insects find a safe and congenial area for hiding under it. As far as percent composition was concerned, among the total insects caught by pit fall 47.46 percent belonged to hymenoptera and among which Formicidae was the dominant order. These findings are in accordance with Santos *et al.,* 2007, who also opined that 56.60% of all the organisms captured by pit fall trap in the olive grove soil fauna were dominated by Formicidae. The Shannon' diversity index calculated for the overall insects trapped by various trapping methods was 2.04, which is quiet high, showing that the biodiversity of the agro-forestry field is rich and represented by various insects of different orders.

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