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(RESEARCH ARTICLE)



Abundance and diversity of foliage insects among different Olericulture Crops

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Abstract

Vegetables have essential nutrients like Vitamins, minerals, antioxidants and trace elements that play a vital role in human nourishment. Insects directly or indirectly affect these vegetables. Diversity indices provide important information about species in a community and help to understand the population structure at the given place. Diversity, evenness, dominance and richness of specific taxa considered the main factors of this indices. The results after the whole research as described in methodology showed that total 389 specimens belonging to 10 orders, 33 families and 59 species were documented from spinach fields while fenugreek pertains to 327 specimens, 9 orders, 30 families, and 55 species, whereas, total 373 specimens related to 11 orders, 34 families and 61 species were documented in case of turnip. *Catocala* and *Drosophila* genus 4.89% (N = 16) was recorded at their peak from Fenugreek, whereas from Turnip, *Culex* was documented with a high percentage of 4.02% (N = 15) and from Spinach, *Catocala* was recorded with an utmost abundance of 4.88% (N = 19). Maximum diversity, Dominance, Richness and Evenness with different values logged for Spinach and Turnip while the least number recorded for fenugreek.

Keywords: Insects; Abundance; Diversity; Spinach; Turnip; Fenugreek.

1. Introduction

Biodiversity is the totality and variety of distant animals and plants at all the levels of their organization from the genetic level up to the ecosystems they contain. Diversity exists from a minute creature like small microbes to gigantic types of animals and plants and it also designated as the capriciousness from all source's aquatic and terrestrial ecosystems [1, 2]. It accomplishes various functions yonder of food production, nutrient recycling, microclimate regulation, detoxification of harmful chemicals that causes threats sustainability of any ecosystem [3].

Insects considered a pivot for the endurance of any ecosystem [4]. They provide their services to humanity in different ways as a pollinator they pollinate about 80% of flowering plants, as decomposers they essential nutrients back to the environment, also important in aeration and conditioning of soil. They also play their vital role in food webs and chains and play their commercial role by providing the honey and silk [5].

Olericulture is basically the subdivision of horticultural science which corresponds with cultivation of vegetables. Vegetables not only enhance palatability but also improves appetite but also provide vitamins, minerals, dietary fiber, and phytochemicals. Some phytochemicals are strong antioxidants and modifying metabolic activation and detoxification of carcinogens. Vegetables in their diverse forms ensure adequate intake of fundamentals nutrients which contributing to solving many nutritious glitches.

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Trigonella foenum-graceum contained a medicinal substance that is used as medicines in Persia and the Middle East. It considered as old aged legumes, which has been used in combination with other vegetables [6]. *Spinacia oleracea* is the prince of all vegetables as it pertains the high grade of iron and other essentials bioactive compounds like a p-coumaric acid, glucuronic acid that rarely found in other vegetables, the other essentials amino acids, vitamin A and ascorbic acid increased the importance of spinach [7].

Insects damage crops by foliage feeding which leading to skeletonized leaves. The species of Aphididae, Aleyrodidae, and Pseudococcida families attack various plants, infesting leaves, stems, fruits and roots [8]. *Brassica rapa* (L.) leaves attacked by larvae of the specialist *Plutella xylostella* L. (Lepidoptera: Yponomeutidae) and herbivory by the chrysomelid beetle (*Phaedonco chleariae*) on Chinese cabbage [9].

By consideration of alliance of foliage insects with vegetables the extant research was performed to draw the diversity and abundance of foliage insects amongst the olericulture crops.

2. Material and methods

2.1. Research site

The study was completed to find the “Foliage insect’s diversity amongst olericulture crops the study was conducted at Vegetable Research Field, Institute of Horticultural Sciences, University of Agriculture, Faisalabad (Punjab), Pakistan (Fig. 1).



Figure 1 Map showing the study site

2.2. Collection

To collect the insect from fenugreek (*Trigonella foenum-graceum* L.), Spinach (*Spinacia oleracea* L.) and turnip (*Brassica rapa*), fields were sampled weekly for two hours at dusk and the basic tools used for collection of insect fauna: direct handpicking, sweep and aerial nets and with the aid of forceps. The samples were stored in jars containing alcohol and glycerin solution concentration of 70:30%. After that specimen preserved and stored in isolated glass ampoules which categorized with time, date and name of vegetable sampled and sample number.

2.3. Identification

The collected specimens were identified with a magnifying glass, light microscope and the stereomicroscope. Collected fauna of insects was classified up to the level of species according to their taxonomy [10] and on electronic means that accessible on the internet.

2.4. Statistical analysis

The data organized in tabulated form in accordance with insect’s morphology and taxonomical basis from order to species level. Shannon Diversity Index was used to find the various diversity indices like evenness and richness [11].

3. Results and discussion

Whole research trials completed as per maneuver, overall 1089 specimens were collected and 327 specimens from were collected from fenugreek, Turnip pertains to 373 specimens while from Spinach total 389 insects' specimens logged and they all belonged to different orders family's genus and species (Fig 2). Taxa composition and diversity of insects were studied in Faisalabad, Pakistan total 1088 specimens were documented that fitted into 8 orders, 24 families, 35 genera and 38 species [12]. The same trend was also noted in the study of [13-14].

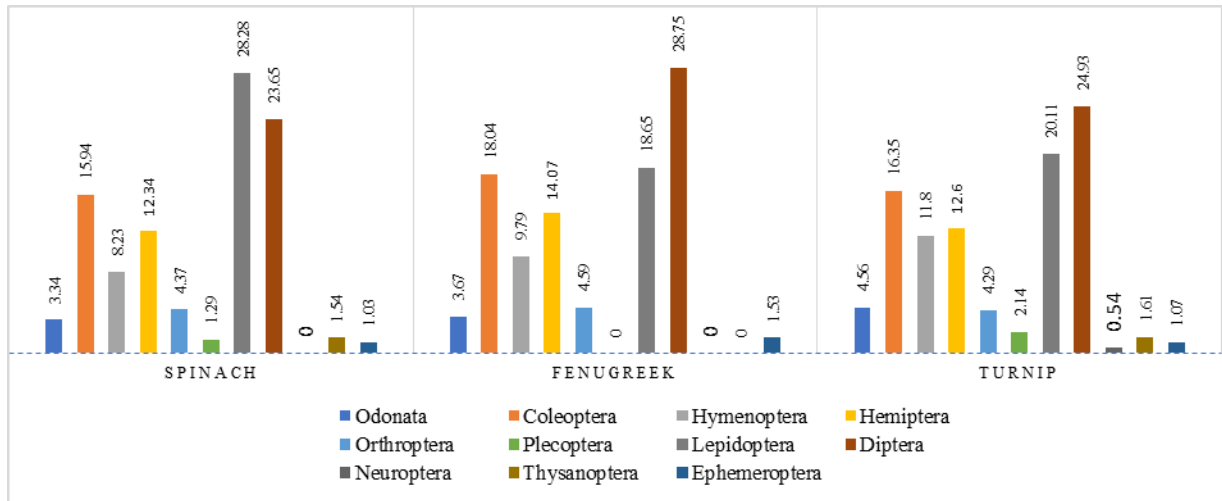


Figure 2 Order wise distribution of insects' diversity in Spinach, Fenugreek and Turnip

Chaudhary [15] found the abundance of wild pollinators on rapeseed and mustard. Devi et al. [16] documented diversity of insect pollinators in reference to a seed set of mustard. Overall documented and analyzed data from Fenugreek showed that highest abundance 2.75% (N = 9) recorded for *Locusta migratoria*, *Meiosimyza affinis*, *Agallia constricta* and *Eupeodes corollae*. But, low abundance (N ≤ 5) documented for various species. Turnip: Maximum relative abundance from turnip field 4.02% (N = 15) was noted for *Culex pipiens*. However minimum abundance (N≤5) was recorded for many species. Spinach: Highest abundance 3.60% (N = 14) was documented for *Platynota exasperatana* But, the least relative abundance (N≤5) was chronicled for various species as shown in (Table 1).

Table 1 Recorded relative abundance among Spinach, Fenugreek, and Turnip

Order	Family	Species	Fenugreek	Turnip	Spinach
Odonata	Libellulidae	<i>Pachydiplax longipennis</i>	1.83(6)	1.61(6)	1.54(6)
		<i>Sympetrum flaveolum</i>	1.83(6)	1.07(4)	0.00(0)
	Aeshnidae	<i>Anax junius</i>	0.00(0)	1.88(7)	1.80(7)
Coleoptera	Curculionidae	<i>Rhinusa tetra</i>	2.45(8)	1.34(5)	1.29(5)
		<i>Hypera postica</i>	2.45(8)	1.34(5)	1.29(5)
	Coccinellidae	<i>Hippodamia tredecimpunctata</i>	2.14(7)	0.27(1)	1.80(7)
		<i>Henosepilachna vigintioitopunctata</i>	1.22(4)	1.61(6)	2.06(8)
		<i>Harmonia axyridis</i>	1.83(6)	2.14(8)	1.54(6)
		<i>Cycloneda munda</i>	1.83(6)	2.14(8)	1.54(6)
	Chrysomelidae	<i>Altica oleracea</i>	1.53(5)	1.34(5)	0.51(2)
		<i>Altica plustris</i>	0.00(0)	1.61(6)	1.29(5)
		<i>Phyllotreta cruciferae</i>	0.61(2)	0.00(0)	0.00(0)
		<i>Crepidodera fluvicirnis</i>	1.83(6)	1.61(6)	1.54(6)
<i>Crepidodera areola</i>		1.53(5)	1.61(6)	1.29(5)	
		<i>Phyllotreta striolata</i>	1.83(6)	1.61(6)	1.54(6)
Hymenoptera	Apidae	<i>Bombus terrestris</i>	3.36(1)	2.95(11)	1.29(5)
		<i>Apis mellifera</i>	2.45(8)	3.22(12)	2.06(8)

	Vespidae	<i>Dolichovespula arctica</i>	1.53(5)	2.41(9)	2.06(8)	
		<i>Vespula vulgaris</i>	2.14(7)	1.34(5)	1.29(5)	
	Diapriidae	<i>Pantoclis trisulcata</i>	0.31(1)	1.88(7)	1.54(6)	
Hemiptera	Aleyrodidae	<i>Aleurocanthus woglumi</i>	1.83(6)	1.34(5)	3.34(1)	
		<i>Trialeurodes vaporariorum</i>	0.00(0)	0.54(2)	1.54(6)	
		<i>Bemisia tabacai</i>	1.83(6)	1.88(7)	1.54(6)	
	Cicadellidae	<i>Amrasca biguttula</i>	0.92(3)	1.61(6)	0.77(3)	
		<i>Agallia constricta</i>	2.75(9)	1.34(5)	1.5(6)	
	Aphididae	<i>Aphis craccivora</i>	1.83(6)	1.34(5)	0.77(3)	
		<i>Brevicoryne brassicae</i>	1.53(5)	2.14(8)	0.77(3)	
<i>Acyrtosiphon pisum</i>		1.83(6)	1.07(4)	0.51(2)		
Pentatomidae	<i>Murgantia histrionica</i>	1.53(5)	1.34(5)	1.54(6)		
Orthoptera	Acrididae	<i>Schistocerca americana</i>	1.83(6)	1.34(5)	2.31(9)	
		<i>Locusta migratoria</i>	2.75(9)	2.9(11)	2.06(8)	
Plecoptera	Perlidae	<i>Acroneuria abnormis</i>	0.92(3)	2.14(8)	1.29(5)	
Lepidoptera	Noctuidae	<i>Diarsia rosaria</i>	1.83(6)	1.61(6)	1.80(7)	
		<i>Apamea devastator</i>	1.83(6)	2.68(10)	1.29(5)	
		<i>Trichoplusia ni</i>	1.53(5)	1.88(7)	1.80(7)	
		<i>Spodoptera exigua</i>	0.00(0)	1.34(5)	2.31(9)	
		<i>Agrotis ipsilon</i>	1.22(4)	1.07(4)	2.57(10)	
	Sphingidae	<i>Manduca sexta</i>	0.00(0)	1.34(5)	2.57(10)	
	Pieridae	<i>Pieris brassicae</i>	1.22(4)	1.34(5)	2.57(10)	
	Nymphalidae	<i>Aglais urticae</i>	1.53(5)	1.34(5)	1.29(5)	
	Coleophoridae	<i>Coleophora albidella</i>	1.53(5)	1.61(6)	2.06(8)	
	Plutellidae	<i>Plutella xylostella</i>	1.53(5)	1.34(5)	1.54(6)	
	Erebidae	<i>Catocala unijuga</i>	2.45(8)	1.34(5)	2.83(11)	
		<i>Catocala palaeogama</i>	2.45(8)	1.34(5)	2.06(8)	
	Tortricidae	<i>Platynota exasperatana</i>	1.53(5)	1.88(7)	3.60(14)	
	Diptera	Tephritidae	<i>Bactrocera cucurbitae</i>	2.14(7)	1.88(7)	1.80(7)
		Agromyzidae	<i>Liriomyza sativae</i>	1.53(5)	1.61(6)	1.80(7)
		Culicidae	<i>Culex pipiens</i>	3.67(2)	4.02(15)	2.31(9)
			<i>Aedes albopictus</i>	2.75(9)	1.88(7)	1.29(5)
		Muscidae	<i>Spilogona falleni</i>	2.14(7)	2.14(8)	2.06(8)
			<i>Hydrotaea ignava</i>	2.14(7)	2.14(8)	1.80(7)
			<i>Coenosia sexmaculata</i>	0.31(1)	2.14(8)	2.31(9)
Calliphoridae		<i>Calliphora vomitoria</i>	0.31(1)	1.616	1.29(5)	
Syrphidae		<i>Eupeodes corollae</i>	2.75(9)	1.34(5)	1.80(7)	
Lauxaniidae		<i>Meiosimyza affinis</i>	2.75(9)	1.34(5)	1.29(5)	
		<i>Calliopum aeneum</i>	0.31(1)	1.07(4)	1.54(6)	
Anthomyiidae		<i>Anthomyia illocata</i>	1.53(5)	1.07(4)	1.54(6)	
		<i>Alliopsis angustitarsis</i>	1.53(5)	1.34(5)	1.54(6)	
Drosophilidae		<i>Drosophila funebris</i>	1.83(6)	1.34(5)	1.29(5)	
Neuroptera		Chrysopidae	<i>Chrysopa perla</i>	0.00(0)	0.54(2)	0.00(0)
Thysanoptera	Phlaneothripidae	<i>Gynaikothrips ficorum</i>	0.00(0)	1.61(6)	1.54(6)	
Ephemeroptera	Siphonuridae	<i>Siphonurus spectabilis</i>	1.53(5)	1.07(4)	1.03(4)	
Total			327	373	389	

The order and family-wise summary of the distribution of insect's diversity fenugreek turnip and spinach was recorded: According to this from spinach, maximum abundance was recorded for Hymenoptera 28.8% and from fenugreek and turnip order Diptera was recorded with the maximum number of species 29% and 25% respectively. The orders with respect to the number of individuals in the different sites were as follows: Orthoptera (32%), Coleoptera (17%), Hemiptera (15%), Diptera (12%), Hymenoptera (10%), Odonata (7%) and Lepidoptera (7%). A maximum number of species was recorded that belonged to Orthoptera and others respectively and these species were found in both sites (Fig. 2). This trend has also been recorded previously as described by Chakraborty *et al.* [17] () Diptera (42%), Coleoptera (18%), Orthoptera (11%), Hymenoptera and Lepidoptera (8%), Hemiptera and Araneae (5%) and Neuroptera (3%). Family distribution was also documented and observed that Chrysomelidae was present in the maximum number (Fig. 3). From Spinach and Turnip fields Noctuidae was documented maximum (Fig. 4, 5).

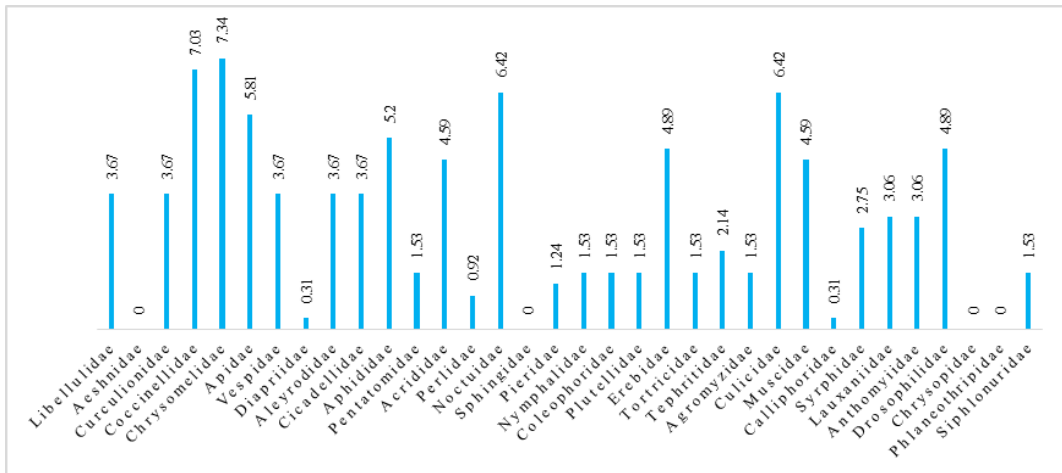


Figure 3 Family-related distribution of insects' diversity in Fenugreek

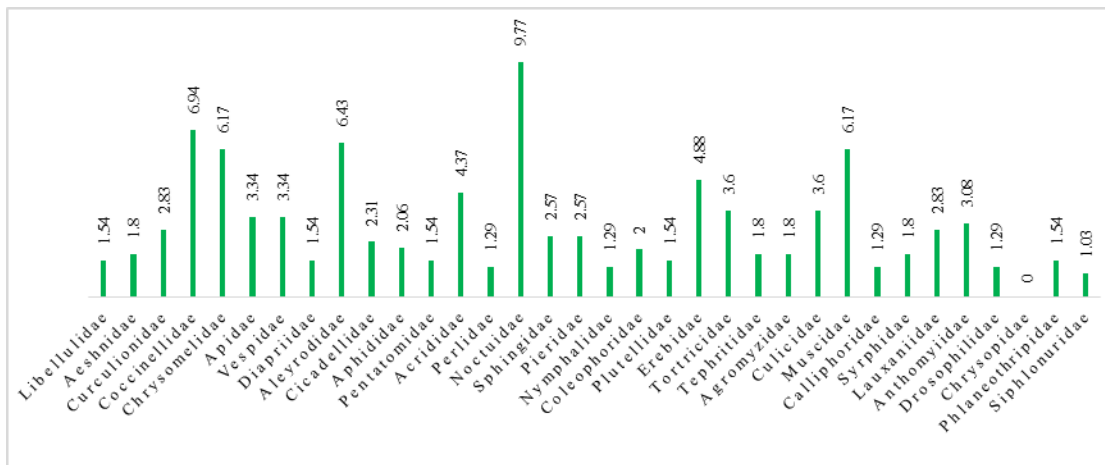


Figure 4 Family-related distribution of insects' diversity in Spinach

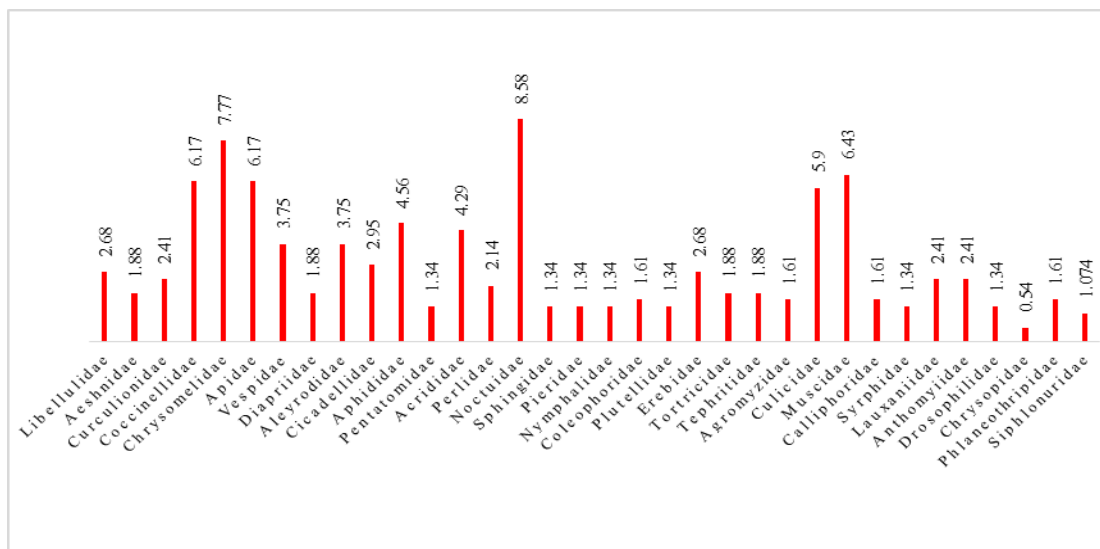


Figure 5 Family-related distribution of insects' diversity in Turnip

It considered important as they provide the pivot knowledge about rareness and commonness of species in a community. So, keeping in view the importance of these aspects, calculations were complete by the Shannon Diversity Index [18]. It was chronicled high from Turnip and Spinach while Diversity_{Maximum} (H'_{max}) was logged highest for turnip and spinach. Evenness was noted extraordinary for turnip and spinach. Dominance was documented supreme for Spinach and Turnip (Fig. 6) [19]. Found the diversity indices for inland terrestrial insects. Richness was noted highest for Turnip and Spinach. Diversity composition of insects was recorded higher in the case of bitter gourd in the morning time [20].

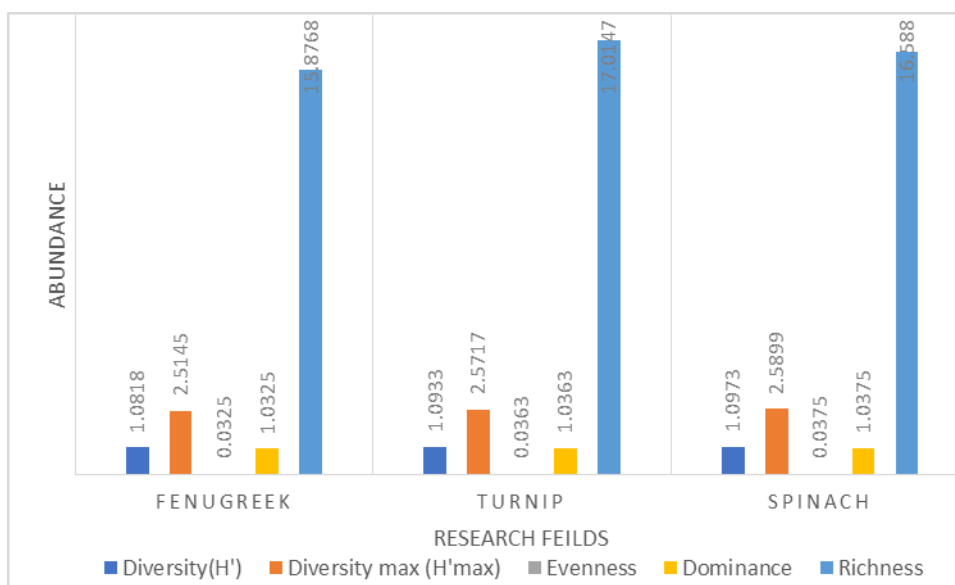


Figure 6 Record of diversity indices from research fields

4. Conclusion

The diversity of insects was recorded for three fields viz. Spinach, Turnip and Fenugreek and it concluded that there is a significant difference in diversity and abundance among the fields. Maximum abundance was recorded from the spinach field. Species richness, abundance and diversity was documented also maximum for spinach fields that evaluate the significant difference of diversity among fields. This study was pre-requisites for any management strategies.

Compliance with ethical standards

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Disclosure of conflict of interest

Authors have no conflict of interest to declare.

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