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A comparative study on the abundance and the diversity of soil arthropods in organic and inorganic turmeric fields of Jagityal, erstwhile Karimnagar district, Telangana

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Abstract
The present study has been undertaken in the Turmeric crop fields located at Shankarpally, a village in Jagityal district of Telangana. A total of 1132 insects from 13 orders were recorded during the study period of 2 years, from July, 2019 to February, 2020, from all the 32 sites. The present study was concentrated only on 13 orders. The abundant insect orders were Hemiptera, Collembola, Aranea, Thysanura, Coleopteran, Orthoptera, Carabidae, Dermaptera, Millipede and Isoptera. The Simpson index D value was calculated as 0.133, 1-D dominance value is 0.867, reciprocal index is 7.536; Shannon index H is 2.34 and evenness value is 0.91 for organic turmeric crop field. The present investigation revealed the relative abundance of the insect orders from the inorganic turmeric crop field is little varied with the taxonomic identity.

Keywords: Turmeric, abundance, evenness, dominance, diversity indices

Introduction
Agriculture is a primary necessity to mankind that provides food. The use of pesticides in agriculture became inevitable for protecting crops from pests, diseases, and weeds, which can significantly impact crop yields and quality. Without the use of pesticides, farmers would face significant losses due to insect damage, plant diseases, and weed competition. This would not only impact food production but also increase the cost of food for consumers that effect food chain supply, economies, survival of the mankind.

Furthermore, the use of pesticides can also contribute to sustainable agriculture by allowing farmers to produce more food on the same amount of land, thus reducing the need for deforestation and the expansion of agricultural land.

Human population has been exploding exponentially. In order to meet the food demands of alarmingly increasing population food grain production has to be produced in a multifold manner. Mechanization of agriculture and application of fertilizers, pesticides and other synthetic and chemical additives culminated in green revolution with great resurgence of food grain production. However, green revolution has some adverse effects on the Nature. The pesticide and chemical residues and run off ultimately enters the water bodies which in turn affects the aquatic living organisms and subsequently affects the other non-target organisms as a result of biomagnification. Dumping of millions of tunes of pesticides every year on large scale is going on in every corner of the planet Earth and there is a need for sustainable agriculture in the context of all these.

On the other hand organic farming is a method of farming system which involves usage of organic waste and other biological materials. Detritus and decomposing organisms carry out the process of decomposition of litter; they regulate the soil health by providing required factors. They also maintain optimum conditions for the growth of plants and for the survival of other biota. Organic farming involves crop rotation, use of animal manure, organic waste and other additives by avoiding pesticides, fertilizers and hormones [1].

Organic agriculture promotes soil health, biodiversity ecological balance [2].

Use of fertilizers also affects the landscape of the farmlands and effects biodiversity in agro ecosystem and finally effects crop yield and also effects human health [3]. It affects abundance, distribution and seasonal distribution of both beneficial and harmful organisms as well.

There is an increasing tendency in the scientific community to study the significance of organic farming and its impact on distribution and survival of organisms [4]. Turmeric is an integral part of Indian culture. It has much significance and reverence in Indian civilization and lives of people. It is being used in traditional system of medicine and has due economic importance. India is the leading producer and consumer of Turmeric. Organic agriculture supports the conservation of biodiversity, when arthropod [5]. Their contributions include ecosystem functioning, nutrient cycling, integrated pest management, prey predator relationship [6, 7, 8, 9, 10, 11, 12].

There is a paucity of information on the impact of organic farming on diversity of insects in Telangana. Therefore to understand the role of organic farming, the current study has been planned.

Materials and Methods

The present study was conducted in the turmeric crop fields located at Shankarapalli village of Jagityal district Telangana for two years from July 2019 to February 2020. It is situated at 18.76 N, 78.90 E in the erstwhile Karimnagar district of Telangana, a state in peninsular part of Southern India. Both organic and inorganic turmeric crop fields were selected to know the abundance, diversity, distribution and seasonal variation of arthropods in a relative manner. In organic farming only organic fertilizers like manure, vermin compost and biofertilizers were used. On the other hand fertilizers like urea DAP and other pesticides are employed in employed in inorganic farming. Nowadays most of the turmeric is being cultivated by organic farming method only.

Insects were collected by hand picking, sweeping areal net, pit fall trap methods altogether. Each of five pitfall traps were set in selected habitats of both the crop fields under study using a plastic glass (10 cm long, 5 cm diameter) 10 meters apart from each other. The soil was dug about 10 cm deep and the glass container filled with water of about 150 mL and 1 mL of detergent fit into the hole and the trap was placed at the same level as the surface of the soil.

The traps were removed after the third day of installation and the samples were collected and kept in insect collection bottles with 10% formalin. They were sorted and preserved in the glass vials containing the alcohol (70%) and glycerin (30%) and identification was done up to the family level with the help of taxonomic keys and scientific literature. The numbers of insects of each family were recorded. The total number of insects, species richness and evenness were calculated. And the data generated was statistically analysed.

Data Analysis

The diversity was calculated by using diversity indices namely: Simpson's index (D) [13], and Shannon-Wiener index (H') and Equitability index (E) [14]. The number of Arthropod species (S), the number of individuals for each species (N), α- and β-diversity indexes were calculated. The α-diversity was calculated from various indices including the Shannon-Wiener diversity index (H) that measures the species diversity within the community of an ecosystem. Simpson index (D) that gives the species dominance. As the D index increases, the diversity decreases.

Results and Discussion

A total of 1132 arthropods were obtained by during July, 2019 to February, 2020. A total of 650 insects were collected from organic crop field, out of which 42 species that belonged to 13 different orders were recorded. Five species of insects from order Orthoptera seven Collembola, five species of Lepidoptera, one species of isoptera, two species of Carabidae, three species of Thysanura, Hymenoptera, Hemiptera, five species of coleoptera, one species in Dermaptera, Millipede, and Millipede and three species of Aranea were obtained from organic crop field (Table 1).

A total of 482 insects were collected from inorganic crop field, out of which 43 species that belonged to 13 different orders were recorded. Four species of insects from order Orthoptera seven Collembola, five species of Lepidoptera, one species of isoptera, Millipede; three species of Thysanura, Hymenoptera, Hemiptera, six species of coleoptera, two species in Dermaptera, Millipede, and Carabidae, and three species of Aranea were obtained from the inorganic crop field.

A total of 1132 insects collected from 32 samples in two different. Insects belong into 13 orders were recorded. Of this 650 were collected from organic crop field and 482 were collected from inorganic turmeric crop field.

Analysis of community structure was carried out for all arthropods collected in pitfall traps. Species richness, i.e. number of species observed (2) evenness, the equitability of abundance across species, (3) diversity index, that integrate both richness and evenness.

Climatic factors, soil pollution, tillage, usage of herbicides and pesticides etc. effect soil Arthropods. Many studies have demonstrated the habitat disturbance role in richness, diversity and abundance of soil arthropods [15]. The Orthoptera is the most abundant followed by Collembola Coleoptera. Collembola and Orthoptera contain nearly all soil arthropods, as they flourish in all tropic levels of the soil's below ground detritus food web [16, 17, 18].

Table 1: showing the abundance and distribution of soil arthropods

	Organic crop field			Inorganic crop field		
Order	**No of species**	**No of individuals**	**Percentage**	**No of species**	**No of individuals**	**Percentage**
Orthoptera	5	48	7.38	4	27	5.60
Collembola	7	161	24.76	7	123	25.51
Isoptera	1	28	4.30	1	15	3.11
Hemiptera	3	82	12.61	3	69	14.31
Carabidae	2	38	5.84	2	24	4.97
Coleoptera	5	78	12	6	67	13.90
Thysanura	3	69	10.61	3	52	10.78

Millipedes	2	19	2.92	2	11	2.28
Aranea	3	54	8.30	3	41	8.50
Dermaptera	2	17	2.61	2	11	2.28
Lepidoptera	5	24	3.69	5	19	3.94
Hymenoptera	3	21	3.23	3	15	3.11
Mantoidae	1	11	1.69	1	8	1.65
Total		650			482	

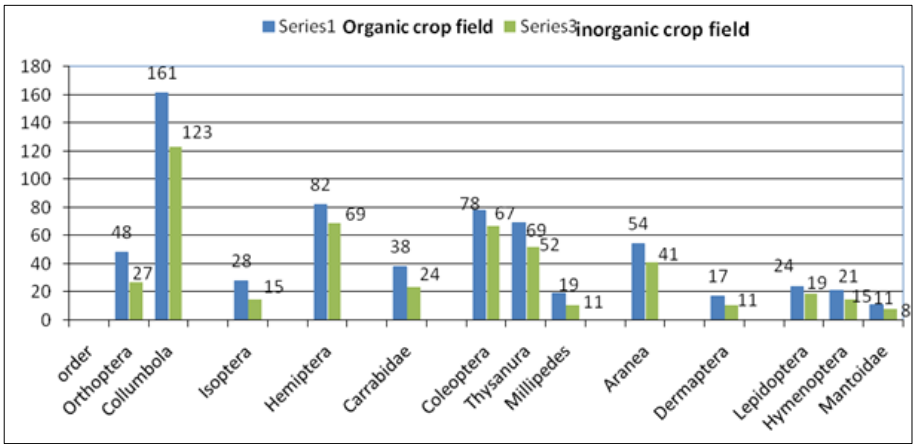

Fig 1: Showing the abundance and distribution of soil arthropods

Land management practices coupled with usage of fertilizers, pesticides may be the reason for the low abundance of insects in inorganic crop field when compared to the organic crop fields. During March, April and May the temperature is usually high and scorching and it affects the abundance and it was noticed in the present study. Species richness, evenness, and diversity index were studied to know the community structure. The Simpson index D value was calculated as 0.133, 1-D dominance value is 0.867, reciprocal index is 7.536; Shannon index H is 2.34 and evenness value is 0.91 for organic turmeric crop field.

The Simpson index D value was calculated as 0.138, 1-D dominance value is 0.82, reciprocal index is 7.232; Shannon index H is 2.36 and evenness value is 0.89 for in organic turmeric crop field.

Conclusion

The present investigation revealed that the relative abundance of the insect orders from the organic turmeric crop field is highly varied with the taxonomic identity (Figure-2). The Collembola (24%) was found to occupy the highest proportion of the insect community followed by hemiptera (12. 61%), Coleoptera (12%) Thysanura (10.61%), Orthoptera (7.36%), Carabidae (5.84%), Dermaptera (2.61%), Millipede (2.91%), Isoptera (4.30%), Hymenoptera (3.23%) Lepidoptera (3.69), Araenia (8.30%), Mantidae was the least abundant (1.12%) order in collected community.

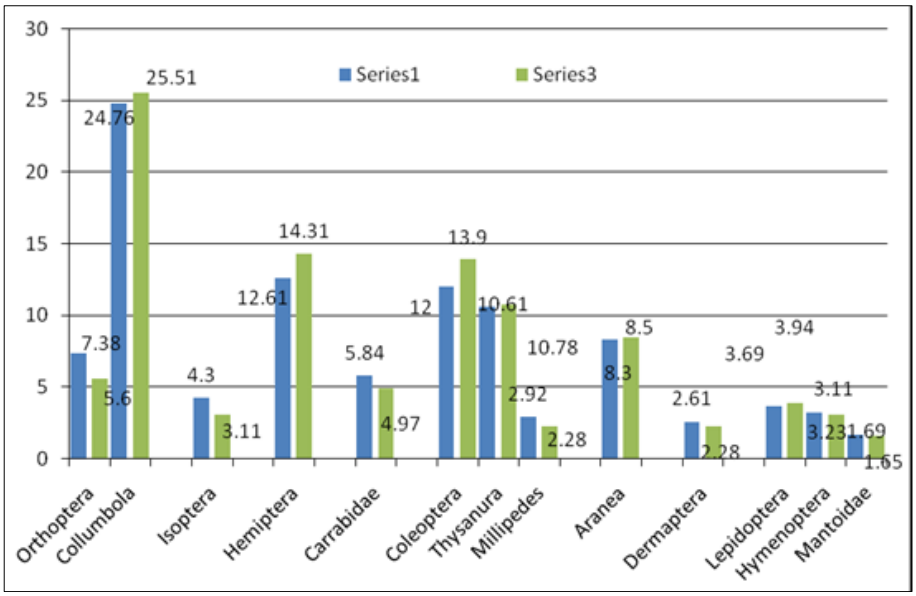

Fig 2: Showing the relative abundance of soil arthropods

The present investigation revealed that the relative abundance of the insect orders from the inorganic turmeric crop field is little varied with the taxonomic identity. So it is not clear whether the farming practice can affect the occurrence of certain species. There was no clear difference in the Evenness between organic and inorganic fields, and

this may be due to the abundance of more predatory species in organic fields that reduces the prey insect population.

The Collembola (25. 51%), was found to occupy the highest proportion of the insect community followed by hemiptera (14.31%), Coleoptera (13.90%) Thysanura (10.78%), Orthoptera (5.6%), Carabidae (4.97%), Dermaptera (2.28%), Millipede (2.28%), Isoptera (3.11%), Hymenoptera (3.11%) Lepidoptera (3.94), Araenia (8.50%), Mantidae was the least abundant (1.65%) order in collected community.

A total of 1132 insects from 13 orders were recorded during the study period of 2 years, from July, 2019 to February, 2020, from all the 32 sites. The present study was concentrated only on 13 orders. The abundant insect orders were Hemiptera, Collembola, Aranea, Thysanura, Coleopteran, Orthoptera, Carabidae, Dermaptera, Millipede and Isoptera. These insects were associated with the above-ground vegetation and litter of the crop field. The Simpson index D value was calculated as 0.133, 1-D dominance value is 0.867, reciprocal index is 7.536; Shannon index H is 2.34 and evenness value is 0.91 for organic turmeric crop field.

The Simpson index D value was calculated as 0.138, 1-D dominance value is 0.82, reciprocal index is 7.232; Shannon index H is 2.36 and evenness value is 0.89 for in organic turmeric crop field.

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