International Journal of Fauna and Biological Studies
Available online at www.faunajournal.com

IJFBS International Journal of Fauna And Biological Studies

ISSN 2347-2677
IJFBS 2017; 4(3): 14-19
Received: 04-03-2017
Accepted: 05-04-2017

Fazal Ellahi
Department of Entomology, Sindh Agriculture University, Tandojam, Sindh, Pakistan

Abdul Ghani Lanjar
Department of Entomology, Sindh Agriculture University, Tandojam, Sindh, Pakistan

Babar Hussain Chang
Department of Entomology, Sindh Agriculture University, Tandojam, Sindh, Pakistan

Fida Hussain Magsi
Department of Entomology, Sindh Agriculture University, Tandojam, Sindh, Pakistan

Ghulam Mujtaba Khushk
Faculty of Agriculture Social Sciences, Sindh Agriculture University Tandojam, Sindh, Pakistan

Aftab Raza
Department of Entomology, Sindh Agriculture University, Tandojam, Sindh, Pakistan

Asif Hussain Chang
Department of Entomology, Sindh Agriculture University, Tandojam, Sindh, Pakistan

Falak Naz Miano
Department of Plant Protection, Sindh Agriculture University, Tandojam, Sindh, Pakistan

Correspondence
Babar Hussain Chang
Department of Entomology, Sindh Agriculture University, Tandojam, Sindh, Pakistan

Insect biodiversity on mix cropping of chilli and onion crops

Fazal Ellahi, Abdul Ghani Lanjar, Babar Hussain Chang, Fida Hussain Magsi, Ghulam Mujtaba Khushk, Aftab Raza, Asif Hussain Chang and Falak Naz Miano

Abstract
The experiment was conducted during winter season 2015 on experimental field of Oil Seed Section, Agriculture Research Institute Tandojam. To determine the insect biodiversity on chilli (Cv. Ghotki) and onion (Cv. Sahzadi) mixed crop, the crop was cultivated on an area of ½ acre. The biodiversity of mix crop field was also compared with the biodiversity of chilli and onion fields cultivated separately. The plants were transplanted on ridges while in mix crop of onion and chilli, the plants were transplanted alternately on the same ridges. Sampling of insect species was done by *in situ* and sweep net methods from first week of October to last week of December 2015. For this purpose, 15 plants were randomly selected from the field of onion and chilli cultivated separately, while 15 plants of each onion and chilli were selected from mixed crop. The selected plants were thoroughly examined for the population of chewing insects while sucking insects were counted by examining 1 leaf per selected plant. Fifty strokes were also performed to collect flying insects in each field. To determine diversity, diversity maximum, species richness and evenness, Shannon diversity indices were used. Results showed that in mix crop, the total specimens 2565 were collected, which were belonging to 24 different species. Among them, 15 species were pests while 6 and 3 species were predators and pollinator, respectively. The highest diversity (H=1.204) was recorded in 2nd week of October while H_{max} ($H^{/}$=1.36) was recorded in 4th week of October. The maximum evenness ($J^{/}$=0.91) and richness (D=1.36) were recorded in 1st week of December, respectively. The paired T-test showed that the population of aphid, onion leaf miner, thrip, mite and cutworm appears non-significantly on alone and mix cropping of onion and chilli.

Keywords: Insect biodiversity, mix cropping, chilli, onion, Pakistan

1. Introduction
Agriculture is central to economic growth and development in Pakistan. Being the dominant sector it contributes 21.4 percent to GDP, employs 45 percent of the country's labour force and contributes in the growth of other sectors of the economy [1]. Chilli *(Capsicum annuum* L.) is one of the important commercial vegetable crops and widely cultivated throughout the tropical and subtropical countries in the world. Green chilli is rich in vitamin A and vitamin C [2] and in 'rutin' which is of immense pharmaceutical need. Intercropping of chilli with different crops offers greater scope to utilize the land and other resources to maximum extent.
Onion *(Allium cepa* L.) is an important bulb crop and indispensable item in every kitchen as condiment and vegetable. It is used as vegetable, salad, spice and in various tasty preparations and also widely used in pickles, chutney, flavouring and cooked vegetable. Onion contains a lachrymatic agent, a strong antibiotic in addition to fungicidal, bacterial, anti-cholestrol, anticancer and antioxidant components such as quercetin [3] and exhibits greater susceptibility to weed competition than most crops due to slow germination and also absence of foliage's [4] had reported higher yield for chilli when intercropped with onion. The present experiment was conducted to study the yield advantages of chilli-onion intercropping compared to mono-cropping in sandy regosol.
The intercropping studies and concepts have been abandoned in the developed countries were planting and harvesting are done mechanically. Intercropping studies under optimum technology indicated substantial increase of more than 50% from different combinations of alternate row cropping over the two separate pure cultures [5]. Noted that through trial and error, some subsistence farmers have undoubtedly developed intercropping systems which reduce the pest population and have allowed them to have an economic yield. This study aims at investigating the extent to which mixed cropping can reduce insect numbers and the damage to crops done by pests in an onion/pepper mixed cropping system.

Diversity varies from local to global scales, and can be defined in many ways. Due to the difficulty of studying unseen organisms in the soil matrix, many measures of diversity aboveground, especially abundance, cannot be easily used belowground. While both species richness (the number of species) and diversity (the number and abundance of species) are easily measured aboveground, until very recently only species richness was estimable belowground for most organisms. Here, when diversity is discussed as a concept it will include measures of both species richness and diversity. Patterns of plant and insect diversity vary along latitudinal gradients. A satisfactory explanation for the latitudinal gradient in species diversity has yet to be identified and may vary by group [6].

Biodiversity is often broadly defined as the different forms of plants, animals and microorganisms that exist, the levels at which they occur (e.g., species, population and ecosystem levels) and the different ways in which organisms, climate and geology combine to form functioning ecosystems. Approximately 1.8 million living species have been named and described and, of these, one million are insects. Insects are ubiquitous in the environment and play important roles in maintaining the stability of ecosystems by being part of the food chain, mediating decomposition processes and through various ecological interactions, such as pollination, predation and herbivory. Large-scale anthropogenic activities such as forest clear-cutting extirpate insect species and destroy ecosystem dynamics and interactions that have been in place for millennia. It has also been estimated that invertebrates represent more than 90% of the planet's 10 million or so animal species [7-8].

Intercropping is the planting of more than one crop in close proximity as part of the same farming system. The design of intercropping system can vary dramatically depending on the purpose of the intercrop for the farming operation. Intercropping produces the benefits of on-farm diversity, increased productivity, resource distribution balance, farm risk reduction, and weed and insect pest control. Intercropping systems for insect pest control includes the planting of a crop that has a repellent effect, an attractant effect, or a combination of both, on a target pest in close proximity to a crop that has the potential to be attacked by it. Many spatial combinations are possible for intercropping, including mixed intercropping, in which different crops are planted in the same row or at alternating rows. Crop rotation means planting different crops on the same plot during different times of the year, and can include some of the benefits of intercropping, such as reducing insect pest populations, increasing beneficial insects, and weed suppression. In addition, non-crop plants such as weeds, cover crops, and habitat plantings can be combined in space and time to influence numbers of pest and beneficial arthropods on the main crop [9].

2. Material and Methods

The experiment on "Insect biodiversity on mix cropping of chilli and onion crops" was conducted at experimental field of Oil Seed Section, ARI Tandojam during winter season 2015. To determine the insect biodiversity on chilli (cv. Ghotki) and onion (cv. Shahzadi) mixed crop, the crop was cultivated on an area of ½ acre. The biodiversity of mix crop field was also compared with the biodiversity of chilli and onion fields cultivated separately the plants were transplanted on ridges while in mix cropping of onion and chilli plants were transplanted alternately on the same ridges. Sampling of insect species were done by *in situ* and sweep net methods from first week of October to last week of December 2015 for this purpose, 15 plants were randomly selected from the field of onion and chilli cultivated separately, while 15 plants of each onion and chilli were selected from mixed crop field the selected plants were thoroughly examined for the population of chewing insects while sucking insects were counted by examining 1 leaf per selected plant. Fifty strokes of hand net were also performed to collect flying insects in each field.

The collected insects were killed in killing bottle (potassium cyanide) and with ethyl acetate then the specimens were brought in to the laboratory Department of Entomology for identification. Since chillies and onion are reservoir for many insect species therefore the present studies were conducted to determine diversity, diversity maximum, species richness and species by using Shannon diversity index in chilli and onion as alone and mix cropping system.

The following diversity indices were used:

$$H = \frac{n \log n - fi \log fi}{n}$$

$$H^{/} = \log k \text{ (Max Diversity)}$$

$$J = \frac{H}{H^{/}} \text{ (Evenness)}$$

$$D = 1 - J^{/} \text{ (Richness)}$$

Where H is the diversity index of total collected specimens, fi is the proportion of the ith species. $H^{/}$ is the maximum diversity, k is the total number of species in the entire crop area. $J^{/}$ is the evenness and D donates the dominance of species and n is the number of species per observation.

3. Results

The results of the experiment showed that insect biodiversity varied in mix cropping of chilli and onion cropping pattern. The periodic insect biodiversity is given as under.

3.1 Biodiversity on mix cropping of chilli and onion

In mix cropping of chilli and onion total 24 species of insects were recorded from October to December 2015. Among them 15 species were pest while 6 and 3 species were predators and pollinators. The collected insects were belonging to different orders Coleoptera, Diptera, Lepidoptera, Homoptera, Neuroptera, Hymenoptera, Hemiptera, Orthoptera, Thysanoptera, Isoptera and Trombidiformes. The details of insect's species and their taxonomic status are given in Table-1 and seasonal population abundance of insect species of different orders is presented in appendices.

The data in Fig. 1 depict that population abundance of insect collected from mix cropping of chilli and onion crop. On the basis of average, maximum population abundance were recorded for thrips (55.07±21.30) followed by mites (38.64±10.05), aphid (17.92±3.78), painted bug (17.57±3.32), weevil (11.92±1.31), whitefly (9.85±1.37), fruit borer (5.14±1.55), cutworm (4.64±1.19), green grass hopper (2.85±1.10), cabbage butterfly (2.28±0.75), cricket (2±0.72), onion leaf minor (1.71±0.75) and house cricket (1.28±0.41), while the minimum population abundance were observed for onion fly (0.92±0.33)

The data in Fig. 2 depict that population abundance of insect collected from onion alone. Maximum population abundance was recorded for thrips (44.28±15.93) followed by mites (12.35±4.60), weevil (11.92±1.31), aphid (11.21±0.97), cutworm (4.21±0.72), onion fly (3.07±1.13) and onion leaf minor (2.28±0.62), respectively. Minimum infestation was observed for butter fly (2.21±0.72).

The data in Fig. 3 depict that population abundance of insect collected from chilli alone. Maximum population abundance was recorded for thrips (84.75±16.88) followed by mites (38.64±10.05), whitefly (8.71±1.36), cutworm (6.42±1.02), painted bug (2.78±0.59), respectively. Minimum infestation was observed for leaf cutter bee (0.64±0.22).

The data in Fig 4 depict that population abundance of pollinators and predators collected from alone and mix cropping of chilli and onion. Maximum infestation was noted for honey bee (3.21±2.01) and bumble bee (1.85±0.59).

The data in Fig 5 depict that population trend of lady bird beetle cultivated alone and mix cropping of chilli and onion. Peak infestation of lady bird were determined during 1 and 2nd week of December afterwards population infestation linearly declined due to climatic change.

The data in Fig 6 depict that population trend of *C. cornea* on cultivated alone and mix cropping of chilli and onion. It was observed from the data that the infestation of *C. cornea* were at maximum level during last week of October to 1st week of November, these are the months of suitable temperature for *C. cornea* adaptation in the environment.

The data in Fig. 7 depict that population trend of zigzag beetle on cultivated alone and mix cropping of chilli and onion. Peak infestation of zigzag beetle were seen during 26th November, 3rd December and continue till 10th December, afterwards the infestation smoothly declined during the entire period of study.

The data in Fig. 8 depict that population trend of hoverfly on cultivated alone and mix cropping of chilli and onion. The hoverfly shows their peak infestation during last of November might be due to coldness of the temperature.

The data in Fig. 9 insect biodiversity cultivated alone and mix cropping of chilli and onion diversity is recorded in mix cropping. It was observed from the data that maximum biodiversity of insect pests were determined on mix cropping as compared to alone (onion and chilli).

The data in Fig. 10 indicates that maximum diversity were observed on 3rd week of October for mix cropping and least diversity of insects pest were noted on last week of December for alone cropping (chilli and onion).

The data in Fig. 11 showed that maximum species evenness were examined during 31st December for mix cropping and minimum species evenness were observed during 29th October for mix cropping. Species evenness on onion alone were determined during 3rd December which is parallel with the mix cropping. Species evenness on chilli alone were seen during 15th October which is lesser than onion alone and mix cropping evenness.

The data in Fig. 12 indicates that the maximum species richness were determined for onion alone during 24th December followed by mix cropping during 3rd December and chilli alone during 17th December. On the basis of ranking, onion alone get 1st ranking for species richness, 2nd ranking for mix cropping and 3rd ranking for chilli alone.

Table 1: Taxonomic position and status of insects collected and recorded in mix-cropping of chilli and onion biodiversity at Tandojam during October to December, 2015

Common name	Technical name	Family	Order	Status
Weevil	*Brachycerus albidentatus*	Curculionidae	Coleoptera	Pest
Onion fly	*Delia antique*	Anthomyiidae	Diptera	Pest
Lady bird beetle	*Coccinella septempunctata*	Coccinellidae	Coleoptera	Predator
Aphids	*Aphis gossypii*	Aphididae	Homoptera	Pest
Honey bee	*Apis florae*	Apidae	Hymenoptera	Pollinator
Green lace wing	*Chrysoperla carnea*	Chrysopidae	Neuroptera	Predator
Hover fly	*Eristalis* sp.	Syrphidae	Diptera	Predator
Onion leaf minor	*Phytomyza gymnostoma*	Eulophidae	Hymenoptera	Pest
Leaf cutter bee	*Megachile* sp.	Megachilidae	Hymenoptera	Pollinator
White ant	*Microtermes obesi*	Termitidae	Isoptera	Pest
White fly	*Bemisia tabaci*	Aleyrodidae	Hemiptera	Pest
Fruit borers	*Symmestrichema dulce*	Gelechiidae	Lepidoptera	Pest
Painted bug	*Bagrada cruciferarum*	Pentatomidae	Hemiptera	Pest
Crickets	*Gryllus campistris*	Gryllidae	Orthoptera	Pest
Thrips	*Thrips tabaci*	Thripidae	Thysanoptera	Pest
Zigzag beetle	*Menochilus sexmaculatus*	Coccinellidae	Coleoptera	Predator
Butter fly	*Danaus plexippus*	Danaidae	Lepidoptera	Pest
Mites	*Tetranychus urtecae*	Tetranychidae	Trombidiformes	Pest
Bumble bees	*Bombax morae*	Apidae	Hymenoptera	Pollinator
Green grass hopper	*Attractomorpha acutipennis*	Acrididae	Orthoptera	Pest
Saw fly	*Athalia proxima*	Tenthredinidae	Hymenoptera	Pest
Cabbage butter fly	*Pieris brassicae*	Pieridae	Lepidoptera	Pest
House cricket	*Acheta domesticus*	Gryllidae	Orthoptera	Pest
Cut worm	*Noctua pronuba*	Noctuidae	Lepidoptera	Pest

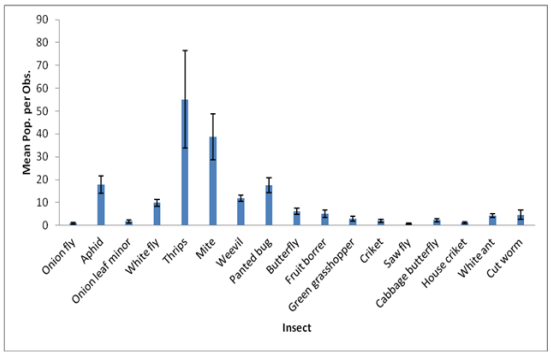

Fig 1: Mean population of insect pests in onion and chilli mix cropping system

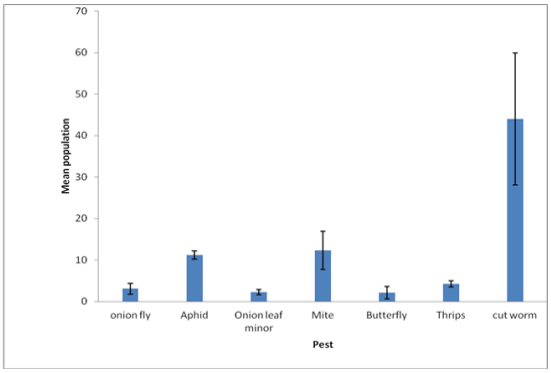

Fig 2: Mean population of different insects on onion crop

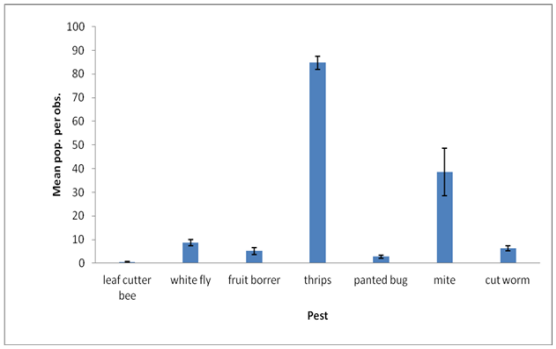

Fig 3: Mean population of insect pests on chilli crop alone and mix cropping system

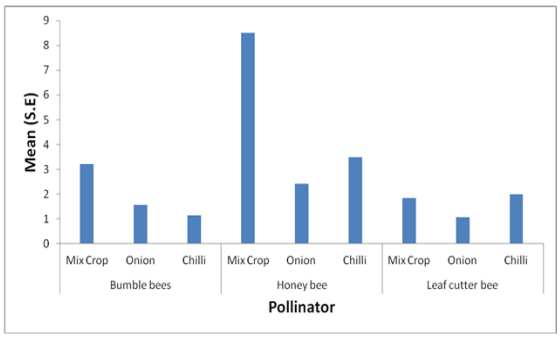

Fig 4: Mean population of pollinator in alone and mix cropping of chilli and onion

3.2 Shannon- Weiner diversity index

The population count of different insect pests, predators and pollinators were made from 1st October to 31st December 2015. The total 2565 specimens were recorded on 15 randomly selected plants of mix cropping of chilli and onion for 14 observations. Twenty four species belonging to different insect orders and different classes of phylum arthropods were collected from mix cropping of chilli and onion throughout cropping season. Diversity ($H^{/}$), diversity maximum (H), specie evenness ($J^{/}$) and specie richness ($D^{/}$) were on every observation by using Shannon- Weiner diversity index.

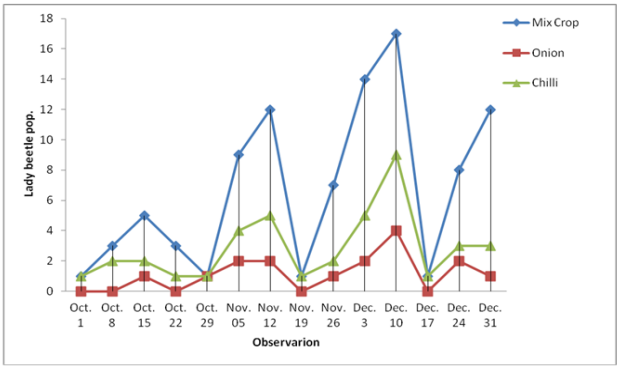

Fig 5: Population trend of lady bird beetle on chilli and onion cultivated alone and mix crop

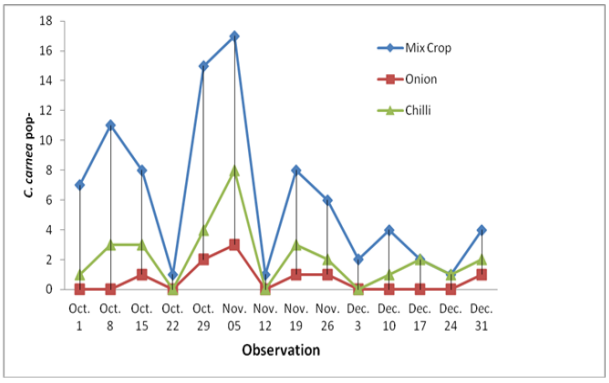

Fig 6: Population trend of crysoperla carnea on alone and mix cropping of chilli and onion

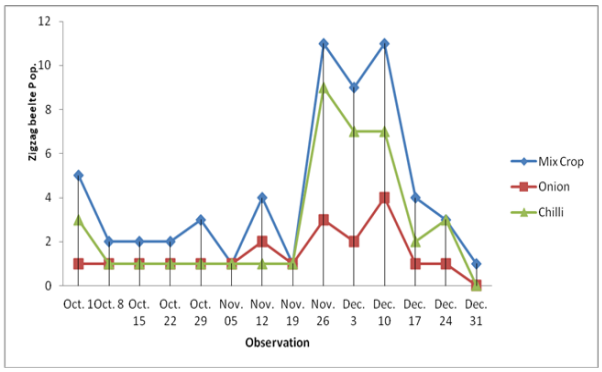

Fig 7: Population trend of zigzag beetle in alone and mix cropping of chilli and Onion

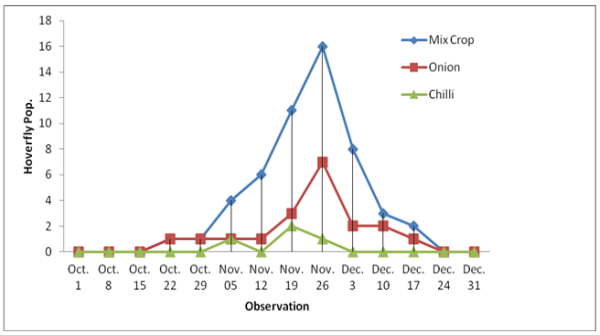

Fig 8: Population trend of hover fly in alone and mix cropping of chilli and onion

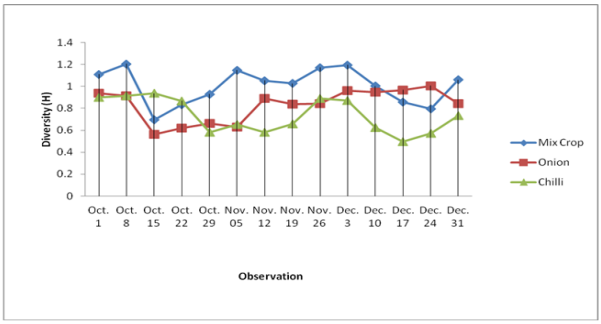

Fig 9: Insect biodiversity on chilli and onion cultivated alone and mix crop

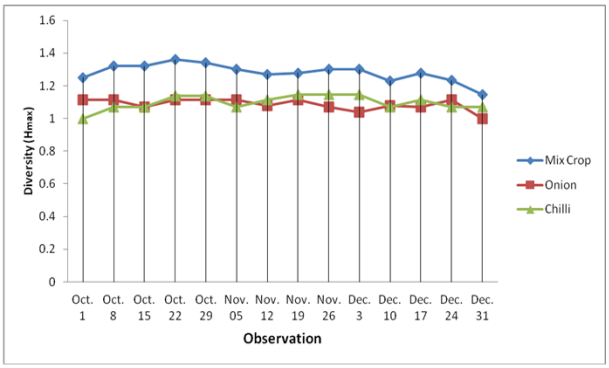

Fig 10: Diversity maximum of insects on chilli and onion cultivated alone and mix crop

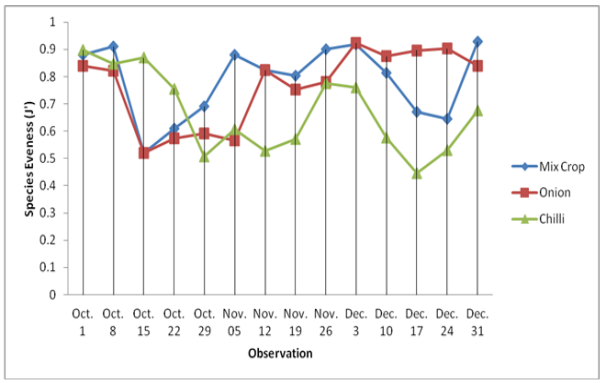

Fig 11: Species evenness in chilli and onion agro eco system as alone and mix crop

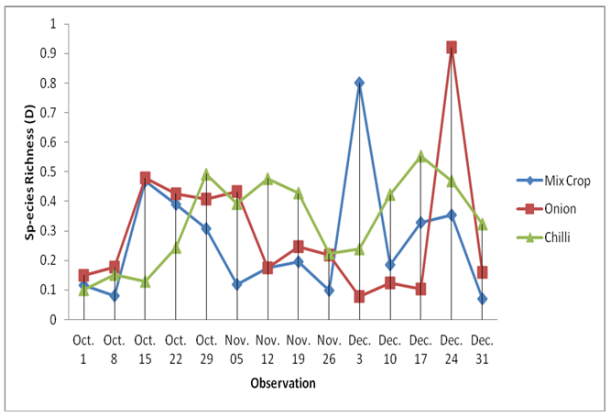

Fig 12: Species richness in chilli and onion agro eco system on alone and mix

4. Discussion

Through the true dimensions of species biodiversity remain uncertain, estimates ranges from 2.6-7.8 million species with a mean of 5.5 million [10]. This estimation represents that 20% of all species on earth, out of them 20,000 new species of all organisms being described each year, most species likely will remain undescribed for many years unless species descriptions increase in rate. About 850,000–1,000,000 of all described species are insect's. Of the 24 orders of insects, four dominate in terms of numbers of described species, with at least 3 million species included in Coleoptera, Diptera, Hymenoptera and Lepidoptera. In the present study the total 24 insect species (pests, predators and pollinators) like *Pieris brassicae*, *Gryllus campistris*, *Attractomorpha acutipennis*, *Symmestrichema dulce*, *Brachycerus albidentatus*, *Microtermes obesi*, *Danaus plexippus*, *Acheta domesticus*, *Bagrada cruciferarum*, *Thirps tabaci*, *Bemisia tabaci*, *Aphis gossypii*, *Tetranychus urtecae*, *Delia antique*, *Phytomyza gymnostoma*, *Megachile sp.*, *Apis florae*, *Chrysoperla carnea*, *Bombax morae*, *Coccinella septempunctata*, *Menochilus sexmaculatus*, *Eri Euxoaauxiliaris* and *stalis sp.* belonging to different insect orders like Coleoptera, Diptera, Lepidoptera, Homoptera, Neuroptera, Hymenoptera, Hemiptera, Orthoptera, Thysanoptera, Isoptera, and Trombidiformes were recorded on mix cropping of chilli and onion from October to December 2015. Insect ecology is the scientific study of how insects, individually or as a community, interact with the surrounding environment or ecosystem [11]. These insects, and others, are responsible for much of the process by which topsoil is created [12]. Many insects are considered pests by humans, insects commonly regarded as pests include those that are parasitic (*e.g.* lice, bed bugs), transmit diseases (mosquitoes, flies), damage structures (termites), or destroy agricultural goods (locusts, weevils) [13]. [14] Found 38 species of order lepidopterous insect from vegetables at Rajasthan. [15] Subjected that various insects and predators like dusky bug, leaf minor, thrips, cricket, aphids, cutworm, white fly, lady bird beetle, ant, big eyed bug, green lacewing, rove beetle and spiders were recorded in berseem agro ecosystem. Although for the better crop production beneficial insect play an important role as pollination, spreading of seeds from one to another place. This helps to spread the plants which increases plant diversity. This leads to better environment and increasing yield [16].

5. Conclusion

In this study twenty four arthropod species belonging to different orders were recorded on onion and chilli mix crop. Seventeen species were identified as pests while 6 and 3 species were predators and pollinators, respectively. The highest diversity was recorded in 2nd week of October on mix cropping. Diversity maximum was recorded in 3rd week of October on mix cropping. Species richness and evenness were highest in 1st weeks of December, respectively on mix cropping. The population of aphid, onion leaf minor, Thrips, mite, and cutworm appears non-significantly on alone and mix crop of onion and chilli.

6. Acknowledgment

We are Cordially to Professor Dr. Abdul Ghani Lanjar for his guidance during research work.

7. References

1. Govt of Pakistan. Economic Survey of Pakistan. Economic Advisor's Wing, Finance Div Islamabad, 2015.
2. Datta S, Jana JC. Genetic variability heritability and correlation in chili genotypes under terai zone of west Bangal. SAARC J Agric. 2010; 8(1):33-45.
3. Baghizadeh A, Baniasadi FGHS, Bonjar GRS, Sirchi H, Massumi M, Jorjandi PR et al. Biocontrol of *Botrytis allii* Munn the causal agent of neck rot, the post harvest disease in onion, by use of a new Iranian isolate of *Streptomyces.* Am. J. Agric. Biol. Sci. 2009; 4:72-78.
4. Hosmani MM. Intercropping Principles and Practices. Univ. Agric. Sci. Dharwad, 1990; 103-109.
5. Way MJ. Observation on cowpea insects at IITA Proceedings of 14th International Congress of Entomology. Canberra. Australia, 1972; 22-30:293.
6. De Deyn GB, Van der Putten WH. Linking above ground and below ground diversity. Trends in Ecology and Evolution, 2005; 20:625-633.
7. Erwin TL. Tropical forest canopies: the last biotic frontier. Bulletin of the Entomological Society of America, 1983; 29:14-19.
8. Wilson EO. The Diversity of Life. Harvard University Press, Cambridge, Massachusetts. 1992, 413.
9. Smith HA, Liburd OE. Intercropping, Crop diversity and Pest management. - Uiversity of Florida, IFAS Extension, ENY, 2015; 862:1-7. Available at: [www.edis.ifas.ufl.edu/in922].
10. Stork NE, McBroom, Gely J, Hamilton C. New approaches narrow global species estimates for beetles, insects, and terrestrial arthropods. P. Natl. Acad. Sci. USA, 2015; 112:7519 e 7523.
11. Schowalter TD. Insect ecology An Ecosystem approach, Academic press. 2006, 417.
12. Gullan PJ, Crantson PS. The insects and outline of entomology Willey, 2004, 483.
13. Bale JS, Van Lenteren JC, Bigler F. Biological control and sustainable food production. Philos. Trans R. Soc. Lond. B Biol. Sci, 2008-2015; 363:761-776.
14. Sharma G. Studies on Odonata and Lepidoptera fauna of foothills of Aravali range Rajasthan Zoological Survey of India, 2011, 104.
15. Wagan TA, Hua H, Wagan ZH. Insects pests and natural enemies associated with Berseem (*Trifolium alexandrinum L.*) in Cotton Field. Journal of Biology Agriculture and Healthcare, 2015; 5(3):129-133.
16. Wilson EO. The Diversity of Life. Harvard University Press, Cambridge, Massachusetts. 1994, 413.