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DIVERSITY AND ABUNDANCE OF ANIMALS IN WHEAT CROPS

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Abstract
Spiders are the most excellent biomarkers and biological control agents worldwide. Spiders have been comprehensively studied in wheat systems, enlightening vast diversity in the nature surroundings. This study was conducted to explore the spider diversity and profusion in wheat crops. In this study, 14 species comprising of 5 families and 8 genera were collected from wheat crop. Sampling was made after the interval of 7 days followed by methods like hand picking, sweep net and pitfall traps. Identification was be made by administrating specimens via proper taxonomical keys. The multiplicity and plenty was examined via suitable statistical analysis. Maximum numbers of spider's species was recorded in the samples of February and March and the least number of species in the December and January in the wheat field. From Pitfall trap method, 14 families, 8 genera and 1075 individuals were recorded. From sweep net method, 5 families, 7 genera and 13 species were recorded. From hand picking method, 6 families, 10 genera and 13 species were recorded. In this study, three species were found to be dominant as compared to others. The most dominant species by using pitfall trap, hand picking, plant shaking methods and sweep net were C.lyoni, C.maya and P. medius.

1. Introduction

Wheat (Tritium aestivum L.) is the most valuable cereal crops all around the world. Wheat is grown on area of 8355 thousand hectares in Pakistan with annual production of 18694 thousand tons, creating an average vintage of 2238 kg hectares which is very little as associated to several other wheat generating states such as 2907 and 3667, 2578 kg per hectare in USA, China and India respectively (Ali et al.,2022). Increasing the worldwide demand for wheat is built on its capacity to form distinctive food ingredients remained a challenge which may overcome through increasing the crop varieties through genetic approaches (Ramzan et al., 2020).

Wheat is rich source of starch and other various constituents especially protein, nutrients (particularly B nutrients), dietary fiber and phytochemicals. Gluten protein in wheat is used for making bread, noodles and pasta including bread, crumpets, muffins, noodles, pasta, biscuits, cakes, pastries, cereal bars, sweet and savoury snack foods, crackers, crisp-breads, sauces and confectionery (Bhojani and Bhatt, 2020). These items might be more appropriate to yield or devour than antiquated nourishments, and structure proportion of western way of life (Rawal et al. 2022).

Wheat is the major crop growing in Pakistan under different kinds of agricultural systems. Insects which feed on plants resulted in severe harm to cultivated crops such as fruit trees, root vegetable, gorgeous and harsh plants (Panhwar et al., 2019). Excessive usage of the insecticides for killing of insects in the agro-ecosystems of Pakistan has increased damaged the overall yield of crops. Spiders are playing an important role as pest control agent and help to prevent the attack of different insects in the crops (Mousa et al. 2019). Spiders are found in virtually all identified biotas, including agricultural ecosystems such as rice, cotton and wheat. Maximum spider species are established in crops in summer and their abundance is high in the fields of agriculture and popular ecosystems (Ahmed et al., 2022).

Spiders are well known and typically valued arthropods and categorized to the class Arachnid, orders Araneae (Kanyile et al., 2022). They have seventh number of creature throughout the world comprising round about 3873 genera, 113 families, fewer than 43,700 species. They are most basic and fruitful invertebrate; exist in all type of habitats widespread (Slazak et al., 2022). Dispersal, variety and insect feeding activities of spiders show importance in the stability of nature. Spiders show a major role in controlling of insect populations in many situations. They play a vital role in keeping and adjustable insect populations in farming field. They mostly feed on insects and display an extensive change of lifestyle and searching plans (Gonzalez et al., 1994).

The aims and objectives of this study to explore the spider diversity and profusion in wheat crops followed by methods like hand picking, sweep net and pitfall traps.

2. MATERIALS AND METHODS

2.1 Study Design and Sample Collection

Current study was considered at (ERA) Entomological research Area University of Agricultural, Faisalabad (31.4303° N, 73.0672° E with an elevation of 184.4 m) Punjab, Pakistan. An area of 2 canals was selected for experiment where wheat crop was sown according to the recommended agronomic practices. The experimental field was kept free from the pesticide's application practices. In the experimental plot, recommended plant protection practices were applied according to the pest situation. The sampling of spiders was done by following methods.

2.1 Pitfall method

Spiders were collected followed by Pitfall trap method. For this purpose, spiders were trapped into a plastic jar filled with 150 ml of 70% ethyl alcohol. A total of 15 pitfalls were installed in the diagonal pattern started from margin of the field. The traps were buried in soil with open flushing into the soil surface. Collected specimens were kept into the glass bottles. The spiders were collected followed by interval of interval of 7 day and was brought in to the laboratory for counting, sorting and identification (Sheikh et al., 2018).

2.2 Sweep net

The sampling of flying and canopy dwelling spiders was carried out by sweep net with size of 37.5cm in diameter. Sweeping was performed for atleast five minutes during each sampling and five samples were randomly collected from each plot (Kulkarni et al., 2019).

2.3 Plant inspection/hand picking

For plant inspection, 10 plants were selected irregularly from each plot to inspect the diversity of visually observable spider. Cotton swab was used for collection of specimens into vial by hand picking method. These specimens were brought to the biological controlled laboratory for the identification with the aid of available taxonomic literature (Zhu and Beroza, 2019).

2.4 Identification of specimens

The specimens that were collected from our study were brought into laboratory for identification. Specimens were kept into the small jars with 70% ethanol and shifted to the laboratory for classification and examination of spiders. Sexually mature spiders were acknowledged with the help of the keys and presented taxonomic literature to possible species level.

2.5 Data analysis:

The data was analyzed by the analysis of variance (ANOVA). Mean comparison was performed with the help of tukey's HSD test.

Results

Fig 1 shows that number of spider gradually increase from December 2019 to march 2020 as the wheat crop grow in size. Table 1 demonstrates that number of spider collected by pitfall method showed a great diversity. Among them, most abundant species collected were perdosa sumatrana(106 individuals were collected). The second abundant species collected by pitfall method was P. songosa (103 individuals were collected). P.mysorensis were least abundant species collected by pitfall method.

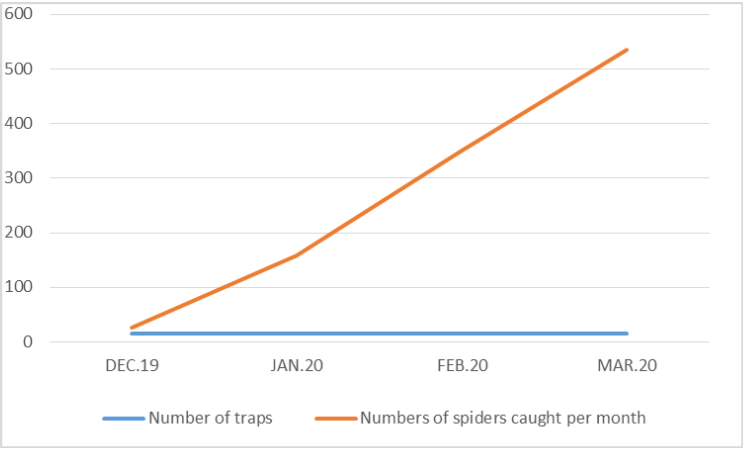

Fig. 1- Average number of spiders captured per trap per month in the wheat field by pitfall method

Table.1- Numbers of spiders (adult + immature) belonging to species recorded in different months from wheat field by pitfall method

Species	December	January	February	March	Total
P. sumatrana	2	19	32	53	106
p. birmanica	3	12	28	39	82
P. oakleyi	3	18	28	39	88
P. songosa	-	5	26	72	103
E.sohani	-	15	24	30	69
L.gobiaensis	-	8	17	39	64
P.mysorensis	-	9	16	28	53
C.tikaderi	-	10	27	32	69
C. charleneae	-	2	25	29	56
R .indica	-	11	22	40	73
M. marapha	1	13	22	38	74
T. pugilis	3	14	26	32	75
C. lyoni	4	18	30	33	85

Fig 2 shows that number of spider gradually increase from December 2019 to march 2020 as the wheat crop grow in size. Table 2 shows that Number of spider collected by handpicking method showed a great diversity. Among them, most abundant species collected was perdosa medius (109 individuals were collected). The second abundant species collected by handpicking method was Cupa kalawitana (102 individuals were collected). C. florae were least abundant species collected by handpicking method.

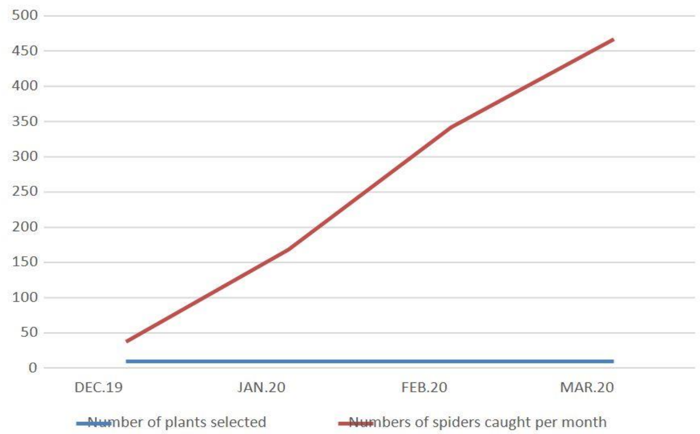

Fig.2- Average number of spiders captured per trap per month in the wheat field by hand picking method.

Table 2- Number of spiders (adult + immature) belonging to species recorded in different months from wheat field by hand picking method.

Species	December	January	February	March	Total
P. medius	3	26	44	36	109
p. sumatrana	3	12	26	37	78
P. oakleyi	-	9	20	36	65
p. birmanica	1	10	20	40	71
C. maya	-	9	20	26	55
C. tikaderi	2	12	23	38	75
C. kalawitana	1	14	39	48	102
C. florae	1	3	14	23	41
P. petersi	-	13	36	40	89
M. orientales.	7	14	29	25	75
P. bengalienasis	6	13	22	33	74
H. partita	6	15	27	42	90
E. banarensis	8	19	23	44	94

Fig 3 shows that number of spider gradually increase from December 2019 to February 2020 as the wheat crop grow in size. There was a significant decrease in number of spider from February 2020 to march 2020. Table 3 shows that Number of spider collected by plant shaking method showed a great diversity. Among them the most abundant species collected was Cupa kalawitana (77 individuals were collected). The second abundant species collected by plant shaking method was Perdosa medius(76 individuals were collected). P. birmanica were least abundant species collected by plant shaking method.

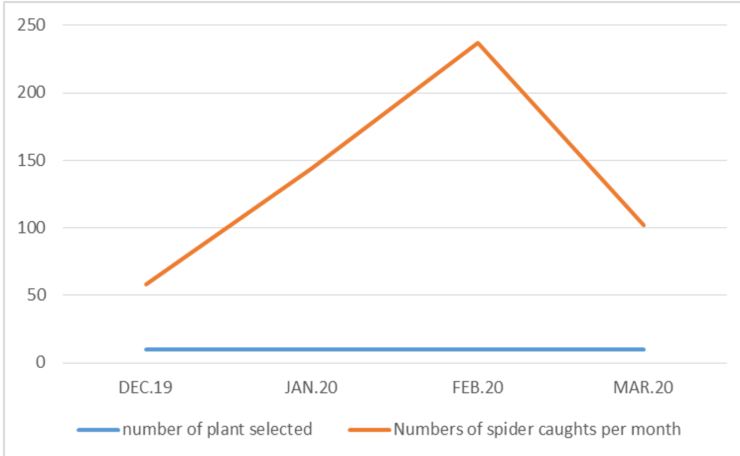

Fig. 3- Average number of spiders captured per plant per month in the wheat field by plant shaking method

Table 3- Numbers of spiders (adult + immature) belonging to species recorded in different months from wheat field by plant shaking method

Species	December	January	February	March	Total
C. kalawitana	3	12	28	34	77
T. elongates	3	6	14	40	63
T. bulani	2	10	11	31	54
P. Songosa	4	13	9	14	40
P. medius	2	12	17	46	76
P. birmanica	5	7	13	11	36
E. sohani	3	4	15	24	46
C. maya	2	13	18	23	56
C .tikaderi	4	11	14	23	52
C. himalayensis	6	14	25	28	73
G. poonaensis	7	13	30	33	83
G. ghafooei.	8	15	28	32	83
C. rukminiae	8	14	15	26	63

3. DISCUSSION

A study by Butt and Khan (2019) reported that spiders considered the most vital biomarkers and biological control agents worldwide. In an ecosystem, spiders are very tolerant to high temperature and play an important role both as predator and prey. The information about their diversity and population abundance reflected great significance for the biological management. Wheat is one of the worlds, most important crops which provide basic food for about half of world's population. Mendez et al. (2017) investigated that pitfall trap appeared as the utmost, cheap and easy method which could be used for sampling. Our findings are agreed with the previous studies. With number of replications and using same pitfall methodology, we compared various regions and the abundance of some species varies with time.

Our findings are correlated with the previous studies. Upadhya et al. (2018) conducted a study on wheat crops with diversity of spiders abundance. They identified that 28 species of spiders comprised of 17 genera having 14 families. The most common families observed in the wheat crops were Araneidae (24%), Tetragnathidae (30%), Salticidae(13%) Clubionidae(9%), Oxyopidae and Thomisidae(6%), Lycosidae(5%), Dictynidae, Arctiidae (3%), Uloborida, Naphosidae (2%), Gnaphosidae, Sparassidae and Theridiidae(1%). Another study conducted by Mendez et al., (2017) reported the 380 spider species were belonged to the genus Neoscona. They used hand picking method and 380 spiders were captured. The spiders were taken from 64 altered plants in which 33 males, 203 individuals were females and 144 individuals were immature. Our findings are agreed with the previous studies.

Another study reported the diversity and ecology of spider (Arachnidae-Arenrae) from Deossipleatue north, Pakistan, in which 1326 spiders belonged to 17 families'25 genera and 29 species were reported with by pitfall and handpicking methods. Mullen and Vetter (2019) investigated the role of spider population in crops of northern-temperate zone in Faridabad. Most of the spiders which were observed were linyphiid which are predators of aphids. Nayone and Vallino (2019) found that numerous numbers of spiders were found in the sheet webs during experiment. Among them, some are Lycosidae, Thomisidae, Clubionidae, Salticidae and Oxyopidae. Their diet was usually consisting of lepidopteran and heteropteran in most regions.

Tanasevitch (2019) investigated that fauna of spiders were common in common in wheat crop of Faisalbad, Pakistan. About 223 species of spiders were observed and captured that were belonged to 11 genera and 7 different families. Spiders from the Lycosidae family were present in large number and least collection was from the Oxipidae family. Marpissa, Lycosa and Pardosa were most dominating genus in that area. Kazim et al., (2015) conducted a study on spiders and reported that maximum number of collections was in June and minimum were collected in October with relative humidity of 59% and 19.2mm average rainfall. Diversity of spiders differs in months and mainly depends on the environmental factors like humidity, temperature, and rainfall.

Maqsood et al. (2016) reported another study that spiders were collected from the different fruit gardens from various localities like Samundri, Jaranwala, Tandlianwala and Faisalabad, Pakistan and belonged to 6 families and 33 species. From these, 1054 species were captured form 6 families. From these, Lycosidae was more ample than others. While, Clubionidae was less in number. Ranasinghe and Benjamin (2018) conducted a similar study and reported maximum fluctuations in the population were observed in September and in the month of October and there were minimum fluctuations observed in June, November and December. It was conclude that spiders diversity have been comprehensively studied in wheat systems, enlightening vast diversity in the associated structure of spiders in the surroundings. Spiders play a significant role to control the insect population in wheat field of ecosystem. They consume various types of prey and do not damage the wheat field.

4. Conclusion

In this study, we investigated the difference in population and diversity of spider fauna in the wheat field by pitfall trap, sweep net method, hand picking methods. The data obtained from different months were compared to find the difference in population and diversity of spider fauna. Sampling was made after the interval of 7 days four methods viz hand picking, shaking the plant, sweep net and pitfall traps. The most dominant species by using pitfall trap, hand picking, plant shaking methods and sweep net were C.lyoni, C.maya and P. medius.

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