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DIVERSITY AND ABUNDANCE OF FAMILY APHIDIDAE FROM SELECTED CROPS OF FAISALABAD, PAKISTAN

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Meaningful diversity measures are necessary to increase awareness on the issue of biodiversity. Specific study of various communities present within the agro-ecosystem is necessary for its management. Aphids act as one of the major pest of crops. Present study was conducted to determine the species diversity and abundance of aphids in cropland of Faisalabad for a period of one year. A total of nine species of aphids were recorded. *Brevicoryne brassicae* was one of abundant species 30% followed by *Myzus persicae* (28%) *Schizaphis graminum* (11%) *Rhopalosiphum padi* (10%) *Rhopalosiphum maidis* (9%) and *Lipaphis erysimi* (8%). Highest diversity of aphids was observed in winter with 65%. The impact of environmental factor on abundance and diversity was determined by canonical correspondence analysis. The presented data base will be helpful in ecological pest management strategies of aphids.
Key words: Biodiversity, aphids, crops, Faisalabad, *Brevicoryne brassicae*.

INTRODUCTION

In an agro ecosystem, efficient use of better resource allows greater diversity. For heterogeneity of habitat there are certain system-level adaptations, as overlap in species niches, niches as diversification, resources partitioning, all of these lead towards complementarity in crop species need (Altieri, 2004; Gliessman, 1998).

In agro-ecology insect is considered as pest when it cause damage and start to reduce the yield of crop or poor quality product (Dent, 2000). Most of aphid species feed on one plant species or are monophagous. Some other aphid species, as Green peach aphid *Myzus persicae*, which can feed on hundreds of plant species, passively feed on sap of phloem vessels in plants. Memerbers of order hemiptera as cicades and scale insects also feed on phloem vessel's sap in similar pattern. As the vessels punctured, the sap in vessels is moved towards aphid food canal forcefully by pressure exerted on it (Malone *et al*., 1999). Longevity of injury in Brassica caused by aphids, affects by the favorable conditions and finally cause yield reduction in crops (Chattopadhyay *et al*., 2005).

Aphids are reported as pest in various crops, found to be causing 10-90% reduction in crop yield. Reduction bases on different crop stages as well as severity of attack (Rana, 2005). In different *Brassica* oilseed, yield losses exceed 70-80% due to severity of infestation of aphid and sporadic attack through them, even no grain formation occurred (Khattak *et al*., 2002). In Pakistan second most important source of edible oil is mustard and rapseed. After cotton, these are traditional oilseed crops where 70% requirement of the edible oil currently meets by itself from country; remaining requirement is fulfilled by import (Rehman *et al*., 1987; Govt. of Pakistan, 2010). One of the important pests of mustard, *Lipaphis erysimi* also affects the potential productivity in India reported by Patel *et al.* (2004).

Wheat is major crop plays important role in stability of Pakistan (Anwar *et al*., 2009). Stay of aphid population on Wheat is for short time period during which rapid multiplication of aphid occurs (Jarosik *et al.* 2003). Future wheat crop in Pakistan is in threat due to aphid infestation and its becoming a serious problem for them (Wains *et al.* 2010). Aphid infestation is major cause of reduction in yield of Vegetables, sometime in indirect way by the transmission of viruses (Capinera, 2002).

Potential crop yield is decreasing every year due to many biotic and abiotic stress factors, one of them is the damage caused by the pests of agricultural crops. Literature has been reported from NWFP (now KPK), Multan (Razaq *at al*., 2011) and its related areas but no detailed study has been reported from Faisalabad, Pakistan. Present study was carried out to determine the diversity and abundance of various species of aphids from cropland of Faisalabad. It's an important step for their control in crop system, should be follow by their control measures.

MATERIAL AND METHOD

***Study area*:** Geographically Faisalabad is located in central Punjab, Pakistan, between latitude 30˚31.5˚ north, longitude 73˚74 towards east, 184.4 meters above sea level with a maximum average temperature of 50°C during summer and minimum average temperature -1°C. The average rainfall recorded during 2010-11 was 400 mm. Maximum rainfall

was recorded during the months of July and August. The environmental and climatic conditions make the soil suitable for cultivation of both Rabi and Kharif crops.

***Sampling method*:** A preliminary survey was conducted to locate the required fields. Different localities were selected for sampling at a distance of 15-30Km distant away from the University campus. Aphids are the host specific pests and the crops sampled were Brassica, Wheat, Fodder, and vegetables fields. From the aerial portion of plants only adult aphids were collected from their colonies. .

An area of 2.5 hectares was selected from each locality, and randomly two fields of seasonal crops were sampled for the collection of specimens. Quadrate method was used for collection of data (Ruby, 2010). Four quadrates, one from each crop were selected. Two samplings were conducted in each month, and a total of 24 samplings were conducted throughout the year on fortnight bases.

Aphids were sampled by direct hand picking method and were collected from the leaf with the help of very fine forceps. Specimens were dislodged from the leaves with staining brush. Jarring method was also used for aphid collection. Specimens were preserved in covered glass viols with preservatives (70% alcohol and few drops of glycerin) and brought to Vertebrate Pest Control Lab. Samples were identified by taxonomic keys provided by (Blackman and Easton, 2000), "Aphids on the world's crops" and "Aphids on the world's herbaceous plants and shrubs" (2006), taxonomic characteristics reported by (Nasir and Yousuf, 1995; Liu and spark, 2003). Per-quadrate number of aphids was calculated by dividing the number of aphids collected from each crop to the number of quadrates sampled during whole sampling period from each crop.

***Statistical analysis*:** Data was analyzed statistically to determine species diversity, richness and evenness with Shannon-Weiner diversity Index (H') (Magurran, 1988). Difference among crops and with respect to time period was taken by comparing the data through t-test. Cluster analysis was applied to investigate the habitat preference of aphids on selected crops (Inayat *et al.,* 2010). Effect of meteorological data on their diversity and abundance was determined by Canonical correspondence analysis (CCA).

RESULTS AND DISCUSSION

A total of 12320 specimen was sampled during the whole study period. Nine species of aphids belonged to eight different genera were sampled from the selected crops of Brassica, Wheat, Vegetables and Fodder. Maximum number of aphids were sampled from *Brassica* (8463) followed by Wheat (1723) Vegetables (1606) and Fodder (528) numbers of specimens.

Distribution in crops:

In brassica out of total six aphid species, the *Myzus persicae* was found abundant with 2879 number of specimens covered (34%) of total number in brassica. *Brevicoryne brassicae* was the second abundant species with number 2412, (33%) of total species. The increasing trend in the population was observed from mid-February to March. Ahmad and Aslam, 2005 reported the abundance of same species in mustard crops in Multan region. Total 21% of *Rhopalosiphum genus* was sampled from brassica crop with its two species. Genus *Rhopalosiphum* was abundant with two species *Rhopalosiphum padi* and *R. maidis,* former was most abundant. Similar estimation about the presence of *genus Rhopalosiphum* in brassica was also documented by (Mubeen, 2009).

Wheat was second infested crop from aphids. A total of 1723 specimens were sampled throughout sampling Season. *S. graminum* was abundant with 51% of total number. *Aphis nerii* was restricted to winter season with (5%) of total samples. Results of aphid abundance in Wheat are in line with results of (Weins *et al.,* 2010) investigated abundance in March.

Vegetables were infested by eight aphid species. Two species *M. persicae* and *B. brassicae* combine to form the (56%) specimens were found abundantly in vegetables. *R. maidis* and *R. padi,* respectively were recorded more in the months of February and March. Abundance of aphid species in vegetables according to our results coincide with Aheer *et al*. (2008) who reported that these pest species significantly affect the yield of various crops of fruits and vegetables. Six aphid species were sampled from fodder crops. *R. maidis* was highly abundant spp. with 42% specimens from fodder crops (Fig.1).

***Cluster analysis*:** presented the habitat preference of different species on selected crops (Fig.2). Aphids are found to be host-plant specific. Present study showed the highest aphid infestation on Brassica crop, followed by Wheat and relatively less on other crops.

***Shannon diversity index*:** Difference among the diversity of crops was measured by it. Table 2 presented the diversity indices of aphids among selected crops. Accordingly, diversity of aphids was significantly different among all selected crops except when compared fodder and wheat. Highest diversity was observed in vegetable (H'= 1.56) followed by brassica 1.51 fodder 1.41 and 1.37 for wheat.

Seasonal variation in abundance of aphids in cropland:

Table 1 shows relative abundance of aphid species in all the four seasons of the year. Maximum infestation was recorded in winter with 65.15% specimens, while in spring 29.1% specimens were captured. The remaining 5.63% and 0.12% specimens were collected in fall and summer respectively. The most dominant species *M. persicae* (30.3%) was found in all the four seasons. The other dominant species *B. brassicae* (27.5%) was restricted to three seasons being absent in summer. *S. graminum* (abundant in wheat crop) was also present round the four seasons. Both the species *M. persicae* and *S. graminum* were present only with seven and

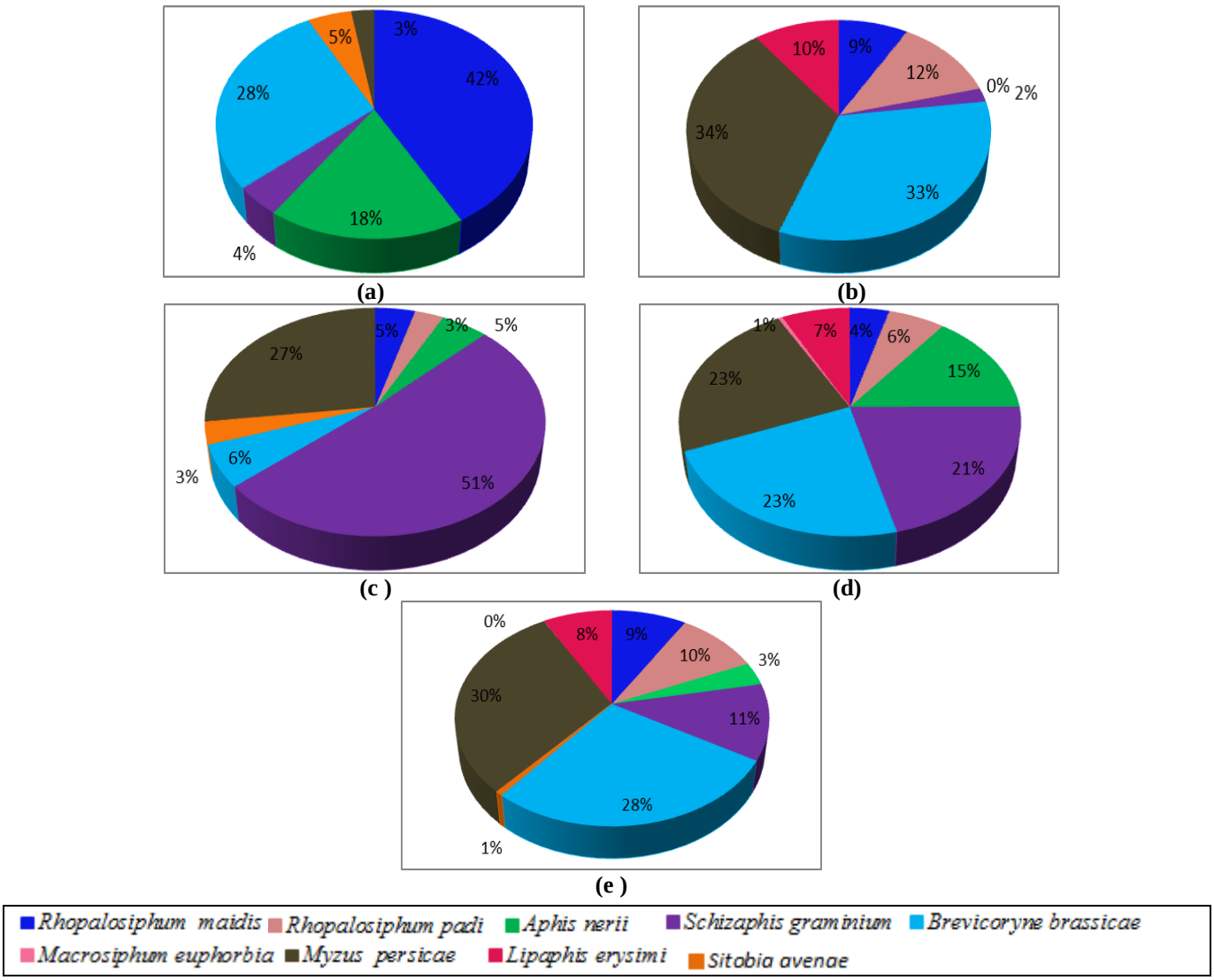

Figure 1. Graphs showing percentage relative abundance of aphids in fodder, brassica, wheat, vegetables and overall in four Crops (a, b, c, d and e).

Table 1. Shannon Diversity Index of four crops (brassica, wheat, vegetables and fodder) of Faisalabad.

Type (Aphids)	N1◦	H/1	E1	N2◦	H/2	E2	T-test	df	P-value
Fodder/Brassica	528	1.410	0.7869	8463	1.519	0.7806	2.815	>120	>0.001**
Fodder/Wheat	528	1.410	0.7869	1723	1.373	0.7056	2.084	>120	>0.01*
Fodder/Vegetables	528	1.410	0.7869	1440	1.569	0.8757	2.814	>120	>0.001**
Brassica/Wheat	8463	1.519	0.7806	1723	1.373	0.7056	4.884	>120	0.376ns
Brassica/Vegetables	8463	1.519	0.7806	1440	1.569	0.8757	0.225	>120	0.8220ns
Wheat/Vegetables	1723	1.373	0.7056	1440	1.569	0.8757	6.443	>120	<0.0001***

H/ = Diversity; E= Evenness. N°=Number of specimens. (*P*-Value for factors are given as (p>0.05: ns, p<0.05: *, p<0.01: **, p<0.001: ***)

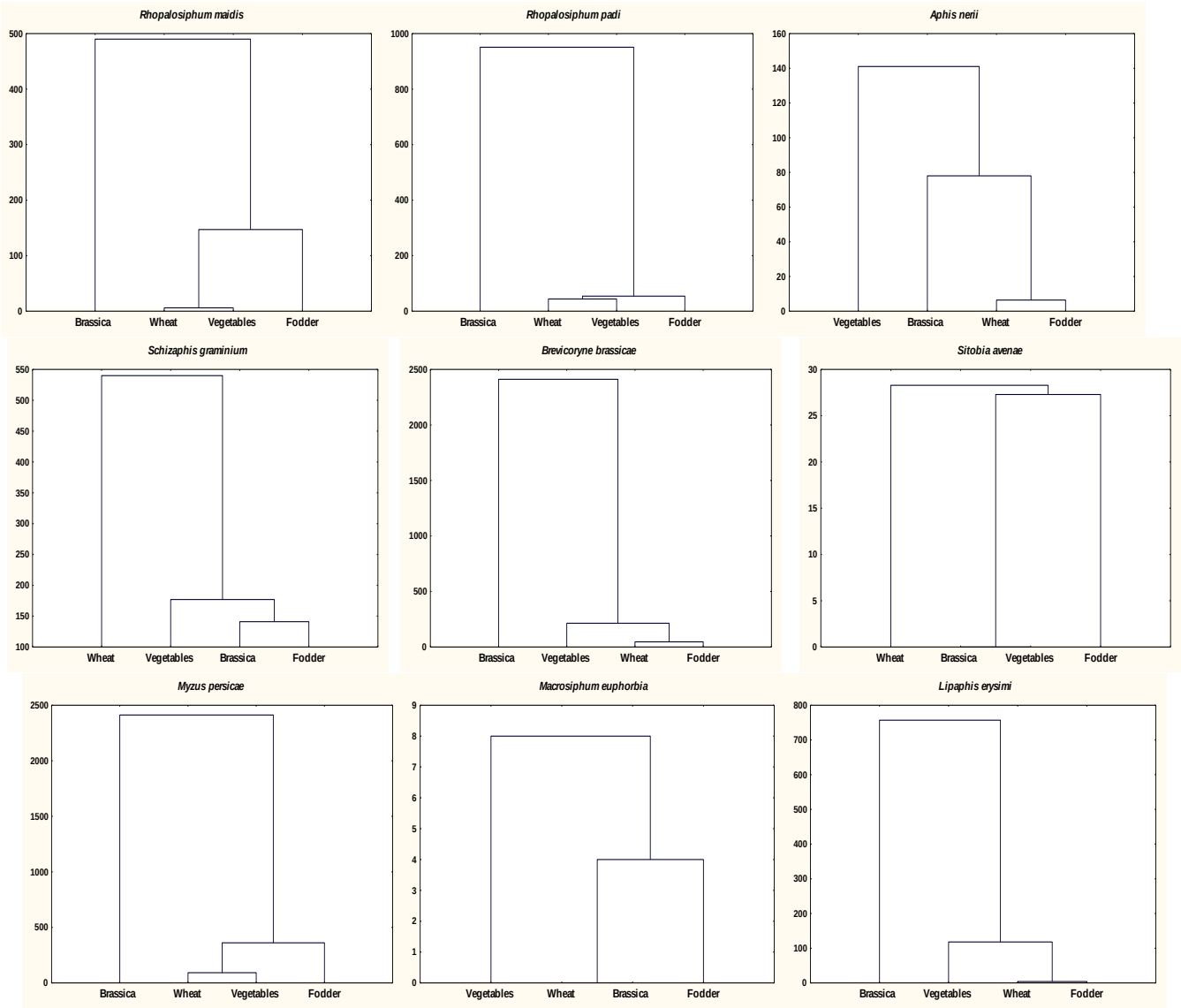

Figure 2. Cluster Analysis (CA) based on Euclidean distance showing Preference of aphid species with selected crops (Fodder, Brassica, Wheat and Vegetables) of Faisalabad. X-axis=Selected crops; Y-axis= Abundance of aphid species.

Table 2. Temporal percent relative abundance of aphid species

	% Relative Abundance				
Aphids	**Summer**	**Autumn**	**Winter**	**Spring**	**Total**
Rhopalosiphum maidis	-	41.10 (285)	8.51 (683)	2.96 (106)	8.72 (1074)
Rhopalosiphum padi	-	3.61 (25)	6.69 (537)	17.80 (639)	9.75 (1201)
Aphis nerii	-	10.80 (75)	3.92 (315)	1.09 (39)	3.48 (429)
Schizaphis graminium	53.3 (8)	18.20 (126)	10.30 (830)	12.30 (441)	11.40 (1405)
Brevicoryne brassicae	-	18.80 (130)	37.40 (3006)	7.17 (257)	27.50 (3393)
Sitobia avenae	-	-	-	2.29 (82)	0.67 (82)
Myzus persicae	46.7 (7)	5.05(35)	24.40 (1955)	48.50 (1738)	30.30 (3735)
Macrosiphum euphorbia	-	-	-	0.22 (8)	0.06 (8)
Lipaphis erysimi	-	2.45 (17)	8.73 (701)	7.67 (275)	8.06 (993)
Total	0.12 (15)	5.63 (693)	65.15 (8027)	29.10 (3585)	100 (12320)

*Column shows % Relative abundance of different aphid species in same season; **Row shows % Relative abundance of same species in four seasons

eight specimens in summer respectively. It was only spring when all the aphid species showed their presence. Our results investigated the abundant population of aphid species was determined in winter season especially in February and March from cropland of Faisalabad, and our results are quite in line with (Aslam *et al*., 2005; Aslam, 2002; Aheer *et al*., 2007: Biwas and Das, 2000). Aslam, (2002) reported peak populations of aphid in March from Multan, Pakistan.

***Shannon diversity index*:** Data was subjected to statistical analysis to check the difference in diversity among four seasons. Significant differences were recorded when all the seasons were compared, except winter and autumn, which showed non-significant differences (Table 3).

***Canonical correspondence analysis*:** Figure 3 shows the Canonical correspondence analysis depicting total of 45% variation in the impact of environmental factors as Temperature, Relative humidity, Rain fall and Wind speed on aphid species. Two species *B. brassicae* and *L. erysimi* showed positive association with rainfall, while *M. persicae* showed positive association with temperature. Findings of (Aslam *et al*., 2005; Aheer *et al*., 2008) that, fluctuation in temperature starts to enhance their population was in accordance to above mentioned results. Declined Rh% improves helpful in the process of population growth. (Srivastava *et al*., 1995) concludes about positive effect of rainfall and increased temperature causes reduction in abundance of aphid population. (Weins *et al.*, 2010) reported negative correlation of rainfall with aphid population in 2005 in Wheat. Reason may be the continuous change in climatic conditions.

***Per-quadrate number*:** of aphids was shown by Table 4. It presented the extent of aphid infestation in selected crops. The mean per-quadrate number was 2.26. From total highest per-quadrate number was calculated for brassica 66.1 followed by wheat 46.1, vegetable 8.36 and least for fodder 2.75. Per-quadrate number of *Myzus persicae* was 7.5 specimens, *S. graminum* 5.0 *R. padi* 2.1 and *R. maidis1*.9, while *M. euphorbia* was represented only in vegetable with 0.013 per- quadrate number.

Table 3. Shannon Diversity Index on temporal distribution of aphids

Type (Aphids)	N1◦	H/1	E1	N2◦	H/2	E2	T-test	df	P-value
Summer/Autumn	15	15	21.6404	285	1.709	0.9538	3.432	<120	>0.001**
Summer/Winter	15	15	21.6404	8024	1.677	0.8618	3.44	<120	>0.001**
Summer/Spring	15	15	21.6404	3585	1.555	0.7077	3.472	>120	>0.001**
Autumn/Winter	285	1.709	0.9538	8024	1.677	0.8618	0.894	>120	0.372ns
Autumn/Spring	285	1.709	0.9538	3585	1.555	0.7077	4.017	>120	<0.0001
Winter/Spring	8024	1.677	0.8618	3585	1.555	0.7077	6.929	>120	<0.0001***

H' = Diversity; E= Evenness, N°=Number of specimens. (*P*-Value for factors are given as (p>0.05: ns, p<0.05: *, p<0.01: **, p<0.001: ***)

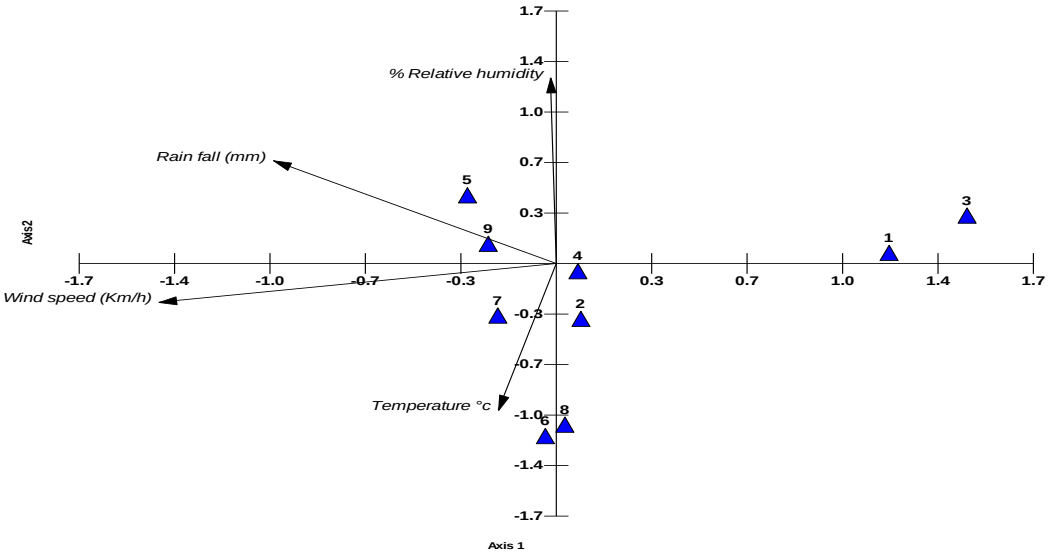

Figure 3. Canonical Correspondence Analysis (CCA) showing the effect of meteorological factors on distribution of aphid species in cropland of Faisalabad. 1. *R. maidis* 2. *R. padi* 3.*A. nerii* 4. *S. graminum* 5. *B. brassicae* 6.*S. avenae* 7. *M. persicae* 8. *M. euphorbia.* 9. *L. erysimi*

Table 4. Total per-quadrate number of different aphid species from selected crops (Brassica, wheat, vegetables and fodder)

Species	Brassica	Wheat	Vegetables	Fodder	Total
Rhopalosiphum maidis	5.55	1.98	0.35	1.15	1.958
Rhopalosiphum padi	8.20	1.45	0.51	-	2.098
Macrosiphum euphorbia	-		0.04	-	0.013
Aphis nerii	0.09	2.38	1.22	0.48	0.973
Schizaphis graminum	1.27	23.57	1.77	0.11	5.072
Myzus persicae	22.5	12.51	1.95	0.07	7.482
Brevicoryne brassicae	21.7	2.79	1.90	0.78	5.771
Lipaphis erysimi	6.84	0	0.61	-	1.591
Sitobia avenae	-	1.47	-	0.14	0.308
Total	66.1	46.15	8.36	2.75	25.266

***Conclusions*:** *Brevicoryne brassicae* was the most abundant aphid species. Other abundant aphid species were *Myzus persicae* from vegetables *Brevicoryne brassicae* from *Brassica*, *Schizaphis graminum* from wheat and *Rhopalosiphum maidis* from fodder crops respectively. From February to March aphid population was recorded in increasing trend. Relatively less temperature and slight rainfall positively affect their population growth. This estimation of diversity and abundance of aphids is a basic step to control them in proper time period. Losses of crop yield caused by aphids can be reduced by enhancing the presence of natural enemies and other control measures.

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