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Preferential influence of wheat varieties (*Triticum aestivum L.*) on population build-up of aphid (Homoptera: Aphididae) and its natural enemies

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Abstract

Six wheat varieties were screened under Bahawalpur conditions for infestation of aphid species complex during 2014-15. Infestation of aphid population and their natural enemies were recorded during February-April 2015. Lowest population of aphid (0.13 aphids/tiller) was recorded on 6309-2013 during 3rd week of April whereas highest population (39.97 aphids/tiller) was harbored on Shafaq-2006 at 1st week of March. A close association between the population of natural enemies and aphid was recorded. Natural enemies (ladybird beetle and syrphid fly) showed negative but non-significant correlation (-0.0078, -0.0081) respectively. No population of lacewing was observed throughout the experiment.

Keywords: Population dynamics, wheat aphid, natural enemies, climatic factors

1. Introduction

Wheat, (*Triticum aestivum L.*) is the most important staple crop of Pakistan and cultivated on almost every part of the country. Economically, it is contributing 10.3% to the agriculture and 2.2% to Gross Domestic Production (GDP) in Pakistan [1]. During 2013-14, area under wheat cultivation was 9039 thousand hectares with an average production of 2797 kg/ha [1]. Wheat is an important source of protein, minerals, starch, lipids, fibers, vitamin B and vitamin E [2]. It contains protein, fats, carbohydrates, dietary fiber and iron, starch which serve as an important commercial product of wheat, after gluten [3].

Wheat crop is under threat of many environmental stresses, diseases and insect pests which causes significant yield loses [4]. Among different threats to wheat production, aphids stand as prominent insect pest. Its infestation cause rolling of flag leaf, trapping of emerging heads and awns that result in poor pollination [5]. Aphid outbreak during early growing stages of wheat is very alarming. It damages the crop by sucking the cell sap from leaves, stem and kernels. Honey dew secreted by the aphid encourages black sooty mould development that leads to 20-80% damage by covering the leaves and interrupted the process of photosynthesis [6]. For past few years, there has been an increased buildup of aphid on wheat crop which is challenging sustainable wheat production in Pakistan [7]. Three species of aphids viz., oat aphid (*Rhopalosiphum padi*), English grain aphid (*Sitobion avenae*) and Green bug aphid (*Diuraphis noxia M.*) were reported on wheat crop in Pakistan [8]. Under such condition, the role of environmental factors and natural enemies like Lady bird beetle (*Menoclitus sex maulatus*), Syrphid fly (*Syrpus balteatus*), Chrysopa (*Chrysoperla carnea*) can be helpful for the control the aphid population [9].

Wheat which was once an insecticides application free crop but there is an increasing trend of insecticides use. The application of insecticides is associated with negative impacts on human health, environmental pollution [10, 11] and prolonged persistence of chemicals in nature [12]. Under natural conditions, many bio-control agents such as lady bird beetle, lacewing and syrphid fly are controlling the aphids in the field. But the numbers of predators are very important and influenced by the fluctuation in the environmental factors. Therefore, it has become the need of time to provide conducive conditions that can help flourish natural enemies. Some wheat varieties naturally had a defence mechanism to resist the attack of aphids. It is therefore essential to screen the available options for wheat production in Pakistan [8]. In the present study, varietal screening was carried out to find out resistive response of targeted varieties against wheat aphid.

The findings could help farmers to align the wheat production with the changing conditions and demand of time.

2. Materials and Methods

2.1 Experimental design

Field study was carried out on wheat in Islamia University of Bahawalpur from December 2014 to April 2015. Line sowing method ($R \times R$ distance of 30 cm) was used for sowing six different wheat varieties IRRI-2008, Shafaq-2006, La-Sani-2008, 6309-2013, Fareed-2006 and Miraj-2008 under Randomized Complete Block Design (RCBD) with three replications. Entire field was divided into 18 subplots each of size 5×8 m. All recommended agronomic practices were applied uniformly in all treatments during the whole cropping season. 100% DAP (46% P_2O_5 and 18% Nitrogen) and 50% Urea (Nitrogen 46%) was applied at the time of sowing whereas remaining 50% of Urea was applied after second and third irrigation at the rate of (25%-25%).

2.2 Data recording

Population of aphid and its natural enemies were recorded in morning at 7:00 am on weekly basis from 15 randomly selected tillers in each subplot [9]. Population of beneficial insects was recorded by following the prescribed methodology of [13, 14]. The aphid population was counted by dislodging aphid on white paper from each selected tiller by using camel hair brush. After recording aphid population from all sub plots data was pooled for entire month and used to calculate population per month.

2.3 Statistical analysis

Data recorded for aphids and their natural enemies population were subjected to repeated measure analysis of variance in "Statistix v8.1" [15] and treatment significance was determined by least significant difference test (LST) ($\alpha = 0.05$) to separate the means [16].

3. Results and Discussion

3.1 Aphid populationon different wheat varieties

The population of aphids and their predators was investigated on different wheat varieties under field conditions. The aphid population was recorded during February-April 2015 under Multan ecological condition. Significant differences were recorded for aphid population on different varieties during February ($F=10.85$, $P=0.0009$), and March ($F=85.72$, $P=0.0000$) however non-significant response was recorded during April ($F=1.11$, $P=0.4156$) Table 1.

Aphid population on wheat crop was on track from 1st week of February to 3rd week of April. The most critical period when the aphid population was observed above the economic threshold level was started from 3rd week of February to 4th week of March which ultimately tend to decrease towards the maturity of crop as temperature started to rise. The maximum population of aphid was recorded during 1st week of March on Shafaq-2006 variety (39.97 aphids/tiller) while minimum population was recorded during 3rd week of April (0.13 aphids/tiller) on 6309-2013. Most vulnerable wheat variety was Shafaq-2006 while 6309-2013 was least attacked by aphid

during the whole cropping season (Fig 1A,B,C).

Aphid started to appear in the first week of February and reached at its peak at 1st week of March, 2015. This in agreement with Aheer *et al.* [17], who also reported the aphid appearance in first week of February and during third week of March aphid population was at peak. Our results are in contrast with those of [18] who observed that aphid population was at peak on February 28th and decline behavior was noticed up to 8th March. However, peak aphid population on 18 March while lowest population was on 21 April has been observed [19]. Results of [20] matched with that results and observed Aphid population which began to rise 16th March and population was increased on 31st of March. Aphid population was at peak during 1st week of March. These results are in partial confirmatory with the findings of [21], where Aphid population appeared on third week of January and on 2nd week of march population was at peak. But present results are in contrast with those of [22], who observed that aphid population/leaf, was maximum on 26th February. After the 2nd week of March population of aphid stated declining and completely diminished during last week of April. This declining behavior was partially similar with the observation of [21], who observed that on 6th April Aphid population was almost diminished on all wheat varieties. Population dynamics of aphids on wheat varieties in Bahawalpur region was studied which showed that varieties with high density of aphids exhibited lower thousand grains weight [22].

The present results show that varieties Shafaq-2006, La-sani-2008 and 6309-2013 are non-significantly different from each other. Whereas, Fareed-2006, IRRI-2008 and Miraj-2008 are significantly different from each other. Similar trend of varying resistance response between different wheat varieties is also documented in previous studies [17, 23, 24]. According to [20] maximum Aphids population was recorded on Inqilab-91, Lasani-08 and Punjab-11.

Most suitable condition for the development of aphid were 30.3 °C maximum temperature and minimum 13.7 temperatures with 45.3% relative humidity were recorded [25]. However, their values represent weekly means of temperature and relative humidity.

3.2 Correlation between Natural enemies and Aphid population

The results indicated negative but non-significant correlation between lady bird beetle, syrphid fly and lacewing. There was no population of lacewing (*Chrysoperla carnea*) during the whole duration of Feb-April 2015. Correlation of aphid population with syrphid fly (-0.0081) was comparatively high than lady bird beetle (-0.0078).

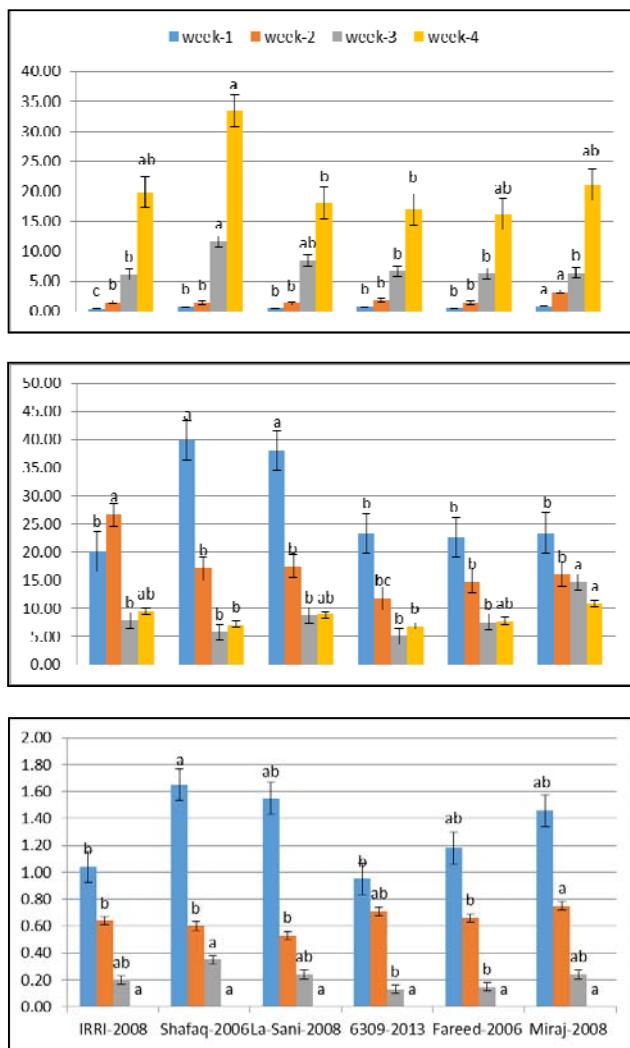
The present studies include that the biological control agents of aphids on wheat did not show any correlation between the aphids and their natural enemies. These results are in confirmatory with [26] who also found non-significant correlation between lady bird beetle and aphid populations on wheat. However, the work of [8] is different where the positive correlation of aphid with lady bird beetle, lacewing and syrphid fly was observed (Table 2).

Table 1: Analysis of variance for Aphid population recorded during 2014-15

Source of variance	df	February		March		April	
		F	P	F	P	F	P
Replication	2						
Varieties	5	10.85	0.00	85.72	0.00	1.11	0.41
Error	10						
Total	17						

Table 2: Correlation between Predators and Aphid population during 2014-15

Parameter	Aphid Population	Syrphid Fly	Lady Bird Beetle	Green Lacewing
R-value	0.401	-0.0081 ^{ns}	-0.0078 ^{ns}	No population observed
P-value	0.8746	0.9746	0.9756	

**Fig 1:** Mean aphid population recorded on wheat crop at Bahawalpur conditions during 2014-15 in February (A), March (B) and April (C)

4. Conclusions

According to our research wheat variety 6309-2013 was comparatively resistant among all others varieties with lowest Aphids population density. However, Shafaq-2006 was most susceptible to aphids. So, it is recommended that 6309-2013 is the best cultivar among all against aphid resistance and farmers were more vigilant during 2nd week of Feberuray 4th week of March to manage field their wheat crops and control aphid population in field after contineous field survey. It can be concluded that although aphid is an emrging pest of wheat, losses of which may surpass affordable level because of its high population, however plant characters can provide valuable share to manage it. Considering the importance of morphological features of wheat plant, this notorious insect pest can be cotrolled without using synthetic insecticides and any harm to environment.

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