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Estimation of yield losses in different wheat varieties due to aphid attack on different dates of sowing in Ecological Zone of Rahim Yar Khan

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Keywords

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Abstract

Wheat (*Triticum aestivum* L.) is a major cereal and staple food crop which plays the vital role in the economy of Pakistan. The present study was planned to determine the yield loss in wheat crop at different dates of sowing for the population of aphids. Planting resistant/tolerant varieties against pests is the main way to overcome these field losses. Present study is an effort to screen different wheat varieties/lines against aphids under field conditions. Wheat varieties, Galaxy-2013, Anaj-2017, Gold-2016, Johar-2016, Aas-2011 and Fsd-2008 were sown at Adaptive Research Farm, Rahim Yar khan during the crop season 2018-2019. The aphid infestation started in the 1st week of February on all wheat varieties at stem elongation stage and increased gradually with the growth of plants. Aphid specie was recorded *i.e Schizaphis graminum* (R.) green aphid mostly in that area. Mean seasonal aphid population (no. of aphids/tiller) on wheat plants during the whole season was the highest in Anaj-2017 (19.2) and Johar-2016 (18.6) and the lowest in Galaxy-2013 (5.2) and Faisalabad-08 (5.8). However, grain yield was the highest in Galaxy-13i.e 4600.9 kg/ha and the lowest was in Johar-2016i.e 3315.4 kg/ah variety. Varietal resistance showed an effective reduction of aphids and gave a significant increase in grain yield.

Introduction

Wheat (*Triticum aestivum* L.) is reported as 65% of grain in human food, 21% as animal feed, 8% as seed and 6% for industrial processing (Khan *et al*., 2009). Its yield per hectare in Pakistan is far less than many wheat producing countries. Yield losses, due to feeding of insect pests particularly the aphids, are massive in wheat crop (Akhtar *et al*., 2010; Khan *et al*., 2011; John et al., 2017). Low yield of wheat per hectare in Pakistan compared to the other advanced countries is due to several abiotic and biotic factors, such as traditional methods of cultivation, varieties, lack of irrigation facilities, barani areas, soil fertility and incidence of insect pests and diseases (Anwar *et al*., 2009). Among the different insect pests, 29 species of the aphid are infested the wheat crop (Geza, 2000). Aphids **(**Homoptera: Aphididae) are known as the

highest damaging pest on wheat crop in Pakistan (Khan *et al*., 2011). Aphids are the major economic insect-pests that cause yield losses in different crops worldwide, especially in temperate regions (Blackman and Eastop, 2000). Population density of aphids also depends on the abiotic factors (Aheer *et al*., .2007 and Wains *et al*., 2008). During spring season (February-March) aphid population increases, at the same time biocontrol agents like *coccinellids* also increase as natural check on this pest (Khan *et al*., 2011). Direct sucking of aphid can cause 10-50% losses while, indirect losses can be 20-80% (Trdan and Milevoj, 1999). *Sitobion avenae* (English grain aphid), *Rhopalosiphum padi* (Bird cherry-oat aphid), and *Schizaphis graminum* (Green-bug) are reported on wheat in Pakistan (Shahid *et al*., 2012; John et al., 2017). *Schizaphis graminum* was the main pest among them (Haider *et al*., 2017) and *Schizaphis graminum* is major specie in Pakistan (Rustamani*et al*., 1999). Damage by aphids to cereal crops are much alarming particularly in wheat crop, though stay for a short period of time, but they have fast multiplication rate and have potential to demolish the crop within few days (Jarosik *et al*., 2003). Due to aphid feeding, variable yield losses are reported in wheat crop. Yield losses can be up to 7.9 to 34.2% with aphid infestation (Akhtar *et al*., 2010). For instance, the yield loss can be 35 to 40% with the presence of 15 aphids tiller^{-1}(Brewer and Elliott, 2004). Plant growth stages directly influence the growth, development and fecundity of insect-pest (Yazdani and Agarwal, 1997). In case of aphids, infestations occur in less numbers in earlier plant growth stages and gradually increase during vegetative growth stage of crop, peaked at heading stage and gradually decline with crop maturity (Aheer *et al*., 2006; Khan *et al*., 2012). Aphid infestation between ear emergence and flowering can cause maximum loss in yield that may reach up to 14% (Liu *et al*., 1986). Therefore, the early detection and management of aphid incidence is important.Host plant resistance is an important part in managing aphids (Khattak *et al*., 2007; Khan *et al*., 2011) which can aid to overcome the economic losses (Akhtar *et al*., 2006). Utilization of resistant wheat varieties is a better option to manage aphid infestations in wheat crop (Iqbal, 2003; Wains *et al*., 2010).Aphid is the key sucking pest of wheat and other crops. It is the regular pest of wheat in Pakistan (Aheer *et al*., 2008). Aphid cause both direct and indirect damage by sucking the cell sap of phloem containing nitrogen contents (Vereijken, 1979).Mann *et al*. (1995) reported that this fluctuation is mainly attributed to climatic conditions, host plant quality, dispersal efficiency and natural enemies. Both physical and biological factors are responsible for aphid fluctuation and densities on various cultivars (Akhtar *et al*. 2009). While, the seasonal abundance and the peak populations of pests though varied from year to year still remained at the mercy of climatic changes and/or parasitoids (Khan *et al*., 2007).Aphid population is high in Feb-March due to the favourable host available in the wheat field (Aheer *et al*., 1994). Economic thresholds levels for aphid in wheat is justified, if 50 or more aphids are present in the seedling stage of the wheat. Moreover, 100 or more aphids are present during the 3-6 inches of plant height and 300 or more aphids when the plant reaches 6-10 inches in height and the visible damage of aphids is on the top terminal portion of leaves. The use of resistant wheat varieties is an important part of the integrated pest management program and can be used to control cereal aphids as resistant varieties have the potential to decrease the population of cereal aphids (Khan and Port, 2008). Aphids can reproduce parthenogenitically producing 3-6 offspring per day; nymphal stage developmental time takes 5-10 days and one aphid can survive up to one month. Some of biological features like shorter developmental time, overlapping of generation and high potential birth rate help aphids to increase population on its host plant (Blackman and Eastop, 1984; Johnson and Lyon, 1998; Dickney and Medina, 2010).

The objectives of the present study were: to screen wheat varieties/lines against aphid infestations with respect to sowing dates to determine wheat yield losses.

Materials and Methods

During 2018-19, the experiment was conducted in the research area, Adaptive Research Farm Rahim Yar Khan. Six commercial varieties of wheat *viz*.,Galaxy-2013, Anaj-2017, Gold-2016, Johar-2016, Aas-2011 and Fsd-2008 were sown on different date'si.e 1st November, 10th November, 20th November, 30th November and 10th December as described in table-1. The experiment was laid out in Randomized Complete Block design with three replicates. The plot area for each wheat variety was 23.5 x 25 feet. Sowing was done by hand drill, using recommended seed rate (125 kg per hectare). Seeds of each entry were planted in strips of adjacent plots with 6 rows distanced at 30.5cm. Standard agronomic practices were done uniformly throughout the experiment. Diammonium phosphate (DAP: 50 kg bag having 46% P and 18% N) and Urea (50 kg having 46% N) were used at

recommended rate of 2.5 bags per hectare. In addition to pre-sowing irrigation, three irrigations were given to crop. Weeds were managed by using three herbicides during the season. Firstly, Stomp® 330EC (Pendimethalin) @ 2.5 liter/hectare was done as a pre-sowing herbicides. Second herbicide, Buctril Super® 600 EC (Bromoxynil + MCPA) @ 750 ml/hectare, was applied after 25 to 30 days as post emergence against broadleaf weeds. Third herbicide, Axial® 100EC (Pinoxanden) @ 825 ml/hectare, was applied on January as post emergence against narrow leaf weeds. The data of aphids and its yield losses was recorded during the whole experimental period (from January 2019 to March 2019). Data was collected after every ten days from 01-01-2019 to 30- 03-2019. During each sampling date, nine tillers from wheat plants from each wheat variety in each replication were randomly selected and the number of aphids per tiller was counted. At harvesting time, the aphid attacks counted on each variety during whole season and also compare varieties with their dates of sowing with respect to aphid attack.The data were analyzed (Steel *et al*., 1997).

Table-1 Wheat Varieties sown on different dates during 2018-19

S.No	Sowing Dates	Wheat Varieties
1	1st November	V1-Galaxy-2013 V2-Anaj-2017 V3- Gold-2016 V4- Johar-2016 V5- Aas-2011 V6- Fsd-2008
2	10th November	All above wheat varieties
3	20th November	All above wheat varieties
4	30th November	All above wheat varieties
5	10th December	All above wheat varieties

Results and Discussion

The aphid population increased gradually with the growth of plants during reproductive stages. The infestations were started on 2nd week of February(flag leaf just visible) on all wheat varieties. The data of aphid speci was taken from 9 tillers of each wheat variety. The data was taken from spike and stem of the wheat plant. The aphid population recorded from the 1st week of February to the last week of March as described in table-2. During the 1st week of February the aphid population was zero as counted on all wheat varieties. During the 2nd, 3rd and 4th week the aphid population gradually increased. During the 5th week of February and 1st week of March the aphid population increases much in numbers and in 2nd week of March the peak aphid population was recorded. Then in the 3rd and 4th week of March the aphid population gradually decreases. The wheat variety Anaj-2017 was greatly infected by aphid population i.e 16.7 average mean during the whole season. Johar- 2016 was at 2nd number i.e 14.1 average mean population of aphid. Two wheat varieties Aas-2011 and Gold-2016 was shown the same tolerance against aphid attack i.e 9.3 and 9.6. Galaxy-2013 and Fsd-2008 were shown little resistance against aphid attack during the whole season i.e 6.7 and 7.7. The resistance and tolerance of each wheat variety depends on the varietal character and environment conditions.The aphids infestation started in the mid of February and gradually increased during the vegetative growth of wheat crop. The population reached to its peak in the mid of March during the heading stage of the wheat and gradually declined when the temperature high. Similar results were shown by Karimullah and Ahmad (1989), they observed that aphids infestation started in the 1st week of February and peaked in the latter half of March with fluctuations in population size. Our results are in conformity with Xiong (1990) and Nawaz (2000) who observed that population of aphids in the field increased with the development of the wheat and peaked at the heading stage.

Table-2 Mean number of aphid specie on wheat crop during crop year 2018-19.

Aphid Specie	Wheat Varieties (V)	1/2/19	7/2/19	14/2/19	21/2/19	28/2/19	6/3/19	13/3/19	21/3/19	28/3/19	Seasonal Mean
S. graminum	V1	00	00	01	04	12	14	16	9	5	6.7
	V2	00	04	08	12	22	28	32	27	18	16.7
	V3	00	02	03	07	11	18	20	15	11	9.6
	V4	00	03	05	10	17	24	29	22	17	14.1
	V5	00	01	03	08	13	16	18	14	11	9.3
	V6	00	00	02	06	13	15	17	10	7	7.7

Mean followed by same letters within the columns are not significantly different at 5 % level of significance (LSD-test)

Table-3 showed the average mean aphid population on different wheat varieties with respect to dates of sowing. Among six wheat varieties the maximum aphid population was recorded on wheat variety Anaj-2017 i.e 19.2 per tiller followed by Johar-2016 i.e 18.6 per tiller. The wheat varieties Aas-2011 and Gold-2016 showed almost similar aphid population i.e 12.6 and 11.8 per tiller. Wheat varieties Fsd-2008 and Galaxy-2013 showed the minimum aphid attack during the whole cropping season with different sowing dates. The aphid population increases with the late sowing of the crop. When the crop sowing timely the aphid attack was observed less. As the sowing time delay it increases the aphid attack. During the season when the wheat varieties sown on 1st November, the aphid attack was less observed i.e 3.5 per tiller. When sown on 10th November it showed 5.1 aphids per tiller. The sowing date 20th November showed 14.3 aphids per tiller that shows increasing number with late sowing. When the wheat varieties were sown on 30thNovemer, it showed aphid population i.e 17.5. The last sowing date 10th December showed the highest aphid population i.e 20.6 per tiller. So it is concluded that aphid population increases with the delay sowing of wheat crop varieties.

Table-3 Mean average Susceptibility and Resistance of wheat varieties against aphid attack with respect to their dates of sowing during 2018-19.

Varieties	1st Nov	10th Nov	20th Nov	30th Nov	10th Dec	Mean Aphid population
V1-Galaxy-2013	02	03	05	07	09	5.2
V2-Anaj-2017	04	06	25	29	32	19.2
V3- Gold-2016	04	06	13	16	20	11.8
V4- Johar-2016	05	07	23	27	31	18.6
V5- Aas-2011	04	05	15	18	21	12.6
V6- Fsd-2008	02	04	05	08	10	5.8
Mean of sowing dates	3.5	5.1	14.3	17.5	20.6	-

Mean followed by same letters within the columns are not significantly different at 5 % level of significance (LSD-test)

Table 4 shows that the highest yield was produced by V_1 Galaxy-13 wheat variety with a percent increase of 38.7% where aphid attack was observed less i.e 5.2 than all other wheat varieties followed by V_6 where Fsd-2008 was sown with percent increase 33.1%. The lowest yield was produced by wheat variety Anaj-2017 with high attack of aphid population i.e 19.2 per tiller with respect to all sowing dates. It is concluded that the wheat variety Galaxy-2013 shows maximum resistance against aphid attack and Anaj-2017 wheat variety shows susceptibility to aphid attack.

Table-4: Percent increase in wheat varieties (kg/ha) with respect to different date of sowings and aphid attack.

Wheat Varieties	Avg. yield (kg/ha)	Percentincrease in yield (%)
V1	4600.9	38.7
V2	3315.4	-
V3	3973.3	19.8
V4	3503.7	5.6
V5	4201.8	26.7
V6	4413.7	33.1

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