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Influence of different sowing dates and wheat (*Triticum aestivum*) genotypes on aphid infestation and its predation in agro-climate of Lasbela region

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Abstract
Wheat (*Triticum aestivum* L.) is an important cereal crop as being consumed as a staple food in the world. The present study was conducted to determine the impact of different sowing dates and wheat (*Triticum aestivum*) genotypes on aphid infestation and its predation. Nine wheat genotypes Tijaban-10, Shalkot-14, Azri-96, Sarsabs, Khirman, Sarang, Esw-4525, NIA-Amber, and Kiran-96 were used in the experiment. The result revealed that a significant decrease in lowest mean population of (*S. avenae* and *R padi*) were observed in Sarsabs (1.25/spike) and kiran (0.63/spike), while a significant increase in highest mean population was seen by Azri-96 (3.98/spike and 4.33/spike). However, in all interval weeks and sowing dates a significant peak mean population of *S. avenae* (6.31/spike) and *R padi* (6.19/spike) were found in 3rd week of 15th November 2015 as compared to 30th November and 15th December 2015. But a significant decrease and less mean population of *S. avenae* (0.03/spike) in 5th week of 15th November and *R. padi* (0.14/spike) were observed in 5th week of 15 December 2015. Although in all sowing dates a significant increase *S. avenae* (2.50/spike) and *R padi* (2.67/spike) in 15th November 2015 and a significant decrease *S. avenae* (1.60/spike) and *R padi* (0.96/spike) mean population were observed in 15th December 2015 in both aphids. However, a significantly increase mean population of predators *C. septempunctata* (0.41), *M. sexmaculatus* (0.33) and *C. carnea* (0.36) were noticed in sowing dates of 15th December 2015 and significant decrease were recorded on sowing date of 15th November 2015.

Keywords: *Triticum aestivum* L, *Sitobion avenae, Rhopalosiphum padi, Coccinella septempunctata, Menochilus sexmaculatus, Chrysoperla carnea*

Introduction
Wheat (*Triticum aestivum* L.) is an important cereal crop as being consumed as a staple food in the world [1]. The agriculture sector has to face many global challenges due to environmental changes and have to take action against the world challenge to increase the crop yields in the water stress environment and No doubt that global warming is also an alarming problem which results in low rainfalls in most of the geographic regions and ultimately results in negative productivity of wheat [2]. But some wheat cultivars are adapted to a broader range of environments, while others have limited environmental adaptation. Cultivars with consistent performance across numerous locations are considered more stable in yield and related traits of economic importance [3]. Numerous factors are responsible for the low yield of wheat like a-biotic factors and low yielding varieties, improper inputs such as irrigation and fertilizers, sowing time, weeds and insect pests [4]. Among insect pests, 29 aphid species infest wheat crop. Dominant species are the green bug, *Schizaphis graminum* (Rondani), bird cherry oat aphid, *Rhopalosiphum padi* (L.), Engliash grain aphid, *Sitobion avenae* (Fabricius), Russian wheat aphid, *Diuraphisnoxia* (Mordvailko) and rose-grass aphid, *Metopolophium dirhodum* (Walker) [5]. Aphid species *S. avenae, R. padi,* and *S. graminum* are the insect pests of wheat in Pakistan [6]. However in district Lasbela following two species of aphid and three species of predators are active on wheat.

Biological control is a major component of Integrated Pest Management (IPM) strategies and the aim of biological control is to reduce pest populations through natural enemies such as predators, parasitoids and pathogens [7]. Adults and larvae of ladybird beetle (Coccinellidae), larvae of hover flies (Syrphidae) and lacewing larvae (Chrysopidae) restrict aphid populations effectively [8, 9]. Coccinellids are outstanding group of predators and 75 species of coccinellids were recorded as predators from Pakistan [10]. They feed on aphids and scale insects, which are important pests in agro-ecosystems [11]. These can inhibit aphids below economic threshold effectively in spring crops and significant aphid control was observed by the predators i.e., Coccinellids and *Chrysoperla carnea* (Stephen) under field conditions in wheat crop [12]. Ecological sustainability has become a key consideration in all aspects of technology development including insect pest management [13]. Crops suffer from extensive damage due to insect pests not only reducing the yield, but are also responsible for deterioration of quality [14]. Currently, about 103,000 tone of pesticides worth about Rs. 25 billion are used in the country for pest control and Most of the currently used pesticides are synthetic and non-selective which have caused serious social and environmental repercussions such as toxic residues in the food chain, development of resistance in insect pests against insecticides and elimination of non-target beneficial organisms [15]. To minimize dependence on insecticides for pest control, other eco-friendly approaches like change of sowing dates, cultivation of resistant genotypes and use of natural enemies may be helpful. Therefore, this study was planned to determine the impact of sowing dates and wheat (*Ttriticum aestivum)* genotypes on aphid infestation and its predation, so that sowing date and different wheat genotypes may be adjusted to minimize aphid infestation.

Materials and Methods

The present studies were carried at the research area of Lasbela University of Agriculture, Water and Marine Science, Uthal during 2015-16.Nine genotypes wheat varieties (Tijaban-10, Shalkot-14, Azri-96, Sarsabz, Khirman, Sarang, ESW-4525, NIA-Amber, and Kiran-96) were used in the present experiment in different sowing dates 15th November 2015, 30th November 2015 and 15th December 2015, with three replications in each treatment. Total 81 plots were prepared for all the sowing dates. Plot size was used 2m X 3m under randomized complete block design (RCBD) with factorial arrangement. All wheat varieties were obtained from Nuclear Institute of Agriculture (NIA) Tandojam, Sindh and were sown on different dates to check the weekly population of aphids and their predation. All data were observed in the morning hours to record the aphids and its natural enemies. The number of grain aphid, bird cherry-oat aphid and insect predators, i.e. green lacewings, seven spotted beetles and zigzag beetles/plant were recorded in the crops sown on different dates. The data were recorded at weekly intervals on 10 randomly selected plants from each plot. A climatic data of site was collected from Metrology Department at the campus during the crop season.

Statistical Analysis

The collected data were statistically analyzed using MSTAT software and entire means were subjected to Least Significant Difference (LSD) at P< 0.05 level.

Results

A significant decrease mean population of Grain aphid (*Sitobion avenae*) was observed in different wheat genotypes on Kiran-96 (1.34/spike), Khirman (1.29/spike) and Sarsabs (1.25/spike), while a significantly increase was seen in Azri-96 (3.98/spike) and Sarang (2.98/spike) Table-1A. Whereas the highest aphid mean population of (6.31/spike) was recorded on 16th February from 3rd week of 15th November, 2015 among in all interval weeks and also lowest population of (0.03/spike) were noticed on 1st March, 2016 in 5th week of 15th November, 2015 Table-1B. However a statistically significant increase in mean population (2.50/spike) of (*S. avenae*) were found in sowing date of 15th November, 2015, though a significant decrease in mean population of (*S. Avenue*) (1.60) were noticed on sowing date of 15th December, 2015. (Fig-1).

Table 1A: Mean population of *S. avenae* on various wheat genotypes sown at different dates

Wheat genotypes	Aphid population
Tijaban-10	1.96cd
Shalkot-14	1.92cd
Azri-96	3.48a
Sarabs	1.25e
Khirman	1.29e
Sarang	2.98ab
Esw-4525	2.40bc
NIA-Amber	2.01cd
Kiran-96.	1.34de

Means sharing similar letters are significantly different by Fisher's LSD test at P = 0.05.

Table 1B: Mean population of *S. avenae* on wheat genotypes at various week intervals and sowing dates

Sowing Dates	Week Intervals				
	Week-1	Week-2	Week-3	Week-4	Week-5
15th November	0.70ij	5.33b	6.31a	0.17jk	0.03k
30th November	1.41fg	3.04d	4.31c	0.83hi	0.93gh
15th December	1.55fg	2.07ef	2.18e	2.04ef	0.17jk

Means sharing similar letters are significantly different by Fisher's LSD test at P = 0.05

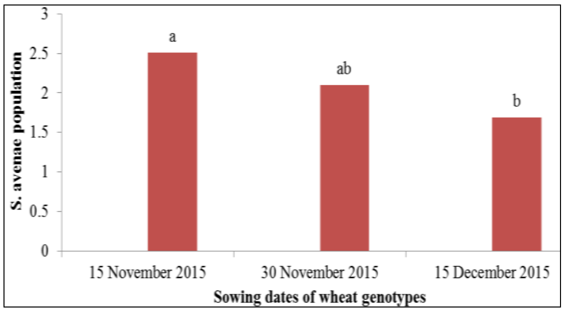

Fig 1: Mean population of *S. avenae* on wheat genotypes sown at different dates

A significant enhance mean population of bird cherry-oat aphid (*Rhopalosiphum padi*) was found in Azri-96 (4.33/spike), whereas a significant reduction in mean population were seen in kiran (0.63/spike) among all different genotypes varieties (Table-2A). However the highest significance in mean population of (5.65) 9th February and 16th February (6.19/spike) was noted from 2nd and 3rd week of 15th November, 2015 among in all interval weeks and also lowest population of (0.14/spike) 22nd March, 2016 and (0.17/spike) 1st March, 2016 were recorded in 5th week of 15th December 2015 and 15th November 2015(Table-2B). But a statistically significant increase in mean population of *R. padi* (2.67) was observed on sowing date of 15th November, 2015, though a significant reduction in mean population of *R. padi* (1.56/spike) and (0.96/spike) were noticed on sowing date of 30th November and 15th December, 2015 (Fig-2).

Table 2A: Mean population of *R. padi* on various wheat genotypes sown at different dates

Wheat Genotypes	Aphid Populations
Tijaban-10	1.74b
Shalkot-14	1.81b
Azri-96	4.33a
Sarsabz	1.46bc
Khirman	1.22c
Sarang	1.45bc
Esw-4525	1.56bc
NIA-Amber	1.44bc
Kiran-96.	0.63d

Means sharing similar letters are significantly different by Fisher's LSD test at P = 0.05.

Table 2B: Mean population of *R. padi* on wheat genotypes at various week intervals and sowing dates

Sowing Dates	Week Intervals				
	Week-1	Week-2	Week-3	Week-4	Week-5
15th November	1.00ef	5.65a	6.19a	0.38gh	0.17h
30th November	0.26gh	2.48c	3.13b	1.20de	0.75ef
15th December	1.29de	1.18e	1.73d	0.50fg	0.14h

Means sharing similar letters are significantly different by Fisher's LSD test at P = 0.05.

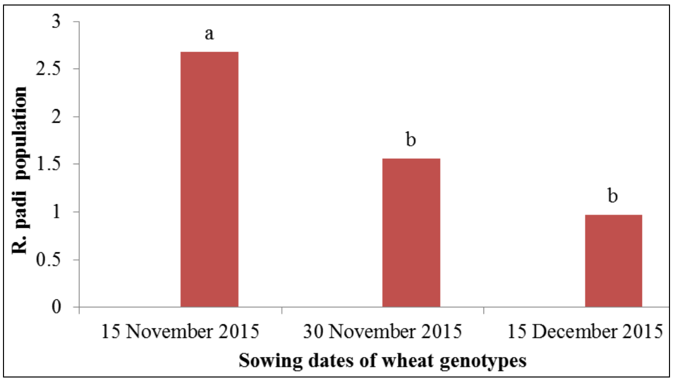

Fig 2: Mean population of *R. padi* on wheat genotypes sown at different dates

A significant decrease mean population of Seven spotted beetle (*C. septempunctata*) were seen in (0.10/plant) 1st and (0.12/plant) 2nd week of 15th November of 2015, and significant increase were observed (0.60/plant) in 5th week of 15th December 2015 among all week intervals (Table-3). Whereas a significantly enhance in mean population (0.41/plant) were recorded by 15th December 2015 sowing dates and decrease were found by 15th November of 2015 sowing dates mention in (Fig-3).

Table 3: Mean population of *C. septempunctata* on wheat genotypes at various sowing dates and week intervals

Sowing Date	Week Intervals				
	Week-1	Week-2	Week-3	Week-4	Week-5
15th November	0.10e	0.20d	0.32c	0.51ab	0.12e
30th November	0.23c	0.31c	0.41b	0.59ab	0.24c
15th December	0.32c	0.40b	0.46b	0.60a	0.28c

Means sharing similar letters are significantly different by Fisher's LSD test at P = 0.05.

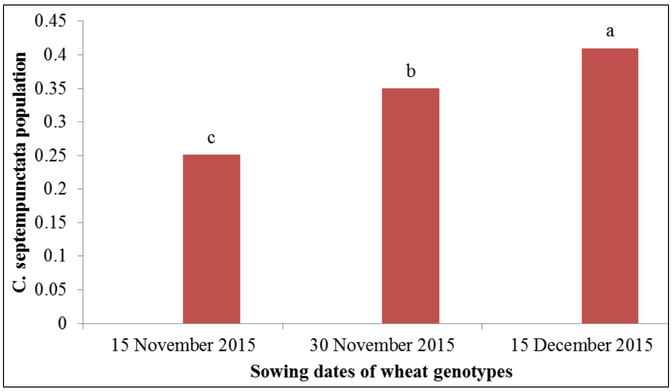

Fig. 3: Mean population of *C. septempunctata* on wheat genotypes sown at different dates

The mean population of Zigzag beetle (*M. sexmaculatus*) of various genotypes in different week intervals is presented in (Table-4). A significant decrease mean population (0.01/plant) was recorded in a 5th and 1st week of 15th November and 30th November, however a significant increase was located in 4th week of 30th November. While a significant augment in sowing dates mean population (0.33/plant) was recorded in 15th December and significantly decrease were seen by (0.21/plant) and (0.25/plant) in 15th and 30th November 2015 (Fig-4).

Table 4: Mean population of *M. sexmaculatus* on wheat genotypes at various sowing dates and week intervals

Sowing Date	Week Intervals				
	Week-1	Week-2	Week-3	Week-4	Week-5
15th November	0.1d	0.26c	0.45b	0.25c	0.01e
30th November	0.01e	0.13d	0.31c	0.62a	0.21c
15th December	0.24c	0.35c	0.41b	0.51ab	0.18d

Means sharing similar letters are significantly different by Fisher's LSD test at P = 0.05.

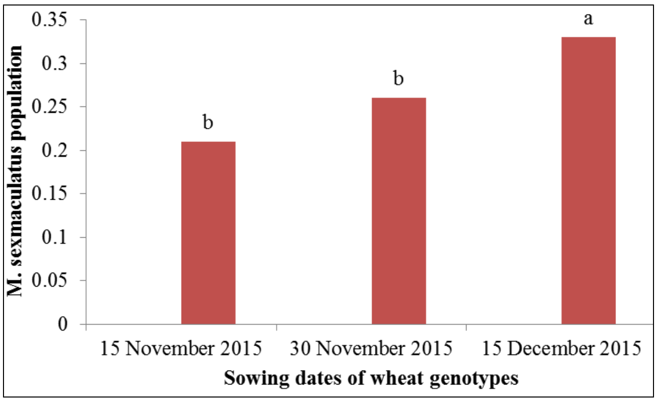

Fig. 4: Mean population of *M. sexmaculatus* on wheat genotypes sown at different dates

An interaction of green lacewing (*C. carnea*) population in different week intervals is presented in (Table 5). A significant reduction of mean population (0.07, 0.09 and 0.12/plant) was founded on 5th weeks intervals in all sowing dates. But significantly increase was seen in 4th week of 30th November 2015. Whereas a significant increase in mean population (0.42 and 0.36/plant) was recorded in 30th November and 15 December, while a significant decrease were observed in 15th November 2015 sowing dates as mention in (Fig-5).

Table 5: Mean population of *C. carnea* on wheat genotypes at various sowing dates and week intervals

Sowing Date	Week Intervals				
	Week-1	Week-2	Week-3	Week-4	Week-5
15th November	0.21f	0.24f	0.38e	0.32e	0.12g
30th November	0.26f	0.43d	0.61ab	0.71a	0.09g
15th December	0.34e	0.48d	0.54c	0.39e	0.07g

Means sharing similar letters are significantly different by Fisher's LSD test at P = 0.05.

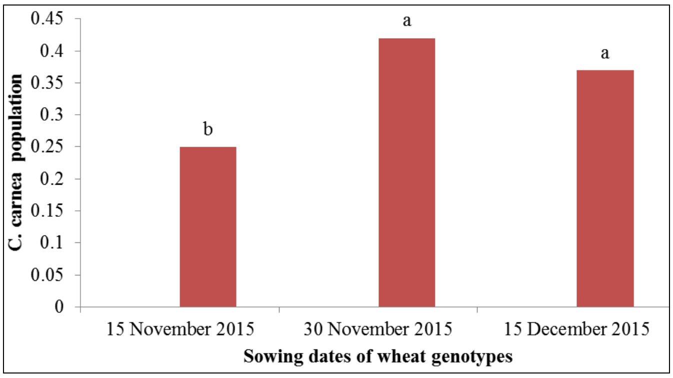

Fig 5: Mean population of *C. carnea* on wheat genotypes sown at different dates

Discussion

The impact of different sowing dates and wheat (*Triticum aestivum*) genotypes on aphid infestation results revealed a significant difference in the number of aphids among the wheat genotypes and their sowing dates. A major infestation was found in the present investigation by two aphid species *R. padi* and *S. avenae* on different wheat genotypes and similar results also were found by [16] who also reported that present of *R. padi* and *S. avenae* with major infestation on different sowing time and different wheat crops [17] reported that the 3rd week of February was found to be very favorable for aphids in wheat fields in the study area. Similar results also were found in present results the highest mean population of *R.padi* and *S. avenae* were observed during 3rd week of all interval weeks sowing dates (Tables 1,2 B). the lowest populations of aphids were seen in Kiran-96, Sarsabz and Khirman, similar results also were found by [18] and the highest population of both aphids were recorded in Azri-96 (Table-1, 2A) Present results are supporting with [19, 20] who reported the augmentation of both aphids population in wheat crops, because crop sown on 15th November and 30th November were found to be the most favorable time for aphid reproductions as the highest aphid population was recorded in these dates. Our results are also in support with the studies of [21, 22, 23, 24] who reported that aphid multiplied faster during cold weather and reached the peak population at the end of February and early March when the ears starting for ripening. 15th November crop sown on aphid population was 6.31/spike which was highest in the mid of February, when the temperature range of the experimental area was 13.65°C to 29.52°C. However, the crop sown on 15th December had the highest population of 2.18/spike in the month of March when temperatures prevailed between 16.5°C to 32.6°C (Table 6).These results agreed with [25] who surveyed that the aphid population on wheat fields in Lahore, Pakistan, as affected by temperature and humidity, from 9 January to 14 April of 1998. Two species of aphid viz., *Schizaphism graminum* and *Rhopalosiphum padi* were recorded infesting wheat in the experimental field. Aphid density peaked on 26 February. During this time, pests started moving from the leaves to the ears. A decline in the aphid population was recorded on 11th March followed by an increased on 27thMarch. [26] who reported that different biotic factors such as predators, parasitoids and different pathogens affect the pests of cereals crops and also affecting them a-biotic factors; such as temperature, rainfall, humidity, wind and sunshine. In present results, the predator's population increased with delayed sowing dates because of their interaction with pests. Aphid's population increased along with predators agreed with [21] who also reported that the natural predator population increased with the increase of aphid population. On 15th November crop sown aphid population increased in the third interval week and later started to shifting in crop sown on 30th November due to lack of pest population. Predator also started shifting to the same crop for predation on aphid. Similarly, both pest and predator population shifted from the crop sown on 30th November to 15th December. [12] Who reported the maximum population of seven spotted beetle in late sowing date of different wheat varieties, similar results also were observed in present results the predators *C. septempunctata, M. sexmaculatus* and *C. carnea* population was higher in late sown crop 15th December 2015 in respective (fig-3, 4, 5).

Table 6: Average monthly meteorological data during experimental period January to March 2015-16

Months	Temperature °C		Relative humidity%	
	Minimum	Maximum	Minimum	Maximum
January	11.55	21.5	48.15	66.45
February	13.65	29.52	40.04	65.77
March	16.75	32.6	38.00	52.28

***Source*:** Uthal Metrological center

Conclusion

In the present investigation revealed the population of insect pests and predators fluctuated with the passage of time in different genotypes of wheat crop. Results showed that the different sowing dates have an impact on aphids and its predation. Whereas, the temperature and humidity favor to increase the reproduction of insect pests and predators on the wheat crop. Present research also indicate that the sowing dates, wheat genotypes and predators can play a vital role to suppress the aphid population on wheat crops.Kiran-96, Sarsabz and Khirman wheat varieties were found resistance and Azari-96 were found susceptible against aphids. Wheat aphid needs to be managed using augmentative release of insect predators in order to keep the safe environment.

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