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EFFECT OF SOWING DATES AND SEEDING RATES ON *SCHIZAPHIS GRAMINUM* IN WHEAT CROP

Jamshaid Iqbal[1], Muqadas Batool[2], Muhammad Nadeem[2*], Khalid Hussain[2], Muhammad Faisal Shahzad[1], Ayat Ullah Khan[1] and Tahir Islam[1]

[1]Faculty of Agriculture, Gomal University, Dera Ismail Khan
[2]Arid Zone Research Institute, Bhakkar.

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***Corresponding Author**:
Muhammad Nadeem
E-mail: nadeem_agrarian@yahoo.com

ABSTRACT

The current study was conducted at Arid Zone Research Institute (AZRI), Bhakkar, Pakistan during 2016-2017 to determine the effect of sowing dates and seed rates on aphid population in wheat crop. For this purpose six sowing dates (SD); SD1 30-10-2016; SD2 10-11-2016; SD3 20-11-2016; SD4 30-11-2016; SD5 10-12-2016; SD6 20-12-2016; and five seed rates (SR); SR1 30kg/acre; SR2 40Kg/acre; SR3 50Kg/acre; SR4 60Kg/acre; SR5 70Kg/acre were applied. No chemical treatments were applied on experiment. The aphid's infestation results revealed that aphids attack started on 24th February then its number gradually increased, peak aphid's population was recorded at 2nd March. Highest aphids attack was recorded on SD3 (20-11-2016) with the mean number of aphids (77.85/5tillers) and least aphids attack recorded on SD6 (20-12-2016) with the mean number of aphids (12.35/5tillers). The TW11510 advanced line have less mean number of aphids (38.23/5tillers) while UJALA-2016 wheat variety was greatly infested with mean number of aphids (60.67/5tillers). The seed rates 50Kg/acre have higher mean number of aphids (55.26/5tillers) but lower mean number (43.05/5tillers) noted at 70kg/acre. Greater yield (6869.7kgha^{-1}) produced by SD2 (10-11-2016), seed rate with higher yield (6358.7kgha^{-1}) recorded at 50kg/acre, TW11510 have higher yield (6059.3kgha^{-1}) than UJALA-2016 wheat.

Keywords: Aphid, sowing date, seed rate, wheat, Pakistan

INTRODUCTION

In Pakistan wheat used as staple food and its products are utilized in different ways. It dominates all other crops as it is staple food of Pakistani's people. Wheat contributed 2.0% of GDP and 9.9% value added in agricultural sector of Pakistan. All parts of grain kernels enriched with nutrients, vitamins and minerals like potassium, selenium, magnesium, phosphorus, zinc, manganese, copper, and iron (Liu *et al*., 2012). The 65% of wheat grain is utilized by humans in the world, the 60% of calories and protein needed for the daily life fulfilled by wheat. About 80% of total wheat production is used for bread whereas about 20% is used for bakery products (Khan *et al*., 2009). Wheat flour is used to form the health beneficial foods. The wheat bran consists of dietary fibers help to reduce the risk of colon cancer along with preventing and curing the some digestive system disorders (Qu *et al*., 2005).

Developing countries facing much challenges of wheat supplies than developed countries. There are number of insects which attack on wheat crop such as termites, cutworm, wheat weevil, jassid, aphid and army worm. Aphid (*Schizaphis graminum* R.) (Hemiptera: Aphididae)also known as also known as green flies and plant lice are one of the most important wheat damaging agent (Khan *et al*., 2011) by injecting infections significantly (Khan *et al*., 2012). The aphids destroy the leaves and its chlorophyll contents by sucking the sap, leaves surface become blocked for photosynthesis due to its honey dews secretion, it provide medium for the growth of mold and fungi. The yield loss due to aphid up to 35-40 percent by sucking the cell sap and 20-80% losses by the transmission of viral and fungal diseases to crop (Aslam *et al*., 2005).Its damaging effects on wheat plant by sucking phloem sap and blocking photosynthesis which ultimately results in leaf distortion, stunting, discoloration, leaf curling and wilting (Khaliq, 2003; Gash, 2012). The most serious disease BYDV-PAV spread worldwide which is transmitted by aphid (Khaliq, 2003). Although aphid

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destroys the whole crop within days because aphids multiplied rapidly (Jarosik *et al*., 2003; Wains *et al*., 2010).

The crop sowing time and proper seeding rate are of great importance which are essential for the plant growth and make the balance competition between the plants for water and nutrients, and also affect the insect growth (Kabesh *et al*., 2009; Nakano and Morita, 2009). Appropriate sowing date is important for growth and development of crop in the field. The competition between plants for nutrients, water and for light is strongly determined by the proper seed rates (Gooding *et al*., 2002). Many researchers have carried out their work on sowing times of wheat and found different results. Therefore one of the most effective techniques is proper sowing time; hence suitable sowing dates are essential due to variation in weather (Dokuyucu *et al*., 2004; Tanveer *et al*., 2009).The purpose of this study to find out the best sowing time, best quantity of seeding rates, and also find the best quality of wheat varieties to minimize the aphid attack on wheat crop.

MATERIALS AND METHODS

The work was planned to evaluate the best sowing dates, seed rates and wheat varieties for greater yield at District Bhakkar. The trials were divided into three experiments.

Effect of sowing dates on aphid infestation

This research work was conducted at the Arid Zone Research Institute, Bhakkar, Pakistan during the wheat season 2016-2017. Bhakkar is located at the North Latitude; 31.6266^{0}, East Longitude; 71.0617^{0}, Altitude; 159m above the sea level. Bhakkar's climate is dry, mostly composed of deserts. The rains fall approximately 213mm annually. Six sowing dates (SD) were planned; SD1 (30th October 2016), SD2 (10th November 2016), SD3 (20th November 2016), SD4 (30th November 2016), SD5 (10th December 2016) and SD6 (20th December) on the environmental basis of Bhakkar district in 2016.

Screening of wheat varieties against aphid infestation

Two wheat varieties Ujala-2016 and TW-11510 advanced line were sown on five different dates at different seed rates.

Effect of seeding rates on aphid infestation

Five seed rates (SR) were selected as; SR1 (30Kg/acre), SR2 (40Kg/acre), SR3 (50Kg/acre), SR4 (60Kg/acre), SR5 (70Kg/acre) were applied in sub plots. The sequence of wheat varieties were same for all the sowing dates but sequence of seed rates were changed in each replications. The summary of trial is given in Table 1.The experiment was designed in split-split plot arrangement. The distance between replicates was 1 meter and plot size was 0.9m x 5m. Row to row distance was kept 9 inch and numbers of rows per plot were four. Total area for each sowing dates was $202m^{2}$.

Land was prepared by following standard agronomic practices. Fertilizers were applied at recommended dose. Sowing was started on dated 30-10-2016 for SD1, other sowing were completed after 10 days intervals. Seed of each variety were weighed accurately, enclosed separately and labeled it with seed rates and varieties. The number of rows was marked with the help of marker at equal distance. There were four rows at equal distance for each treatment. The seed was sown by hand drill method, replicated thrice. After germination all the standard agronomic practices (regular irrigation, fertilizer and weedicides) were followed throughout the growing season. No insecticides were used. Each sowing date was labeled with the prepared sign board. Each treatment (rows) was also separately tagged with small iron sign board. Labeling of trial treatments (sowing dates, seed rates and variety name) were helpful at the time of aphids and yield data. Six irrigations were applied from sowing to harvesting after 20-25 days intervals.

There was no aphid attack seen in the month of January in all planting dates. Aphids attack started on 24th February, and then aphid's data was recorded on weekly basis at all planting dates. Next data was collected after one week at 2nd March 2017, third at 10th March 2017. After that aphid's numbers become declined. Aphids disappeared at the 1st week of April. Maturity data was also taken near to crop ripening on dated 17-04-2017. Maturity data was taken six times prior to ripening of each sowing dates. After maturity data the schedule of harvesting were planed according to the maturity level of crop. Harvesting of wheat was done on weekly basis according to the sowing time as early sowing early harvesting, late sowing its harvesting also late. Wheat of six sowing dates was thrashed separately. The sample of each trial was kept in separate bags with tag of sowing dates. All bags were weighed at electronic balance and recorded its yield.

Data of aphids attack on crop was interred into excel spreadsheet and transferred into statistics 8.1. ANOVA test was applied for analysis of variance between the seeding rates, sowing dates and also with wheat varieties. LSD test was also applied for the significance differences at the probability level 0.05. Graph were made on the excel spread sheet. Grain yield was also recorded, yield data kg/hectare were interred separately into excel spread sheet, than yield data transferred into the computer software statistics 8.1 to calculate the yield kg/hectare, and evaluate the high and lower yield at different sowing and seeding rates.

RESULTS

Effect of sowing dates on wheat aphid's infestation

The results (Table 2) revealed the means number of aphids /5 tillers at different sowing dates. There was significant difference in mean number of aphids/5 tillers observed during six sowing dates (SD1, SD2, SD3, SD4, SD5, SD6).Number of aphids/5 tillers was highly significant (83.17) in the wheat varieties sown at 30 October 2016. SD1 (30-10-2016) was heavily infested by aphids with the mean number of aphids 29.86/5tillers, followed by the SD2 (10-11-2016) with the mean number of aphids 23.00/5tillers, SD3 (20-11-2016) with the mean number of aphids 17.43/5tillers, SD4 (30-11-2016) with the mean number of aphids 16.76/5tillers, SD5 (10-12-2016) with the aphids number was 9.53/5tillers, SD6 (20-12-2016) was least effected by aphids number 5.90/5tillers respectively. All sowing dates showed highly significant difference among them. The results (Table 2) also showed that on dated: 02-03-2017, highest aphid population was recorded at early sowing SD1 (30-10-2016) with the mean number of aphids 119.40/5tillers, followed by SD3 (20-11-2016) having mean number of aphids 112.03/5tillers, SD2 (10-11-2016) with mean number of aphid 108.47/5tillers,

SD4 (30-11-2016) with less aphid attack have 47.70/5tillers aphid numbers, SD5 (10-12-2016) with aphid numbers 31.77/tillers, SD6 (20-12-2016) have least aphid attack with number of aphids 18.73/5tillers. All sowing dates differed significantly from each other. The results (Table 2) also indicated that on dated: 10-03-2017, SD1 (30-10-2016) have highest aphids numbers 100.23/5tillers, followed by SD3 (20-11-2016) with aphid count 98.43b/5tillers, while SD2(10-11-2016) have 85.33/5tillers mean number of aphids, SD4 (30-11-2016) with mean aphids numbers 27.53/5tillers, SD5 (10-12-2016) have less attack with aphid count 25.70/5tillers and SD6 (20-12-2016) have least aphid numbers 12.43/5tillers. All sowing dates showed significant different from each other.

The results (Table 2) on first date of observation (24-02-2017) indicated that aphid attack was greater on early sowing SD1 (30-10-2016) with aphid numbers 29.90/5tillers while on second date of observation (02-03-2017) the aphid number become increased to 119.40/5tillers but in third date of observation (10-03-2017) number of aphids become decreased to 100.23/5tillers while aphid totally disappear at the end of March. The second sowing date SD2 (10-11-2016) have 23.00/5tillers mean number of aphids at the first dated of observation (24-02-2017) while 108.47/5tillers at second date (02-03-2017) after that number of aphids become decreased on dated (10-03-2017) that were 85.33/5tillers. Aphids disappear at the end of March. In SD3 number of aphids were 17.43/5tillers at (24-02-2017) followed by 112.03/5tillers on dated (02-03-2017) while aphids number become decreased to 75.97/5tillers at 10-03-2017. SD4 (30-11-2016) having mean aphids number 16.76/5tillers on dated: 24-02-2017, 47.70/5tillers on dated: 02-03-2017, 27.53/5tillers on dated: 10-03-2017, respectively. SD5 (10-12-2016) having aphids number 9.53/5tillers on dated: 24-02-2017, 31.77/5tillers on dated: 02-03-2017, 25.70/5tillers on dated: 10-03-2017, respectively. SD6 (20-12-2016) having aphids number 5.90f/5tillers on dated: 24-02-2017, 18.73/5tillers on dated: 02-03-2017, 12.43/5tillers on dated: 10-03-2017 respectively. The results (Table 2) also depicted that SD1 was massive infested at mean number of aphids 83.17 followed by SD3 with mean aphid number 75.97, SD2 with aphid infestation 72.26, SD4 with aphid attack/tillers 30.67, SD5 at 22.33 aphid attack/5 tillers, SD6 having least aphid attack 12.35/5tillers.From the above results it is concluded that early sowing at the end of October was not suitable being highly aphid infested.

The Fig. 1 expressed the yield of wheat, according to data analysis of yield, SD2 (10-11-2016) have highest yield 6929.7 kg/ha, followed by SD3 (20-11-2016) have 6207.9 kg/ha yield, SD4 (30-11-2016) having 5981.6 yield kg/ha, SD1(30-10-2016) have 5861.6, SD5 (10-12-2016) produced 5676.8 yield kg/ha, least wheat yield 4738.1kg/ha was recorded at SD6 (20-12-2016). Yield of different sowing dates shown significant difference at $LSD_{0.05}$ (Least significant difference) except SD1 (30-10-2016) and SD4 (30-11-2016) were statistically at par. SD2 (10-11-2016), SD3 (20-11-2016) and SD4 (30-11-2016) shown greater yield as compared to late sowing dates: SD5 (10-12-2016) and SD6 (20-12-2016) have lowest yield. It could be concluded that temperature in the month of November was suitable for wheat sowing and its growth. Maximum number of tillers was recorded at November sowing crops. The greater yield was recorded at 10th November sowing crop. Late sowing in December have low yield because the low temperature in the month of December was not suitable for wheat growth. The minimum numbers of tillers were recorded at late sowing in December. It is recommended that sowing must be completed from 10th Nov to 30th Nov at Bhakkar region for better crop yield.

Screening of wheat varieties against aphids infestation

The results (Table 3) revealed that wheat advanced line TW11510 have less aphids attack with the aphid numbers 10.21/5 tillers as compared to wheat variety Ujala-2016 with the number of aphids 23.96/5 tillers at the end of February (24-02-2017). During March (02-03-2017) when data was collected, the number of aphids recorded low 54.82/tillers of TW11510 while UJALA-2016 greatly infested with the number of aphids 91.25/tillers. At March (10-03-2017) aphid's number was again high 66.81/5tillers on UJALA-2016 but TW11510 advanced line have low number of aphids' 49.66/5tillers.

The results of Table 3 indicated that aphid attack on TW11510 advanced line started at (24-02-2017) with the number of aphids 10.21/5tillers, on (02-03-2017) aphid attack was on its peak with the number 54.82/5tillers, on (10-03-2017) number of aphids were reduced to 49.66/5tillers. While aphid attack on UJALA-2016 was 23.96/5tillers on dated: 24-02-2017, numbers of aphids reached to its peak with the number 91.25/tillers on dated: 02-03-2017, Number of aphids decreased to 66.81/5tillers on dated: 10-03-2017.

The statistical analysis data indicated that highest aphids attack with the aphids mean number (60.67) per 5 tillers was recorded at Ujala-2016 wheat variety while lower mean number of aphids (38.23) was recorded at TW11510 advanced line showing significant difference between the wheat varieties. It could be concluded that ujala-2016 seems to be more susceptible while TW11510 advanced line was more resistant to aphid attack, showing significant differences from one another.TheFig.2 indicated that yield of wheat cultivars, TW11510 advanced line have greater yield i.e., 6059.3 kg/ha while Ujala-2016 having less yield (5739.3 kg/ha).

Effect of seed rates on wheat aphid's infestation

The results (Table 4) revealed that date: 24-02-2017 having 70kg/acre seed rate showed highest mean number of aphids (25.33/5tillers) followed by 60 kg/acre seed rate with 18.50/5 tillers, 30Kg/acre and 40kg/acre having 14.83/5tillers and 14.44/5tillers, respectively. While 50kg/acre seed rate were least infested with mean number of aphid 12.30/5tiller. All seed rates showing significant difference to each other except 30kg/acre and 40kg/acre were statistically at par. While at second date of observation i.e., 02-03-2017 with seed rate 70kg /acre having highest mean aphid number 90.66/5tillers, followed by 60kg /acre with 76.13, 40kg/acre and 30kg/acre with aphid number 73.94/5tillers and 73.41/5tillers, respectively. 50kg/acre showed least aphid attack with 50.91/5tiller. All seed rates showed significant difference to each other except 30kg/acre and 40kg/acre having non-significant difference. On third date of observation dated:10-03-2017 the highest number of aphids was 75.86/5tiller at 70kg/acre seed rate, followed by the seed rate 60kg/acre have

(69.63/5tiller), 40kg/acre have number of aphids (51.58/5tiller), 30kg/acre shown (49.00) number of aphids, 50kg/acre seed rate have least number of aphid 45.30. Mean numbers of aphids/5tillers shown significant difference among all seeding rates.

The results (Table 4) also depicted that aphid attack started at the end of February (24-02-2017), 30kg/acre seed rate having number of aphids 14.83, its number become increased to (73.41) on dated: 02-03-2017 and then its numbers decreased to 49 on dated: 10-03-2017, Similarly 40kg/acre seed rate have aphid attack 14.44/5tillers on dated: 24-02-2017, and number of aphids/5 tillers become increased to 73.94 on dated: 02-03-2017, number of aphid/5tillers decrease to 51.58 on dated:10-03-2017, 50Kg/acre seed rate having least mean number of aphid/5 tillers i.e., 12.30 on dated: 24-02-2017, the aphids number increased to (50.91/5tillers) on dated:02-03-2017, and its number become reduced to (45.30/5tillers) on dated: 10-03-2016, 60kg/acre seed rate have number of aphids 18.50/5tillers on 24-02-2017, 76.13/5tillers at 02-03-2017, 69.63/5tillers at 10-03-2017, respectively. Seed rate @ 70kg/acre has highest number of aphids /5tillers 25.33 at 24-02-2017, 90.66 at 02-03-2017, 75.86 at 10-03-2017, respectively. The results (Table 4) also indicated that highest aphid attack was observed on treatment with 70kg/acre seed rate having aphid infestation (63.95) followed by 60kg/acre (54.75), 40kg/acre (46.65), 30kg/acre (45.75), least aphid count was noted at 50kg/acre (36.18) respectively.

The Fig. 3 revealed the yield kg/hactare of different seed rates. The seed rate 50kg/acre have highest wheat yield 6358.7 kg/ha, followed by 70kg/acre seed rate with yield 5986.4 kg/ha, 60kg/acre have yield 5866.7 kg/ha and 30kg/acre, 40kg/acre with 5683.4 and 5601.3 yield, respectively. Seed rate 50kg/acre, 60kg/acre and 70kg/acre showed significant difference, while 30kg/acre and 40kg/acre showed non-significant difference.

Table 1.
Summary of wheat trial on different seed rates, wheat varieties at six sowing dates during 2016-2017

Sr.No	Varieties	Seed rates at R1	Seed rates at R2	Seed rates at R3
1	TW11510	30Kg/acre	60Kg/acre	70Kg/acre
2	TW11510	40Kg/acre	70Kg/acre	60Kg/acre
3	TW11510	50Kg/acre	30Kg/acre	40Kg/acre
4	TW11510	60Kg/acre	50Kg/acre	50Kg/acre
5	TW11510	70Kg/acre	40Kg/acre	30Kg/acre
6	Ujala-2016	30Kg/acre	60Kg/acre	70Kg/acre
7	Ujala-2016	40Kg/acre	70Kg/acre	60Kg/acre
8	Ujala-2016	50Kg/acre	30Kg/acre	40Kg/acre
9	Ujala-2016	60Kg/acre	50Kg/acre	50Kg/acre
10	Ujala-2016	70Kg/acre	40Kg/acre	30Kg/acre

Table:2
Mean number of aphids/ 5 tillers in different sowing dates during 2016-2017

Sowing Dates	DATE1(24 -02-2017)	DATE2(02 -03-2017)	DATE3(10 -03-2017)	Means
SD1(30-10-2016)	29.86a	119.40a	100.23a	83.17a
SD2(10-11-2016)	23.00b	108.47c	85.33c	72.26 c
SD3(20-11-2016)	17.43c	112.03b	98.43b	75.97b
SD4(30-11-2016)	16.76d	47.70d	27.53d	30.67d
SD5(10-12-2016)	9.53e	31.77e	25.70e	22.33e
SD6(20-12-2016)	5.90f	18.73f	12.43f	12.35f
F Values	4630.29**	34773.7**	19511.7**	72125.3**
$LSD_{0.05}$	0.40	0.76	0.91	0.36
CV%	4.11	1.82	2.73	1.28

Means having same letters in a column are not significantly different at alpha 0.05
**- highly significant different
*- significantly different

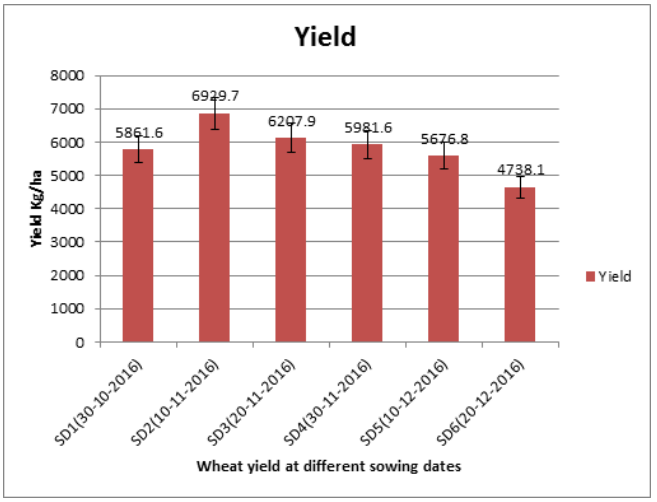

Fig: 1
Yield Kg/hectare at different sowing dates

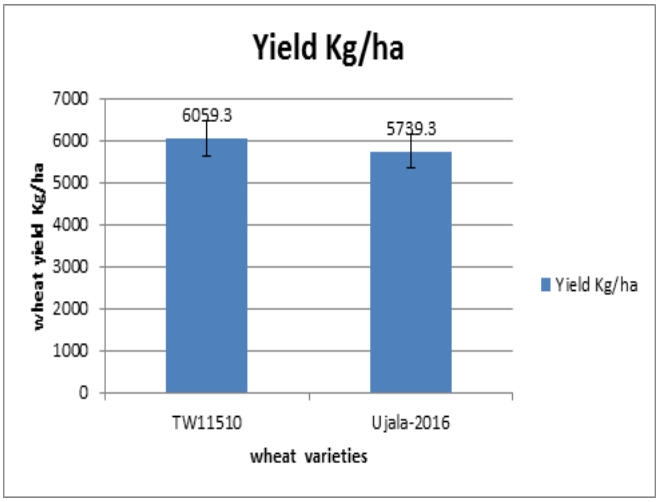

Fig: 2
Yield Kg/hectare of different wheat varieties

Table: 3
Aphids mean number per 5 tillers on different wheat varieties

TREATMENTS	DATE1(24-02-2017)	DATE2(02-03-2017)	DATE3(10-03-2017)	Means
TW11510	10.21b	54.82b	49.66b	38.23b
UJALA-2016	23.96a	91.25a	66.81a	60.67a
F Values	9247.72**	52384.0**	26694.4**	60720.0**
LSD $_{0.05}$	0.31	0.34	0.22	0.19
CV %	5.62	1.46	1.21	1.24

Means having same letters in a column are not significantly different at alpha 0.05
**- highly significant different *- significantly different Ns- Non significant

Table. 4
Mean number of aphids/5 tillers on different seed rates.

SEED RATE	DATE1(24-02-2017)	DATE2(02-03-2017)	DATE3(10-03-2017)	Mean
1 (30Kg/acre)	14.83c	73.41c	49.00d	45.75d
2 (40 Kg/acre)	14.44c	73.94c	51.58c	46.65c
3 (50 Kg/acre)	12.30d	50.91d	45.30e	36.18e
4 (60 Kg/acre)	18.50b	76.13b	69.63b	54.75b
5 (70 Kg/acre)	25.33a	90.66a	75.86a	63.95a
F Values	451.46**	1989.15**	2338.95**	5916.56**
LSD $_{0.05}$	0.67	0.89	0.78	0.38
CV %	8.47	2.62	2.89	1.65

Means having same letters in a column are not significantly different at alpha 0.05
**- highly significant different *- significantly different Ns- Non significant

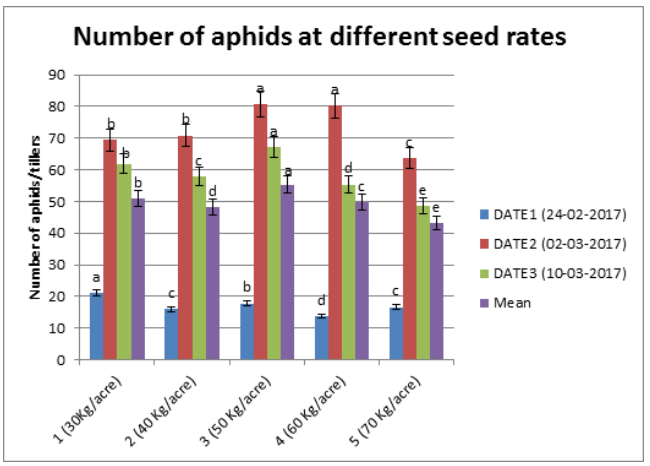

Fig: 3
Mean number of aphid/5 tillers at different seeding rates

DISCUSSION

It is evident from the results that greater wheat yield could be obtained by early sowing, proper seed quantity, and suitable use of wheat varieties. In the present work, the population of aphid was gradually increased from vegetative growth stage to reproductive stage. Similar results were also observed by Bhambhro (2002), Riazuddin and Khattak (2004) and Aslam *et al*. (2005) who reported that aphids breed at the faster rate in cold environment and attain peak at the 4th week of February and early March when crop near to ripening. According to our research work aphid attack started on 24th February and highest aphid population was recorded at the 2nd March, similar result was reported by Ahmad *et al*. (2015) who reported that aphid attack started on February-24 and increased till March -22, then decline up to the first week of April. The present results were partially similar to Ahmad *et al*. (2016) who reported higher number of aphids during March and lower numbers in February and April.

Present research work revealed that early sowing (30th October) was infested with greater number of aphids (83.17/5tillers) but late sowing (December) were least affected (12.35/5 tillers). The results of Wains *et al*. (2010) were also disagreeing with present finding and showed that early sowing has least aphid infestation than late The results were contradicted with the finding of Shahzad *et al*. (2013) and Hussain *et al*. (2015) who that early sowing crop were least affected by aphids than late sowing crop. The present study can be correlated with the work of Akhtar *et al*. (2012) who estimated the highest yield (6292.4kg/hectare) was produced at first November sowing crop, whereas less yield (2020.4kg/hectare) was obtained from late planting at January-16.

In present study it could be concluded that early sowing in November gave better yield as compared to late sowing. These results are in accordance with the observation of Shahzad *et al*. (2013) who reported that early sowing produce greater yield (5650 kg/hectare). Present findings are same as Dokuyucu *et al*. (2004) who evaluated the yield and yield related parameters at different planting dates. Baloch *et al*. (2010) formulated that higher yield were obtained in early sowing on 25th October to 10th November at the seeding rate 150 kg/hectare.

In the present research work seed rate 50kg/acre have higher yield than other seed rates, because this quantity of seed provide proper space for growth and obtained enough nutrients and moisture. Gooding *et al*. (2002) observed quality and yield of wheat was seriously affected at higher seed rates. While present results are in conformity with the work of Soomro *et al*. (2009) who reported that seed rate 150 kg/ha was effective and produced higher yield. Contradicted results were reported by Chauhdary *et al*. (2016) who reported massive crop yield, greater number of tillers, spike and plant's height were gained at the 160 kg ha^{-1} seed rate.

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