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Genetic study of some agronomic traits of Wheat (Triticum aestivum L.)

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Abstract: A study was conducted to evaluate eight parents and their 15 F_1's in randomized complete block design with three replications for different agronomic characteristics. For plant height the line Aas 2011, tester 10065 and hybrid AARI 2011×9459 showed maximum plant height. Among lines, testers and crosses, the line Ujala 2016, tester 10065 and cross Johar 2016×9515 showed maximum number of tillers and number of spikelets per spike. The line AARI 2011, tester 9515 and hybrid Ujala 2016×9459 showed maximum spike length. For number of grains per spike line Johar 2016, tester 9515, and cross of AARI 2011×10065 showed highest value. The highest results were found for 1000 grain weight by line Ujala 2016, tester 9459 and Punjab 2011×9459. The line Aas 2011, tester 9459, and hybrid AARI 2011×9515 showed higher grain yield per plant.
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Key words: Wheat (*Triticum aestivum* L.), yield, Line × tester analysis

Introduction

Wheat (Triticum aestivum L.) is the most widely cultivated crop among the cereals and is the principal food crop in most areas of the world (Kashif et al., 2001). It is the leading grain crop of the temperate climates of the world. Global demand for wheat is growing at approximately 2% per year, twice the current rate of gain in genetic yield potential. Pakistan is one of the largest wheat producing countries of the world. The geometrical increase in Pakistan population has been a challenge for agricultural scientists (Hammad et al., 2013). To feed burgeoning population of Pakistan, there is a dire need to improve wheat genotypes having high yield potential. This could be achieved by exploring maximum genetic potential from available wheat germplasm (Esmail et al.,2007). Plant breeders focus on development of high yielding wheat cultivars by crossing good general combining lines and selecting desirable transgressive segregants from resulting hybrids for grain yield and other traits (Hassan et al., 2007). Some researchers determined that the general combining ability effects for yield and other characters have played a significant role in selecting parents for grain yield (Akbar et al., 2009; Hussain et al., 2014). The aims of this study were to determine evaluation of the germplasm for yield and some yield components in a line × tester crossing design in bread wheat.

Materials and methods

The experiment was performed in University of Agriculture Faisalabad at experimental area of department of Plant Breeding and Genetics for estimation of combining ability effects by applying line×tester mating design. The experiment contains five different lines namely (Ujala 2016, Johar 2016, Aas 2011, Punjab 2011 and AARI 2011) of spring wheat and 9515, 9459 and 10065 used as testers. These wheat varieties were crossed in line ×tester method during 2017-2018. At matured stage, the seeds were selected each and harvested.

1. Ujala 2016×9515
2. Johar 2016×9515
3. Aas 2011×9515
4. Punjab 2011×9515
5. AARI 2011×9515
6. Ujala 2016×9459
7. Johar 2016×9459
8. Aas 2011×9459
9. Punjab 2011×9459
10. AARI 2011×9459
11. Ujala 2016×10065
12. Johar 2016×10065
13. Aas 2011×10065
14. Punjab 2011×10065
15. AARI 2011×10065

In 2nd year of experiment the F_1 seeds along with its 8 maternal were grown at field in RCBD pattern along its 3 blocks in 2nd last week of November. In each block, the lines are placed randomly in experimental unit. Every replication contained eight parents as well as fifteen F_1 crosses along with 3m single row for treatment. P-P Distance was 10cm as well as R-R distance is 30cm. In each hole 2 seeds were sown with dibbler. After germination, the thinning was done one seedling/hole. The experimental population is under normal condition as per sowing to maturity. For good production, all efforts were implemented in field. The best 10 plants were selected from each line for the data analysis. Data were recorded for plant height, spike length, peduncle length, flag leaf area, number of tillers per plant, number of grains per spike, number of spikelet per spike, density of spike, thousand grain weight and yield of grain/ plant from selected plant at maturity stage. The analysis of variances was done to all data taken from different traits of wheat and estimated the significant difference of parents and crosses as given by (Steel *et al*., 1997).

Results and discussion

The study of crop along with its genetic composition is needed for enhance their yield in order to participate those class which were emerging in these increasing population. The breeders should have enough information for the nature of inheritance as well as yield or yield related traits for bringing improvement in present genotypes and making better genotypes.

For introduction of new breeding programme first from segregating generation identify or select those plant which have superior characters on the basis of morphological effect. For most quantitative characters its genetic base is highly associated with its physical appearance so the phenotypic action is used for reliable selection. The quantitative characters which are associated with one or more than genes along with environmental factors and other factors impact on them are participated in selection which proved that selection is difficult. So that for better implementation in breeding programme and for finding plants with desirable characters and desirable yield the impact of breeder is greatly involved.

The procedure which is majorly applied in crop plant wheat is the combining ability analysis in which hybrids are formed from parents which were organised to estimate the ability which are transfer to next characters. The combining ability could be divided for two types SCA and GCA effects. The current study involved the nature of inheritance of yield or yield related traits by applying line×tester analysis and studied the genetic action and combining ability made from Kempthorne (1957). For elimination of more number of parents from GCA and SCA the line×tester analysis will be performed. This method can be used for fifteen crosses which are developed from five lines and three testers. The line×tester analysis method and analysis of variances can be applied on calculated data. The results were prescribed below:

Analysis of variances (ANNOVA)

For all plant trait the analysis of variances was showed in Table NO 1. For all plant characters namely height of plant, spike length, no of spikes within spikletes, spike density, thousand weights of kernel and kernel production within plant showed significant differences.

Table 4.1: Mean square ANOVA for traits studied in wheat using RCBD design

Source of variation	D.F	Plant height (cm)	Spike length (cm)	No. of tillers per plant	No. of grains per spike	No. of spikelets per spike	1000- grain weight (g)	Grain Yield per plant (g)
Genotype	22	0.686*	1.694NS	0.144*	7.15*	0.889NS	0.233*	12.935**
Replication	2	0.686NS	1.694NS	0.144NS	7.15NS	0.889NS	0.233NS	12.935NS
Error	44	3.6359	0.81674	2.33763	15.174	0.68445	2.1092	8.7817

*= Significant at $P < 0.05$
** = Significant at $P < 0.01$
ns = Non- significant

Mean performances of lines, tester and their cross combinations

Plant height (cm):

Data taken in between the females, males and combination of crosses applied at field trial exhibited big variety for expression within overall characters. Within females, head of plant ranges by 92.8 cm to 104.5 cm. Height of plant maximum ranged 104.5 cm was taken from line Johar 2016 in respect to lines 99.6 cm taken from line Ujala 2016, 99.5 cm taken from line Aas 2011, 94.08 cm measured from line Punjab 2011, 94.08 cm measured from line AARI 2011. Among testers height of plant ranked from 91.3 cm to 96.5 cm. Highest height of plant 96.5 cm was calculated from tester 10065 proceed by 9459(91.74 cm) and 9515 (95 cm) indicated in below Table. Among crosses, plant height ranked from 84.5 cm to 106.88 cm. AARI 2011×9459 indicated 106.88 cm the

maximum plant height and minimum plant height was showed by cross AARI 2011×10065 (84.5 cm) as showed by below Table. For all lines, testers and crosses mean values were showed in Fig 1.

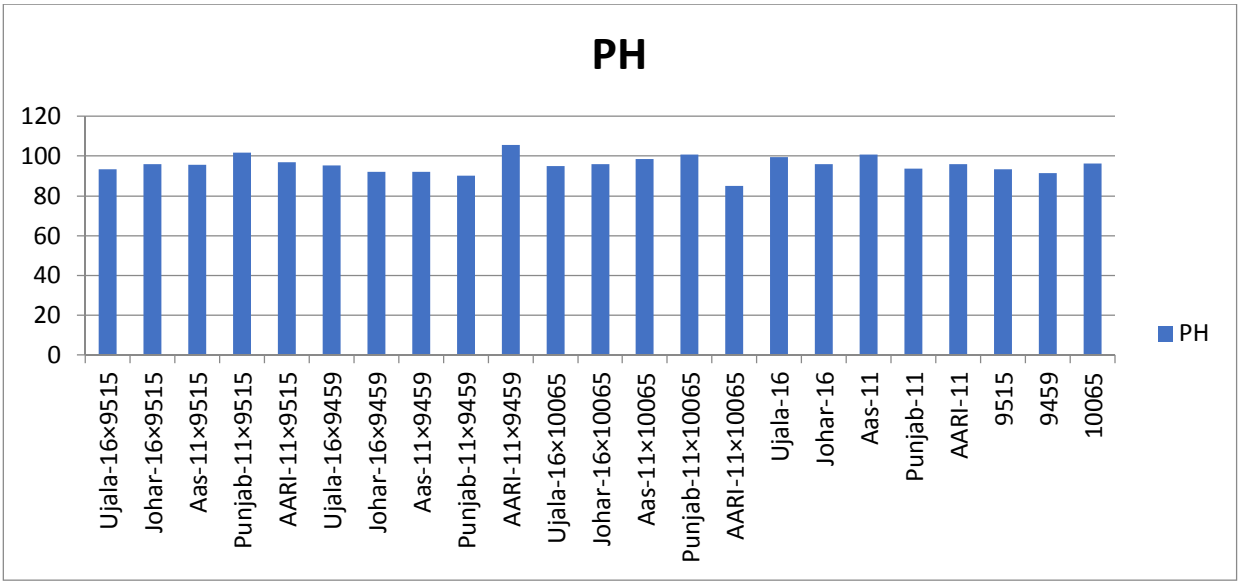

Fig 1: Mean values of lines, testers and crosses for plant height

Number of tillers per plant

Number of tillers is dominant character in case of yield. As more number of tillers per plant more the yield of kernel. Data taken within all the lines, testers and crosses applied in the field experiment exhibited big range of expression among overall characters. Among lines, no. of tillers per plant ranges from 10 to 16.6. Number of tillers per plant maximum ranged 16.6 was taken from line Ujala 2016 in respect to lines 16 taken from line Johar 2016, 12 taken from line Aas 2011, 11.6 measured from line AARI 2011, 11 measured from line Punjab 2011. Among testers number of tillers per plant ranked from 5.6 to 11.6. Highest number of tillers per plant 11.6 was calculated from tester 10065 proceed by 9515 (11.2) and 9459 (8.4) indicated in below Table. Among crosses, number of tillers per plant ranked from 8.8 to 19.6. Johar 2016×9515 indicated 19.6 the maximum no. of tillers per plant and minimum number of tillers per plant was showed by cross AARI 2011×9459 (8.8) as showed by below Table. For all lines, testers and crosses mean values were showed in Fig 2.

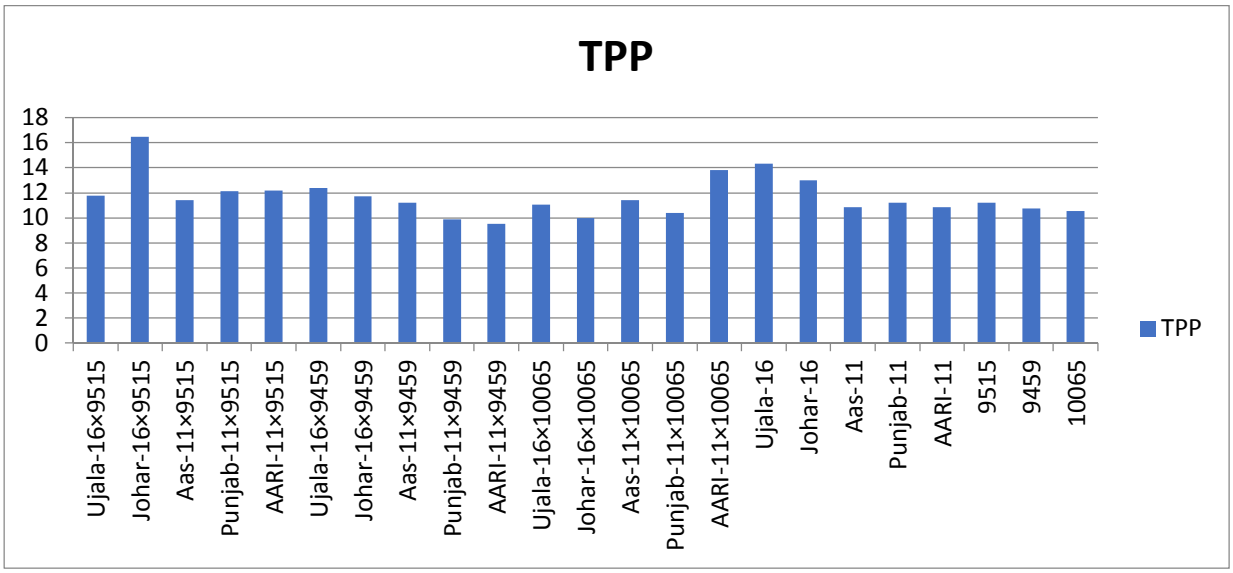

Fig 2: mean values of lines, testers and crosses for number of tillers per plant

Spike length (cm)

Data taken from all the females, males and crosses applied in the field experiment exhibited big variety to reveal of overall characters. Within females, spike length ranges by 10.42 cm to 14.88 cm. Spike length highest ranged 14.88 cm was taken from line AARI 2011 in respect to lines 14.52 cm taken from line Punjab 2011, 13.56 cm taken from line Ujala 2016, 13.26 cm measured from line Johar 2016, 12.54 cm measured from line Aas 2011. Among testers length of spike ranked from 12.94 cm to 14.36 cm. Highest spike length 14.36 cm was calculated from tester 9515 proceed by 9459(13.86 cm) and 10065 (12.94 cm) indicated in below Table. Among crosses, spike length ranked from 10.34 cm to 14.48 cm. Ujala 2016×9459 indicated 14.48 cm the maximum spike length and minimum spike length was showed by cross AARI 2011×9459 (10.34 cm) as showed by below Table. For all lines, testers and crosses mean values were showed in Fig 3.

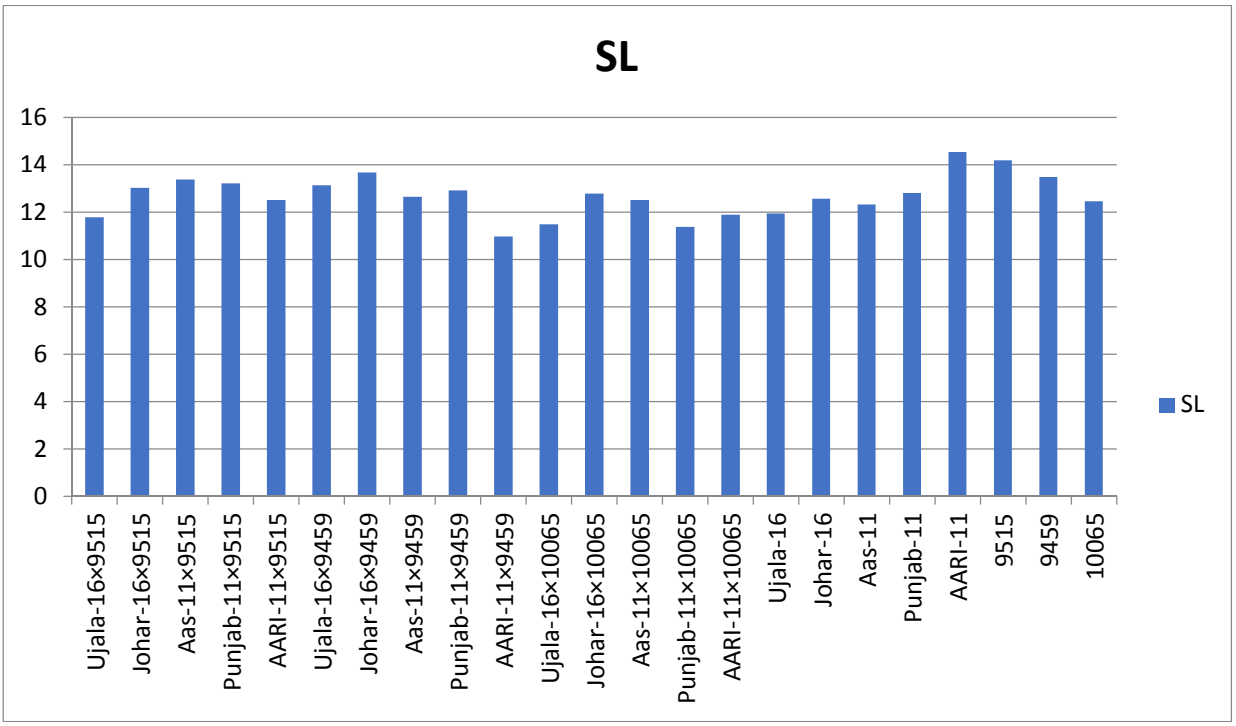

Fig 3: mean values of lines, testers and crosses for spike length

Number of spikelets per spike

Data taken from all the lines, testers and crosses applied in the field experiment exhibited big range of expression for all characters. Among lines, number of spikelets per spike ranges from 18 to 21.2. Number of spikelets per spike maximum ranged 21.2 was taken from line Ujala 2016 in respect to 21 taken from line Punjab 2011, 20.8 taken from line AARI 2011, 19.8 measured from line Aas 2011, 19.2 measured from line Johar 2016. Among testers number of number of spikelets per spike ranked from 19 to 20.4. Highest number of number of spikelets per spike 20.4 was calculated from tester 10065 proceed by 9515 (20.2) and 9459 (19.6) indicated in below Table. Among crosses, number of spikelets per spike ranked from 18.2 to 21.4. Johar 2016×9515 indicated 21.4 the maximum number of spikelets per spike and minimum number of tillers per plant was showed by cross AARI 2011×9515 (18.2) as showed by below Table. For all lines, testers and crosses mean values were showed in Fig 4.

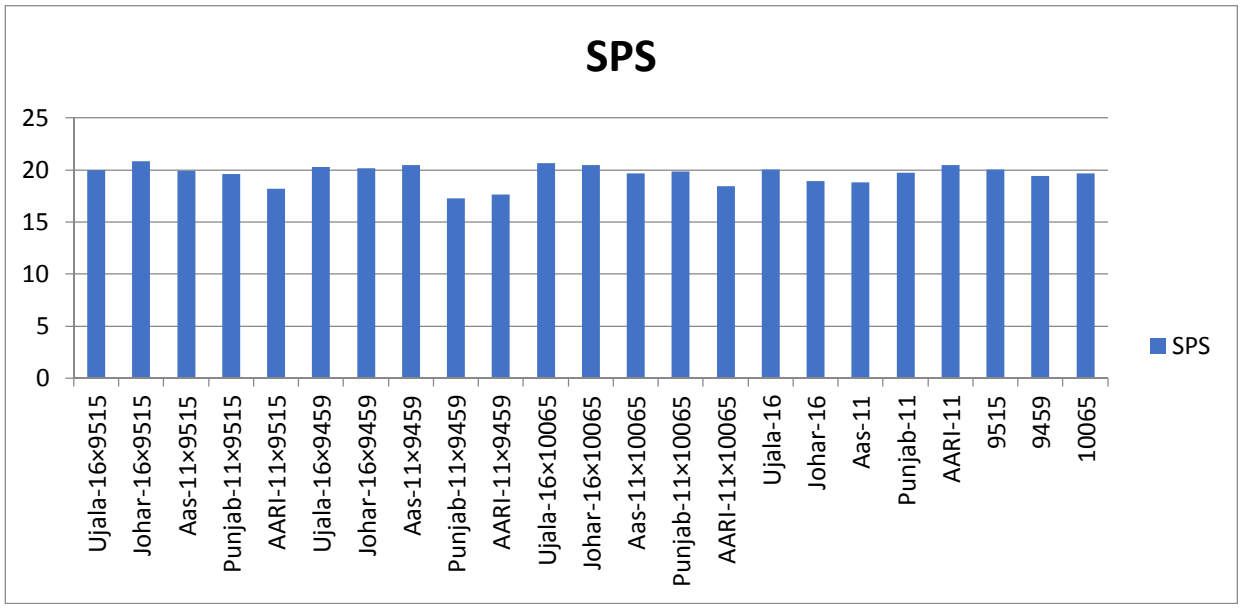

Fig 4: mean values of lines, testers and crosses for number of spikelets per spike

Spike density

Data taken from all the lines, testers and crosses applied in the field experiment exhibited big range of expression for all characters. Among lines, spike density ranges from 1.39 to 1.79. spike density maximum ranged 1.79 was taken from line Ujala 2016 in respect to 1.74 taken from line Punjab 2011, 1.66 taken from line Johar 2016, 1.66 measured from line Aas 2011, 1.43 measured from line AARI 2011. Among testers spike density ranked from1.37 to 1.63. Highest spike density 1.63 was calculated from tester 10065 proceed by 9459 (1.52) and 9515(1.45) indicated in below Table. Among crosses, spike density ranked from1.24 to 2.00. Ujala 2016×10065 indicated 2.00 the maximum spike density and minimum spike density was showed by cross Punjab 2011×9459 (1.24) as showed by below Table. For all lines, testers and crosses mean values were showed in Fig 5.

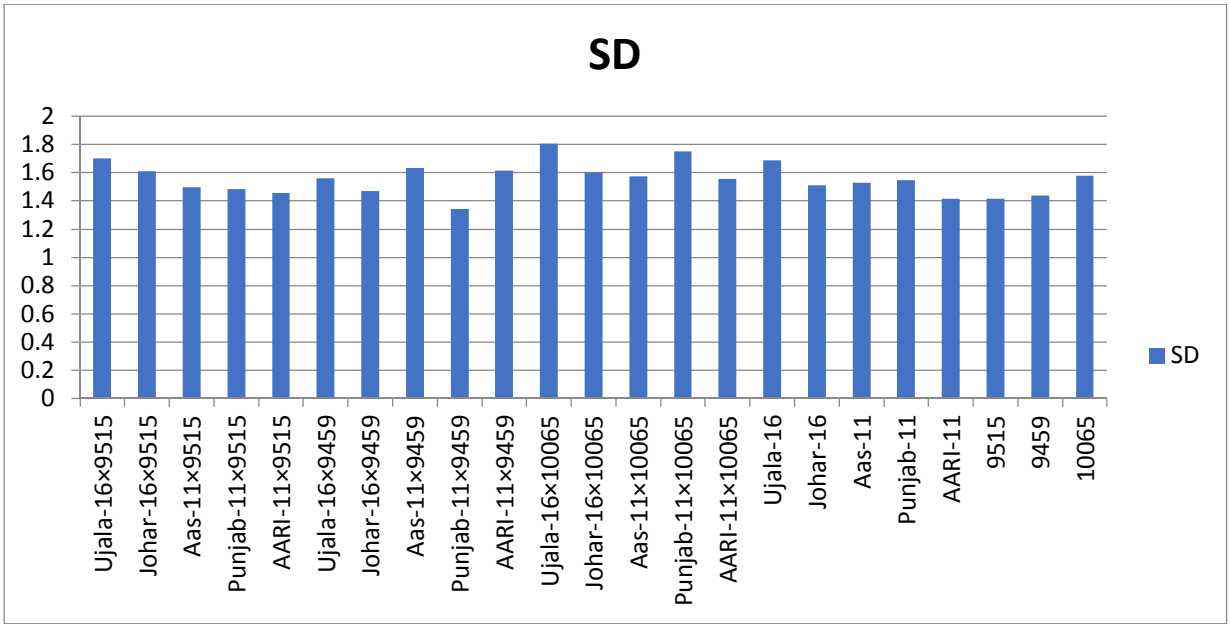

Fig 5: mean values of lines, testers and crosses for spike density

Number of grains per spike

Data taken from all the lines, testers and crosses applied in the field experiment exhibited big range of expression for all characters. Among lines number of grains per spike ranges from 58.5 to 76. Number of grains per spike maximum ranged 76 was taken from line Johar 2016 in respect to 69.5 taken from line Ujala 2016, 67.8 taken from lines Aas 2011, 54.8 measured from line Punjab 2011, 58.5 measured from line AARI 2011. Among testers number of grains per spike ranked from 65 to 73. Highest number of grains per spike 73 was calculated from tester 9515 proceed by 9459 (65.5) and 10065 (65) indicated in below Table. Among crosses, number of grains per spike ranked from 43 to 77.6. AARI 2011×10065 indicated 77.6 the maximum number of grains per spike and minimum number of grains per spike was showed by cross Aas 2011×9459 (43) as showed by below Table. For all lines, testers and crosses mean values were showed in Fig 6.

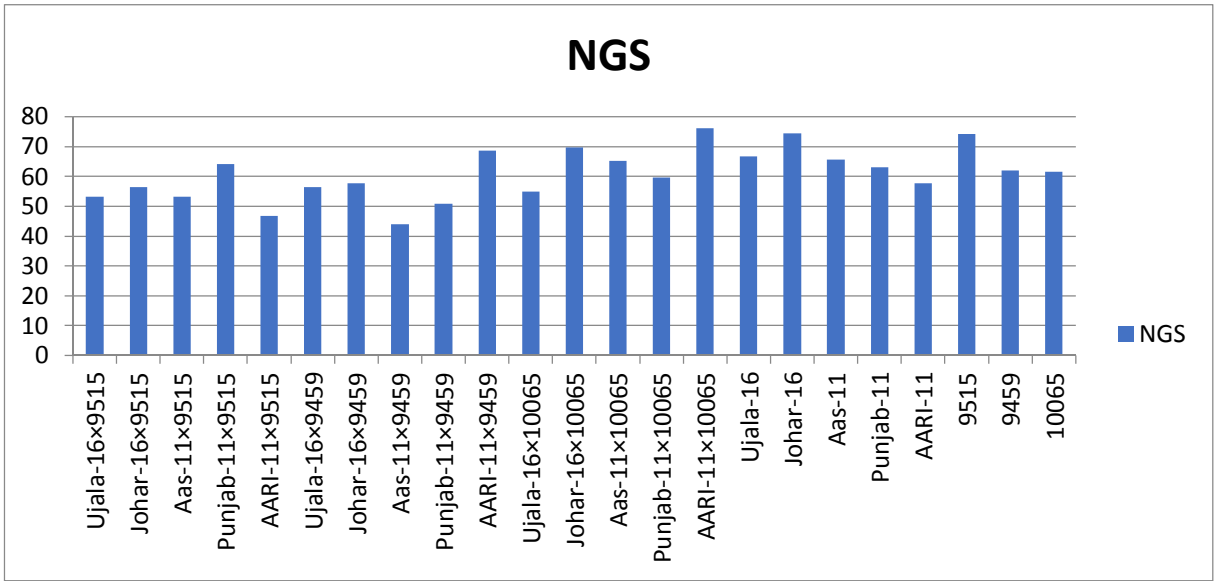

Fig 6: mean values of lines, testers and crosses for number of grains per spike

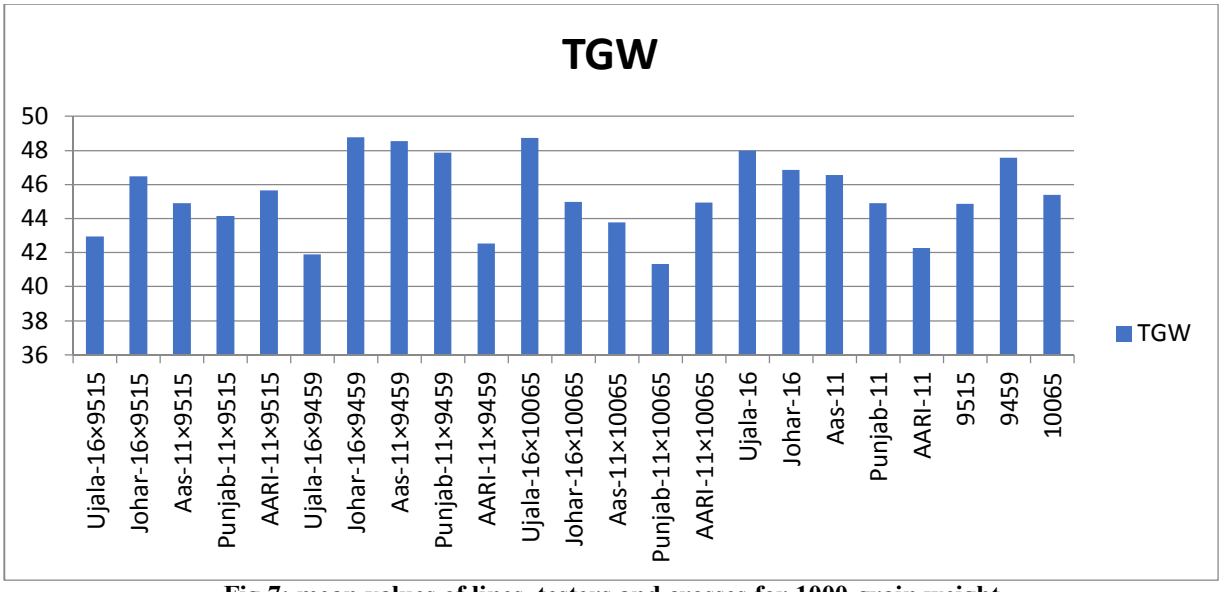

Fig 7: mean values of lines, testers and crosses for 1000-grain weight

1000-grain weight (g)

Data taken from all the lines, testers and crosses applied in the field experiment exhibited big range of expression for all characters. Among lines 1000-grain weight ranges from 43.26 g to 49.52 g. 1000-grain weight maximum ranged 49.52 g was taken from line Ujala 2016 in respect to 49.51 g taken from line Johar 2016, 47.54 g taken from lines Aas 2011, 45.62 g measured from line Punjab 2011, 43.26 g measured from line AARI 2011. Among testers 1000-grain weight ranked from 45.52 g to 48.63 g. Highest 1000-grain weight 48.63 g was calculated from tester 9459 proceed by 10065 (46.09 g) and 9515 (45.52 g) indicated in below Table. Among crosses, 1000-grain weight ranked from 40.21 g to 49.65 g. Punjab 2011×9459 indicated 49.65g the maximum 1000-grain weight and minimum 1000-grain weight was showed by cross Punjab 2011×9515 (40.21 g) as showed by below Table. For all lines, testers and crosses mean values were showed in Fig 7.

Grain yield per plant (g)

Data taken from all the females, males and crosses applied in the field experiment exhibited big varied of overall characters. Within female's grain yield per crop plant ranges from 22.45 g to 26.67 g. Grain yield per plant maximum ranged 26.67 g was taken from line Aas 2011 in respect to 22.65 g taken from line Johar 2016, 22.47 g taken from lines Punjab 2011, 22.45 g measured from line AARI 2011,23.46 g measured from line Ujala 2016. Among testers grain yield per plant ranked from 18.63 g to 24.65 g. Highest grain yield per plant 24.65 g was calculated from tester 9459 proceed by 9515 (19.45 g) and 10065 (18.63 g) indicated in below Table. Among crosses, grain yield per plant ranked from 10.12 g to 26.31 g. AARI 2011×9515 indicated 26.31 the maximum grain yield per plant and minimum grain yield per plant was showed by cross Aas 2011×9515 (10.12 g) as showed by below Table. For all lines, testers and crosses mean values were showed in Fig 8.

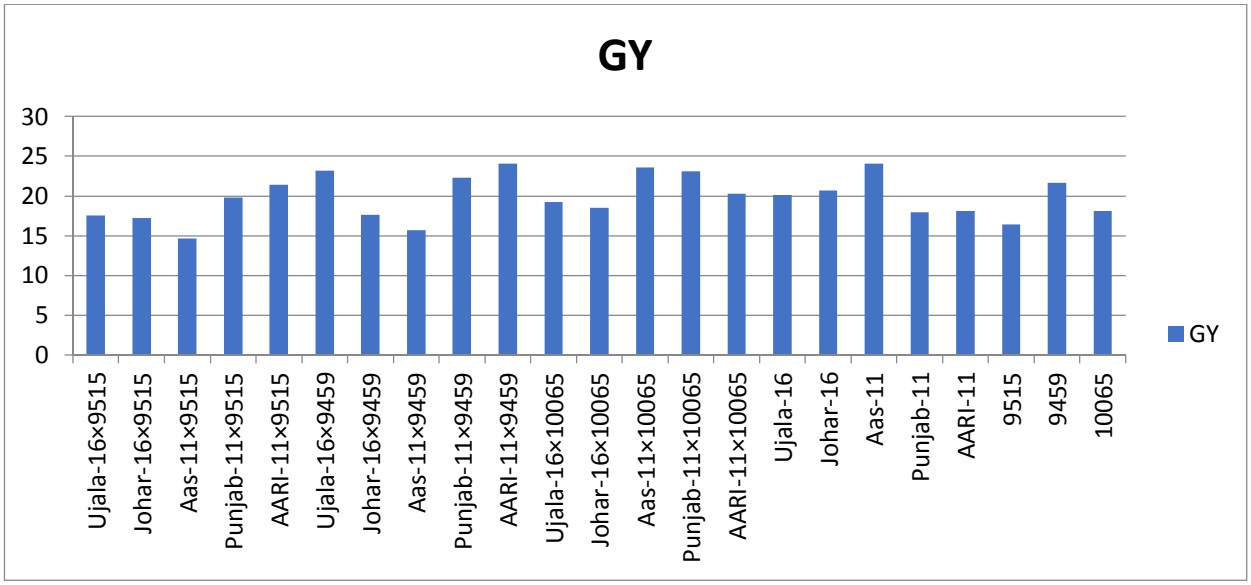

Fig 8: mean values of lines, testers and crosses for grain yield per plant

Conclusion

Considerable genetic variation exists in wheat genotypes for improving basic yield components. The research evaluated that the parental material namely Ujala 2016, Johar 2016, Aas 2011, Punjab 2011 and AARI 2011 could be used in hybridization method for future breeding procedures. The cross combination Aas 2011×10065, Aas 2011×9459 and Punjab 2011×9515 will be good for better breeding program.

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