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Genetic Potential of Newly Developed Bread Wheat Advanced Lines for Important Traits under Normal and Late Planting Dates

MUHAMAMD ISHAQ
Wheat Breeding &Genetics Section
Cereal Crops Research Institute (CCRI)
Pirsabak Nowshera Khyber Pakhtunkhwa, Pakistan
Department of Plant Breeding and Genetics
University of Agriculture, Peshawar, Pakistan
GULZAR AHMAD
Wheat Breeding &Genetics Section
Cereal Crops Research Institute (CCRI)
Pirsabak Nowshera Khyber Pakhtunkhwa, Pakistan
KHILWAT AFRIDI
Wheat Breeding &Genetics Section
Cereal Crops Research Institute (CCRI)
Pirsabak Nowshera Khyber Pakhtunkhwa, Pakistan
IBIN-AMIN KHALIL
Wheat Breeding &Genetics Section
Cereal Crops Research Institute (CCRI)
Pirsabak Nowshera Khyber Pakhtunkhwa, Pakistan
Department of Plant Breeding and Genetics
University of Agriculture, Peshawar, Pakistan

Abstract:

Development of newly wheat lines suitable for normal and late planting is one of the prime objectives of wheat breeding programs. A field experiment was conducted at Cereal Crops Research Institute, Pirsabak, Nowshera during 2013-2014, to identify high yielding bread wheat genotypes suited for Normal and late planting dates in the central agro ecological zone of Khyber Pakhtunkhwa. The genotypes included in this study were developed by different Research Institute in khyber Pakhtunkhwa. A set of twenty genotypes were planted under the same sowing conditions during 2013-2014, using two different

sowing dates (November & December) as a separate factor. Statistical analysis of the data revealed that significant differences in days to heading, days to maturity, plant height, and grain yield kg ha^{-1} were observed for all the genotypes with respect to early and late sowing dates. The results indicated that the overall performance of the genotypes was the best with respect to normal sowing. Based on the average values of normal and late sowing, days to heading, days to maturity, plant height, and grain yield kg ha^{-1} ranged from 111 to 115 days, 147 to 151 days, 81.5 to 112.6 cm and 2048.1 to 4420.4 kg ha^{-1} respectively. Though all the characters were negatively affected as a result of late sowing .However the genotypes PS-11, PS-12 and SRN-10023 with grain yield of 4420.4, 4155.6 and 4006.5 kg ha^{-1} respectively performed well under Normal and late planting dates as compared to those of the best checks (Pirsabak-2013 & Pirsabak-2008). Genotype PS-11 was found best as it out yielded all other lines and checks and stable under both planting dates. Results indicated that these wheat genotypes among existing germplasm may have in built tolerance against terminal heat stress/ under late planting condition and can be sown by farmers under normal and late production system.

Key words: Advanced lines, Genetic potential, planting dates, High yield, Tolerance

Introduction

Wheat (*Triticum aestivum* L.) belongs to family Gramineae and is one of the leading cereals of many countries of the world. Its diverse uses, nutritive importance and storage qualities have made it a staple food for more than one-third of the world population. In Pakistan wheat occupies 37.1% of the total cropped area while its share in total production is about 70%. It is the principal food grain produced and occupies a leading position in the cropping patterns of Pakistan. Wheat contributes 10.1 percent to the value added in agriculture and 2.2 percent to the GDP. Wheat was grown in Pakistan on an area of 8.7 million ha which produced 24.2 million tons with an

average yield of 2787 kg ha^{-1} during 2009-10 (Economic survey of Pakistan, 2012-113). The average yield of wheat in Pakistan is very low when compared with technologically advanced countries of the world like USA, Australia, France, China, Brazil etc.

Although timely sowing of wheat is a prime condition to achieve the maximum yield per hectare there are several constraints (viz., delay in rain fall, unavailability of irrigation water and machinery at proper time, sowing of wheat after sugarcane and rice crop etc.) which prevent timely sowing of the crop. Apart from other biotic and abiotic stresses responsible for low wheat productivity in the province, late heat stress during grain filling period of the normal as well as late planted wheat is also considered one of the major environmental factors drastically reducing wheat production in most of the wheat growing areas under different agro-ecologies of country including Khyber Pakhtunkhwa (Subhan *et al.*, 2004).

Increased tolerance in late planted wheat is very essential to enhance and stabilize wheat productivity in the country. Breeding for selecting genotypes with increased heat tolerance is therefore, one of the most vital objectives in wheat improvement programme. In order to compensate yield losses in wheat caused by late sowing, breeders are searching wheat genotypes that have increased tolerance under late planting condition (Reynolds *et al.*, 1998; Irfaq *et al.*, 2005). The present study was carried out in to select genotypes among the existing wheat germplasm with in built resistance/tolerance to terminal heat stress associated with late planting so as to utilize them for development of high yielding, widely adapted and good quality varieties suitable for cultivation under late planting conditions in Khyber Pakhtunkhwa.

Materials and Methods

The genotypes included in this study were developed by different Research Institutes across khyber Pakhtunkhwa. A set of twenty wheat genotypes listed in table1 were evaluated at Cereal Crops Research Institute, Pirsabak, Nowshera during 2013-2014, to identify high yielding bread wheat genotypes suited for Normal and late planting dates.(November & December). Genotypes were evaluated in randomized complete block design with replications. Each genotype was sown in 5 meter long 6 rows each with row to row distance of 30 cm. Plot area for each entry was 9 m^2. Uniform seed rate of 100 kg ha^{-1} was used. Planting was done with hand hoe. Fertilizer was applied at the ratio of 120:60 kg ha^{-1} of NP in the form of Single Super Phosphate (SSP) and Urea. SSP was applied as basal dose at the time of sowing while urea was applied in split doses; half at the time of sowing and half with first irrigation. All other recommended and standard agronomic practices were kept normal and uniform for all the experimental units in order to reduce experimental error. Data were recorded on days to heading, days to physiological maturity, Plant height and grain yield (kg ha^{-1}). Data were analyzed statistically with the statistical package MStat-c (Knowledge Dynamics Corporation, USA). LSD test was used for the significance of treatment differences.

Results and Discussion

Days to heading

Individual and combined Analysis of variance results revealed highly significant differences among the genotypes sown under normal and late planting dates (Table II).Under normal planting, days to heading range from 117 to 124 days with mean value of 119 days. Genotypes SRN-10013, SRN-10055 and Pirsabak-2013 took the minimum (117) days to start

heading while, maximum (124) days were taken by local check Pirsabak-2008 to start heading. On the other hand under late sowing days to heading range from 103 to 107 days and genotypes PS-13, SRN-10013, SRN-10055 and SRN-10023 were found best as it headed earlier than the check cultivar. Based on the average values of normal and late sowing, reveal that minimum (111) days to heading were recorded for PS-13, AUP-2281, CT-10164, SRN-10023, SN-307, Pirsabak 2013 representing earliness of the genotypes where as maximum days to heading were recorded for the genotypes PS-15 , DN-105 followed by Local check Pirsabak 2008. Decrease in days to heading was observed when genotypes were sown late as compared to normal sowing. % reduction for days to heading range from 10.48 to 15.36 (Table III). Significant differences for days to heading were observed by when genotypes were planted on different sowing dates. These results are in agreement with those of Irfaq et al., (2005) &2007.

Days to physiological maturity

Highly significant difference in the mean values for the character under consideration was observed as a result of the genotypes, different sowing dates and interaction between genotypes and dates (Table II). The mean values for all the genotypes with respect to days to maturity differed from one another under the influence of both the sowing dates. Differences in the mean values for the genotypes were highly significant under the influence of normal sowing date whereas non-significant differences in the mean values were there under late sowing condition. Under normal planting days to maturity ranged from 156 to 160 days. Genotype Pirsabak-2013 took the minimum (156) days to maturity while, maximum (160) days were taken by genotypes PS-12 and DN-105 to mature. On the other hand under late sowing days to maturity range from 137-143 days and genotype SRN-10013 was found best as it mature earlier than other genotypes. Based on the average

values of normal and late sowing, days to maturity ranged from147 to 151 days. Results revealed that minimum days to maturity were recorded for PS-13, SRN-10013 representing earliness of the genotypes where as maximum days to maturity were recorded for the genotypes PS-12, DN-105 and SN-306. For days to maturity % reduction ranged from 10.46 to 12.68 representing decrease in days to maturity. (Table III). Significant decrease in days to maturity was also reported by Jain *et al*., (1992) Irfaq et al., (2005) &2007.

Plant height (cm)

Analysis of variance results revealed highly significant differences for plant height under Normal, late planting dates. Combined ANOVA results showed that genotypes effects. Sowing dates and genotypes x sowing dates were highly significant (Table II). Under normal sowing plant height ranged from 84.4 to 118.8 cm. short stature genotype was Pirsabak-2008 while maximum (118cm) plant height were observed for SRN-10013.on other other hand at late sowing condition plant height ranged from78.5 to 106.5. Minimum plant height was recorded for Pirsabak-2008 while maximum plant height (106.5cm) was recorded for SRN-10013. Based on average value under normal and late planting dates, plant height ranged from 81.5 to 112.6. Minimum plant height (81.5 cm) was recorded for Pirsabak-2008 followed by PS-14(104. 5cm) while maximum height (112.6 cm) was observed for SRN-10013. For plant height % reduction ranged from -0.61 to 13.07. (Table IV). Decrease in plant height were observed for different genotypes as a results of late planting. The decrease in plant height must have been occurred due to shortness in growth period as well as photosynthetic period because of terminal heat stress in association with late sowing. The present results are in agreement with those of Shazad *et al*., (2002) and Irfaq *et al*., (2005) who also observed reduction in plant height of different wheat genotypes as a result of late sowing.

Grain yield

Significant differences in the mean values for grain yield was observed between different genotypes, dates and interaction b/w dates and genotypes under both normal and late sowing dates (Table II).Under normal sowing grain yield ranged from 2514.8 to 5459.3 kg ha^{-1}. Genotype DN-105 produced minimum grain yield (2514.8 kg ha^{-1}) while, PS-11 produced maximum (5459.3 kg $ha^{-1)}$ under normal sowing condition. On the other hand at late sowing condition grain yield ranged from 1581.5 to 3381.5 kg ha^{-1}. Minimum grain yield was recorded for DN-105 while maximum grain yield was recorded for PS-11. Based on average value under normal and late planting dates, grain yield ranged from 2048.1 to 4420.4 kg ha^{-1}.Average over both sowing dates DN-105 produced minimum grain yield (2048.1 kg ha^{-1}) showing poor performance under both sowing dates. Genotypes PS -11 produced maximum gain yield (4420.4 kg $ha^{-1)}$ averaged over both planting conditions show its superiority over other genotypes. For grain yield reduction ranged from 29.89 to 53.07 % (Table IV). Decrease in grain yield was observed for different genotypes as a results of late planting. Grain yield is a complex and polygenic character and highly influenced by genotype, environment and genotype x environment interaction (Sial *et al.,* 2003; Arain *et al.,* 2001). Our results are in agreement to those of Okuyama *et al.,* (2005) Darwinkel *et al*., (1977), Kirby (1967), Jain *et al*., (1992) and Kumar *et al*., (1994) who found that delay in sowing is directly associated with consistent reduction in grain yield.

Conclusion and Recommendation

Results of the presents study revealed that genotypes performed well under normal planting while consistence reduction in studied traits was observed as a results of late sowing. However Genotypes PS-11, PS-12 and SRN-10023 with grain yield of 4420.4, 4155.6 and 4006.5 kg ha^{-1} respectively

performed well under Normal and late planting dates as compared to those of the best checks (Pirsabak-2013 & Pirsabak-2008). Genotype PS-11 was found best as it out yielded all other lines and checks and stable under both planting dates. Genotype PS-11 has in built tolerance against late sowing condition and is suitable for both planting dates.

Table I: List of the newly developed wheat lines included in the study

Wheat Lines	Parentage/ Pedigree	Breeding Statation
PS-11	MTRWA92.161/PRINIA/5/SERI*/SERI*3//RL6010/ 4*YR/3/PASTOR/4/BAV92	CCRI Pirsabak
PS-12	MTRWA92.161/PRINIA/5/SERI*3//RRRI*3//RL6010/4*YR/3/PASTOR/4/BAV92	-do-
PS-13	BERKUT/EXCALIBURCMSA02M00148S-028ZTM-028RLNIM-010Y-010M-5S-OM-02Y-OB	-do-
PS-14	QUAICGSS01B00046T-099Y-099M-099M-099Y-099M-32Y-0BYPPM	-do-
PS-15	PIN/BOW//OPATA/3/HXL7573/2*BAU	-do-
AUP-1953	_____	Agric Uni Peshawar
AUP-2281	_____	-do-
AUP-4959	_____	-do-
CT-10164	WAXWING*2/TUKURU	NIFA Peshawar
CT-10187	PBW343/PASTOR//OTUS/TOBA97	-do-
SRN-10013	D67.2/P66.270//AESQURROSA 320)/3/….	-do-
SRN-10023	YANAC/3/PRL/SARA//TSI/VEE#5/4/CROC_1/…	-do-
SRN-10055	PBW343*2/KUKUNA//KRONSTAD F2004/3/PBW 343*2/…	-do-
DN-105	CHAM-8	ARI D.I.Khan
BAFFA-1/309	BABAX/LR2//BABAX/3/ER2000	ARS Baffa Mansehra
BAFFA-2/343	SOKOL/3/PASTOR//HXL 7573/2*BAU	-----do-------
SN-306	CROC_1/AE.SQUARROSA (224)//OPATA/3/BJY/COC//	ARS Serai Naurang
SN-307	CROC_1/AE.SQUARROSA (205)//BORL95/3/KENNEDYCMSS99M02166S-040M-040SY-11M-2Y-8M-0ZTB-OSY	-------do------
Pirsabak-2013 check	----------	CCRI Pirsabak
Pirsabak-2008 Local check	----------	-----do----

Table II: Individual and combined ANOVA for various traits.

	SOV	DF	Days to heading	Days to maturity	Plant height	Grain yield
Normal planting	Genotypes	19	81.210**	4.543**	176.15**	1278318.88**
	Replication	2	15.417	8.550	40.34	379475.70
	Error	38	3.031	1.006	5.35	216364.26
Late planting	Genotypes	19	4.460**	6.957NS	167.178**	604521.63**
	Replication	2	3.267	4.017	0.729	201460.39
	Error	38	0.723	3.999	4.492	101549.73
Combined ANOVA	Date of sowing	1	6497.41**	10193.6**	2721.77**	95040000**
	Genotypes	19	13.8**	9.9**	325.83**	1514779**
	Reps within sowing	4	1.79	6.3	19.67	290177
	Date of sowing x Genotypes	19	4.64**	1.6NS	16.41**	368139**
	Error	76	0.92	2.5	4.81	158983
	CV(%)		0.86	1.06	2.17	11.54

**= Highly significant at 1% level of probability NS= Non signioficant

Table III: Mean values for days to heading and maturity of 20 wheat lines evaluated under normal and late planting dates at CCRI, Pirsabak Nowshera during 2013-14.

	Days to heading				Days to maturity			
Genotypes	**Normal**	**Late**	**Mean**	**% reduction**	**Normal**	**Late**	**Mean**	**% reduction**
PS-11	121	105	113	12.95	159	140	150	12.13
PS-12	123	106	114	13.86	160	141	151	11.88
PS-13	119	103	111	13.97	157	138	147	11.91
PS-14	118	105	112	11.02	158	140	149	11.58
PS-15	123	107	115	12.77	159	141	150	11.30
AUP-1953	119	106	113	11.45	157	139	148	11.68
AUP-2281	118	105	111	11.05	157	139	148	11.06
AUP-4959	120	104	112	12.81	157	138	148	11.70
CT-10164	118	104	111	11.86	158	140	149	11.39
CT-10187	120	105	113	12.74	159	140	149	11.76
SRN-10013	117	103	110	11.68	157	137	147	12.53
SRN-10023	119	103	111	13.45	158	139	149	12.21
SRN-10055	117	103	110	12.00	158	138	148	12.68
DN-105	123	107	115	13.24	160	142	151	11.04
BAFFA-1/309	119	106	112	10.96	159	142	150	10.50
BAFFA-2/343	120	105	112	12.26	159	140	150	11.95
SN-306	118	105	112	10.48	159	143	151	10.46
SN-307	118	104	111	11.58	157	139	148	11.49
Pirsabak-2013(Check)	117	105	111	10.51	156	139	148	11.09
Local check	124	105	114	15.36	159	139	149	12.76
Mean	**119**	**105**			**158**	**140**		
LSD for genotypes =		**1.10**			**LSD for genotypes**		**=1.81**	
LSD for sowing =		**0.34**			**LSD for sowing**		**=0.57**	
LSD for genotypes x sowing =			**1.56**		**LSD for genotypes x sowing**			**= 2.57**

Table IV: Mean values for days to heading and maturity of 20 wheat advanced lines evaluated under normal and late planting dates at CCRI, Pirsabak Nowshera during 2013-14.

	Plant height				Grain yield			
Genotypes	**Normal**	**Late**	**Mean**	**% decrease**	**Normal**	**Late**	**Mean**	**% decrease**
PS-11	110.3	101.3	105.8	8.13	5459.3	3381.5	4420.4	38.06
PS-12	110.1	101.0	105.5	8.24	5027.8	3283.3	4155.6	34.70
PS-13	105.8	93.7	99.7	11.44	4040.7	2688.9	3364.8	33.46
PS-14	104.2	104.8	104.5	-0.61	3664.8	2609.3	3137.0	28.80
PS-15	109.9	101.3	105.6	7.77	4485.2	3133.3	3809.3	30.14
AUP-1953	108.1	98.7	103.4	8.70	4672.2	2946.3	3809.3	36.94
AUP-2281	109.3	104.3	106.8	4.54	3853.7	2701.9	3277.8	29.89
AUP-4959	110.5	97.2	103.8	12.07	4540.0	3072.2	3806.1	32.33
CT-10164	100.4	89.8	95.1	10.52	4766.7	2257.4	3512.0	52.64
CT-10187	102.9	93.5	98.2	9.11	4233.3	2355.6	3294.4	44.36
SRN-10013	118.8	106.5	112.6	10.33	4377.8	2283.3	3330.6	47.84
SRN-10023	104.5	92.2	98.3	11.80	5214.8	2798.1	4006.5	46.34
SRN-10055	105.8	92.0	98.9	13.07	4087.0	2025.9	3056.5	50.43
DN-105	98.1	90.3	94.2	7.89	2514.8	1581.5	2048.1	37.11
BAFFA-1/309	113.5	102.8	108.2	9.42	4501.9	2631.5	3566.7	41.55
BAFFA-2/343	109.9	100.0	104.9	8.98	3957.4	2325.9	3141.7	41.23
SN-306	112.2	102.5	107.3	8.62	4742.6	2225.9	3484.3	53.07
SN-307	105.2	94.3	99.8	10.33	3992.6	2429.6	3211.1	39.15
Pirsabak-2013(Check)	92.5	82.3	87.4	11.02	4931.5	2322.2	3626.9	52.91
Local check	84.4	78.5	81.5	6.99	3833.3	2248.1	3040.7	41.35
Mean	**106**	**96**			**4345**	**2565**		
	LSD for genotypes = 2.5216				**LSD for genotypes= 458.49**			
	LSD for sowing = 0.7974				**LSD for sowing = 648.41**			
	LSD for genotypes x sowing = 3.5661				**LSD for genotypes x sowing = 648.41**			

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