Research Article

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Ekin
Journal of Crop Breeding and Genetics

5(1):1-6, 2019

Ekin International biannual peer-reviewed journal

Comparative Performance of Triticale Genotypes in North Western Plain Zone of India for Grain Yield and its Attributes

Om Parkash BISHNOI[1*] **Suresh**[1] **Rishi Kumar BEHL**[1]

[1] Department of Genetics and Plant Breeding, CCS Haryana Agricultural University, 125004, Hisar, India

[*] Corresponding author e-mail: opbishnoi363@gmail.com

Citation:
Bishnoi O. P., Suresh., Behl R. K., 2019. Comparative Performance of Triticale Genotypes in North Western Plain Zone of India for Grain Yield and Its Attributes. Ekin J. 5(1):1-6, 2019.

Received: 11.09.2018 ***Accepted: 18.12.2018*** ***Published Online: 28.01.2019*** ***Printed: 29.01.2019***

ABSTRACT

The man-made cereal triticale is gaining importance globally. Though, little work has been done in India yet, the results of coordinated trials conducted over two years *i.e.* 2013-14 and 2014-15 are quite encouraging. Seven triticale genotypes were evaluated against two bread wheat checks *i.e.* HD 2967 and WH 1105 in RBD design in a plot size of 2.40m x 6.0m with twelve rows in each plot spaced 20 cm with four replications at CCS HAU, Hisar research farm. The data of grain yield from each plot (middle ten rows) was obtained and expressed in quintal per hectare. The ancillary data on days to heading, days to maturity, plant height, grain texture, grain colour and thousand grain weights were taken. In 2013-14 the mean grain yield at different centres ranged from 44.5 q/ha (Gurdaspur) to 55.8 q/ha (Ludhiana) over two locations, TL 2942 exhibited the highest grain yield (56.6 q/ ha) against the bread wheat check HD 2967 (50.9 q/ha). The performance of the test entries was comparable to wheat checks for agronomy and grain characteristics. For thousand grain weight the test entry TL 2998 (49.0 g) and TL 2997 (47.0 g) showed high mean grain weight as comparable to wheat checks WH 1105 (37.0 g) and HD 2967 (41.0 g). It was interesting to note that none of the triticale line was found to be susceptible against the yellow rust while wheat check HD 2967 showed 20s yellow rust susceptibility. For days to maturity, days to heading, height and grain colour, the triticale lines were at par with wheat checks while the grain thresh-ability in wheat check was medium and texture was semi-hard whereas in triticale thresh-ability ranged from medium to hard and texture semi-hard to hard.

Keywords**:** triticale, grain yield, diseases reaction, abiotic stress

Introduction

Triticale (× *Triticosecale*) is the first reported man made cereal developed by crossing wheat (*Triticum* spp.) as a female with pollen of rye (*Secale cereale*) in 1875 to combine the positive attributes of these parents into a single plant (Wilson, 1875). Triticale genotype thus produced were called primary triticale while, secondary triticale was developed by crossing different primary triticale genotypes (Ammar *et al.*, 2004). Triticale has high yielding potential even under marginal growing conditions and it could be an attractive alternative for raising cereal production all over the world. Both hexaploid (6X; AABBRR) and octoploid (8X; AABBDDRR) types of triticale have good potential, but hexaploid triticale (Durum wheat x Rye) is most successful due to its superior vigour and reproductive stability (Mergoum et al. 2009). In general, triticale combines the high yield potential of wheat with various biotic and abiotic stress tolerance of rye, making it more suitable for marginal conditions like acidic and saline soils, or soils with heavy metal toxicity and various disease and pests' inoculums (Sharma *et al.*, 2017). Despite having many advantages over both wheat and rye, global triticale production is still very low. In 2013, about 4 million hectares of triticale was grown worldwide. Poland, Belarus, Germany, France, and Russia are the major triticale producing countries (Anonymous, 2013). Although, it has proven an important crop for changing climate, but still there is lack of research on this crop.

The low adoption of triticale is due to the factors including production concerns, availability of end-use markets, production economics, policy and strong competition from wheat. Among the production factors, its susceptibility to various diseases, such as ergot, rusts and leaf spots poses major threats. Spring triticale cultivars generally mature later than wheat, which limits its production in countries such as Canada, which has short growing season. The primary objectives for triticale improvement programs are emphasized to lower the production risks and costs of production, while increasing the economic returns per hectare. In different program on triticale breeding in worldwide, large number of genotypes of 6x triticale have been developed. These differ with each other with regard to expression of grain yield components, grain yield potential, tolerance to plant diseases and grain quality. In this study, we attempted to evaluate triticale genotypes developed at Punjab Agricultural University, Ludhiana in semi-arid ecology of Haryana state at Hisar.

Materials and Methods

The comparative yield trials were conducted over two years (2013-14, 2014-15) at various locations *i.e.* Gurdaspur and Delhi (High rainfall), Ludhiana (medium rainfall) and Hisar (low rainfall) falling in North-Western Plain Zones of India. The soils of these locations are characterized by low to medium organic carbon and low to medium nutrient pool. The data were obtained from each location, compiled and presented in All India Co-ordinated Wheat and Barley Improvement Project Progress Report, 2013-14 (Anonymous, 2014).

In these trials, seven triticale genotypes namely TL 2996, TL 2997, TL 2998, TL 2999, TL 3000, TL 2942 and TL 2969 were evaluated against bread wheat checks HD 2967 during 2013-14 while in 2014-15, triticale genotypes TL 3001, TL 3002, TL 3003, TL 3004, TL 3005, TL 2942 and TL 2969 were evaluated against bread wheat check WH 1105 in Randomized Block Design in a plot size of 2.40 m x 6.0 m with twelve rows in each plot spaced 20 cm with four replications. Sowing of these genotypes ranged from last week of October to first week of November. Various agronomic characteristics like days to heading, days to maturity, plant height and grain characteristics *i.e.* thousand grain weight and grain color were recorded. Disease reaction of two important diseases; yellow rust and black point were also recorded on plot basis. Appropriate statistical tools like analysis of variance and critical difference of mean and coefficient of variances were employed for comparative analysis.

Results

In 2013-14 the mean grain yield at different centres ranged from 44.5 q/ha (Gurdaspur) to 55.8 q/ha (Ludhiana) over two locations, TL 2942 exhibited the highest grain yield (56.6 q/ha) against the bread wheat check HD 2967 (50.9 q/ha). It was interesting to note that triticale genotypes developed at Ludhiana out yielded wheat grain yield significantly. This reveals the impact of selection intensity on triticale selectively as against wheat checks developed at other locations (New Delhi and Hisar). The performance of the test entries was comparable to wheat checks for agronomic and grain characteristics (Table 1). For days to maturity, days to heading, plant height and grain colour, the triticale lines were at par with wheat checks while the grain texture of wheat genotype was semi-hard whereas in triticale it was semi-hard to hard.

For thousand grain weight the test entry TL 2998 (49.0 g) and TL 2997 (47.0 g) showed high mean grain weight as comparable to wheat checks WH 1105 (37.0 g) and HD 2967 (41.0 g). It was interesting to note that none of the triticale line was found to be susceptible against the yellow rust while wheat check HD 2967 showed 20s yellow rust susceptibility (Table 3).

Likewise, in 2014-15 the general mean of triticale trial at different centres in NWPZ ranged from 42.5 q/ha (Hisar) to 54.4 q/ha (Ludhiana) while the general mean yield of trial at other two locations was 49.4 q/ha (Delhi) and 47.6 q/ha (Gurdaspur). At zonal level the test entry TL 3002 (51.8 q/ha) was the highest yielding genotype followed by bread wheat check WH 1105 (49.6 q/ha). The test entries TL 3003 (49.2 q/ha) and TL 3001 (48.9 q/ha) were at par with wheat check WH 1105 (Table 2). During this crop season, most of the ancillary characteristics for grain and agronomic traits were at par in wheat and triticale (Table 4). Black point incidence is considered to be negative factor; it ranged from 0 to 1.2% in triticale as against 0.2% in wheat check genotype WH 1105 while TL 3004 showed zero incidence of black point. The mean 1000-grain weight was considerably higher in TL 3004 (41.0 g) and TL 3005 (41.0 g) as against wheat check WH 1105 (37.0 g).

From trials conducted over both the years it is apparent that triticale has a competitive potential for grain yield and its attributes as well as disease resistance. Other trials conducted at Hisar exhibited higher Zn and Fe uptake as compare to wheat (Vats et al. 2016). Even under many other trials, triticale figured to have better micro-nutrient use efficiency (Kaur et al. 2007).

Conclusion

Triticale has distinct advantage over wheat to produce more grain and straw yield under restricted irrigation and nutrient supply**.** Our result has revealed that some triticale genotypes significantly out yielded wheat varieties with considerable gain yield under restricted irrigation and medium fertility (at Hisar; Table 1 and 2)**.** Location effects play important role in determining grain yield and is attributes. Similarly, triticale genotypes have shown very low reduction in yield as compared to wheat under high temperature stress conditions (Suresh et al. 2018). Other than this, triticale can be used as a fodder crop as it has a higher fodder yield and nutritional quality as compared to other fodder crops (Jindal et al. 2017). The grain of triticale has high protein content and essential amino acids due to which it can be used in the feeding of poultry and other monogastric animals like swine (Żurek et al. 2017). From these studies it is proved that triticale has a good gene pool of abiotic stress tolerant genes. We can also use these genes in wheat breeding programmes related to high temperature stress through analytical breeding.

Table 1. Location and Zonal mean yield (q/ha) of various genotypes during 2013-14.

Serial No	Genotype	Yield (q/ha)				
		Delhi	Ludhiana	Gurdaspur	Zonal	Rank
1	TL 2996	53.5	55.4	49.7	52.8	2
2	TL 2999	57.1	45.8	4.34	48.8	5
3	TL 3000	38.3	59.3	40.4	46.0	6
4	TL 2998	38.8	34.8	33.1	35.6	8
5	TL 2997	40.5	43.2	41.8	41.8	7
6	TL 2942(C)	52.2	63.7	53.9	56.6	1
7	TL 2969(C)	46.9	60.6	45.2	50.9	3
8	HD 2967(C)	61	43.5	48.2	50.9	4
G.M	-	**48.5**	**50.8**	**44.5**	**47.9**	-
C.D.	-	**7.5**	**5.2**	**3.3**	**3.1**	-
C.V.	-	**10.5**	**6.9**	**5.1**	-	-
D.O.S.	-	**29.10.13**	**06.11.13**	**05.11.13**	-	-

Table 2. Location and Zonal mean yield (q/ha) of various genotypes during 2014-15.

Serial No	Genotype	Yield (q/ha)					Rank
		Delhi	Hisar	Ludhiana	Gurdaspur	Zonal	
1	TL 3001	53.2	42.5	53.2	46.7	48.9	4
2	TL 3002	51.6	43.5	62.8	49.5	51.9	1
3	TL 3003	47.1	43.2	57.7	48.8	49.2	3
4	TL 3004	52.8	44.4	49.2	46.9	48.3	5
5	TL 3005	52.8	40.9	53.2	45.8	48.2	6
6	TL 2942(C)	47.7	40.3	48	51.3	46.8	4
7	TL 2969(C)	42.9	39.7	53.2	44.1	45.0	8
8	WH 1105(C)	47.2	45.6	57.9	47.8	49.6	2
G.M	-	**49.4**	**42.5**	**54.4**	**47.6**	-	-
C.D.	-	**8.2**	**3.7**	**5.9**	**6.9**	-	-
C.V.	-	**11.3**	**5.9**	**7.4**	**9.8**	-	-
D.O.S.	-	**5.11.2014**	**17.11.2014**	**6.11.2014**	**6.11.2014**	-	-

Table 3. Agronomic traits and disease reaction recorded on various genotypes during 2013-14.

Serial No	Genotype	Rust Reaction	Agronomic Characteristics			Grain Characteristics	
			Days to heading	Days to maturity	Plant height	Colour*	1000-grain weight
1	TL 2996	0	97	151	105	A	43
2	TL 2999	0	98	151	107	A	40
3	TL 3000	0	93	151	106	A	42
4	TL 2998	0	92	149	106	A	49
5	TL 2997	0	92	149	111	A	47
6	TL 2942(C)	0	96	149	112	A	40
7	HD 2967 (C)	20S	102	150	104	A	41
8	TL 2969(C)	0	97	150	104	A	39

A: Amber color

Table 4. Agronomic traits and disease reaction recorded on various genotypes during 2014-15.

Serial No	Genotype	Black Point	Agronomic Characteristics			Grain Characteristics	
			Days to heading	Days to maturity	Plant height	Colour*	1000-grain weight
1	TL 3001	0.2	101	152	102	A	39
2	TL 3002	0.8	97	150	105	A	39
3	TL 3003	0.2	99	150	105	A	40
4	TL 3004	0.0	100	149	101	A	41
5	TL 3005	0.4	100	152	104	A	41
6	TL 2942C)	0.4	99	151	102	A	35
7	HD 2967(C)	1.2	102	151	108	A	35
8	TL 2969(C)	0.2	105	151	100	A	37

A: Amber color

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