Pak. J. Bot., 39(7): 2349-2352, 2007.

BREEDING FOR YIELD AND YIELD COMPONENTS IN SEMI-DWARF WHEAT (*TRITICUM AESTIVUM* L.) GENOTYPES

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Abstract

Yield and yield component studies were conducted for 15 advanced lines/genotypes including three check varieties viz. Sarsabz, Kiran-95 and Soghat-90. The data were recorded for the plant height, days to heading, spike length, number of spikelets per spike, number of grains per spikelet, number of grains per spike, grain yield of main spike, 1000-grain weight, and grain yield (kg/plot). In this yield comparison line 6-12 had the highest plot grain yield (1.75 kg). The subsequent lines which had comparatively better grain yields were 3-02 (1.68 kg) and line 7-03 (1.6 kg). The possible reasons for the highest grain yield in 6-12 could be due to mid maturing, medium plant height (80.3 cm) and higher number of grains per spikelet. The higher grain yield (kg/plot) in line 7-03 could be due to its higher number of grains per spike, higher grain yield of main spike and highest number of grains per spikelet. In check varieties Kiran-95 had comparatively higher grain yield (kg/plot) the possible reasons could be due to its early heading, higher number of grains per spike.

Introduction

Dwarf and semi-dwarf varieties of wheat (*Triticum aestivum* L.) have been cultivated in Asia (Japan and Korea) for more than a century (Dalrymple 1986). Plant height in wheat is determined by genes on many chromosomes (Law *et al*., 1978). To date 21 genes of major effect on plant height have been found to be associated with *Rht* symbols in wheat (McIntosh *et al*., 1998). Their successful introduction into Europe was achieved early in 20th century by the Italian breeder Strampelli. Universal acceptance of semi-dwarf wheats followed the pioneering work of Norman Borlaug whose CIMMYT wheat germplasm features in the pedigree of most modern, high yielding and semi-dwarf wheat varieties. The semi-dwarf genotypes became particularly important with the use of chemical fertilizers, since they are able to respond to fertilizer application without lodging (Gale & Youssefian 1985). Zhou *et al*., (2007) reported that the most significant increase in grain yield occurred in the early 1980s, largely because of the successful utilization of dwarfing genes and the 1B/1R translocation. The aim of this study was to evaluate and select best progenies derived from various combinations for further testing from different crosses for varietal evolution.

Materials and Methods

Twelve advanced wheat genotypes from various crosses and three check varieties viz., Sarsabz, Kiran-95 and Soghat-92 were selected. The material was grown with five meter row length with six rows. The experiment was conducted with completely randomized block design with four replicates. At harvest central four rows were harvested for data recording (five plants per replicate). The characters studied were days to heading, plant height, spike length, spikelets per spike, number of grains per spikelet, number of grains per spike, grain yield per spike, 1000-grain weight and grain yield (kg/plot). Correlation studies were based on pooled data.

Results and Discussion

In this yield comparison line 6-12 (Table 1) had the highest grain yield (1.75 kg/plot). The possible reasons for the higher yield in 6-12 (*Rht*$_1$) could be due to mid-maturity, medium plant height (80.3 cm), and higher number of grains/fertility per spikelet. Richards (1992) reported that there is an optimum plant height (70-100 cm) at which maximum grain yield could be achieved by the use of semi-dwarf genes. The subsequent lines which had comparatively higher grain yield per plot were 3-02 (1.68 kg) and line 7-03 (1.6 kg). The higher grain yield in line 3-02 could be due to the longer spikes and higher number of spikelets per spike. Line 3-02 do not carry Norin-10 dwarfing genes, could be carrying the semi-dwarf gene *Rht*8. Line 3-02 is a best line, however, under high soil fertility it lodges and reduces yield. The higher yield in line 7-03 could be due to its higher number of grains per spike, higher grain yield of main spike and the highest number of grains per spikelet. Allan (1997) reported the presence of GA-insensitive *Rht-Blb* and *Rht-Dlb* dwarfing genes are associated with greater kernel number per spike to increase the kernel number per unit area. The higher grain yield in line 54-03 (1.51 kg/plot) could be due to “tall dwarf” plant height, longer spikes, higher number of grains per spike and spikelet. Law *et al*., (1978) reported that plant height has positive association with grain yield within major dwarfing gene group. The higher grain yield (1.54 kg/plot) exhibited by line 15-10 could be due to the highest number of spikelets per spike, higher number of grains per spike and also higher main spike grain yield. In this comparison Sarsabz was the earliest variety in days to heading and line 17-11 the late heading. Line 8-14 had the short plant height (71.8 cm) and the 54-03 the tall dwarf plant height (92.9 cm). Line 8-14 had the shortest spikes (9.5cm) and 54-03 the longest spikes (12.62 cm). Sarsabz variety had the lowest number of spikelets per spike (18.1) and line 15-10 the highest number of spikelets per spike (23.4). Line 8-14 had the reduced number of grains per spike (51.15) and line 5-02 the highest number of grains per spike (67.6). Line 8-14 had the lowest main spike yield (1.72 gm) and line 14-06 the highest yield (2.54 gm). Line 3-02 had the lowest number of grains per spikelet (2.39) and line 7-03 the highest (3.26) grains. Line 8-14 had the lowest grain yield per plot (0.975 kg) and line 6-12 the highest grain yield (1.75 kg/plot). Line 8-14 had the lowest 1000-grain weight (33.62 gm) and 15-10 the boldest grains (40.02 gm).

Combined correlation analysis results are presented in Table 2. Plant height had positive and significant associations with spike length (r =0.298***), spikelets per spike (r =0.154**), number of grains per spike (r =0.178**) and grain yield of main spike (r =0.230***). Jamali & Ali, (2003) reported the positive and significant correlation of plant height with grain yield of main spike (r =0.522***). However, plant height had non-significant correlation with number of grains per spikelet. Spike length had highly and positively associations with spikelets per spike (r =0.623***), number of grains per spike (r =0.492***) and grain yield of main spike (r =0.522***). However, spike length had non- significant correlation with number of grains per spikelet (r =0.015). Number of spikelets per spike were highly and positively correlated with number of grains per spike (r =0.700***) and grain yield of main spike (r = 0.672***). Number of grains per spike had positive and significant association with grain yield of main spike (r =0.920***) and number of grains per spikelet (r =0.646***). Yield of main spike had positive and significant correlation with number of grains per spikelet (r =0.567***). Hence the conclusion is that selection based on increased plant height up to certain extent (70-100 cm) and high grain yield per spike could result better varieties.

Table1. Mean performance of F_6 genotypes for agronomic character

Genotype	Days to heading	Plant height (cm)	Spike length (cm)	Spikelets per spike	No: of grains per spike	Grain yield of spike (g)	Grains per spikelet	Grain yield (kg/plot)	1000 Grain weight (g)
4-03	85d	84.8cde	10.35f	20.75ef	53.6ef	1.99de	2.59fg	1.15fgh	37.28cd
5-02	89c	83.35e	11.87c	22.6abc	67.6a	2.44ab	2.98b	1.03h	36.13defg
6-12	80g	80.3fg	10.9e	20.25f	59.15cd	2.08cd	2.91bc	1.75a	35.19gh
7-03	79h	84.85cde	10.9e	20.25f	66.2a	2.37b	3.26a	1.6abc	35.8efg
14-06	89c	79.2g	11.72cd	22.95ab	65.85a	2.54a	2.86cde	1.513bcd	38.68b
15-10	91b	86.65bcd	12.05bc	23.4a	61.75bc	2.47ab	2.63f	1.54abc	40.02a
17-11	93a	80.45fg	12.47ab	22.45abcd	65.2ab	2.40ab	2.89bcd	1h	36.91cde
51-02	89c	82.45ef	11.25de	21.55de	61.05c	2.19c	2.82cde	1.08gh	35.87efg
54-03	89c	92.9a	12.62a	21.7cde	64.9ab	2.39ab	2.98b	1.51bcd	36.85cde
22-03-7	89c	73.55h	12.45a	20.5f	51.85f	1.84ef	2.52g	1.264efg	35.66fgh
3-02	82f	87.75b	11.82c	22.3bcd	53.45ef	1.84ef	2.39h	1.68ab	34.59hi
8-14	83e	71.8h	9.5g	18.35gh	51.15f	1.72f	2.78de	0.98h	33.62i
Sarsabz	74j	87.15bc	11.85c	18.1h	53.05ef	2.13cd	2.93bc	1.3def	37.84bc
Kiran-95	76i	91.85a	11.98bc	20.3f	56.9de	2.09cd	2.80de	1.4cde	36.81cdef
Soghat-95	85d	84.5de	11.15e	19.2g	53.4ef	1.93e	2.77e	1.25efg	36.19cdef

Table 2. Correlation studies in wheat for Trial-I during the year 2003-2004

Characters	Spike length (cm)	No. of spikelets/ spike	No of grains/spike	Grain yield of main spike	No. of grains/spikelet
Plant height (cm)	0.298 ***	0.154 **	0.178 **	0.230 ***	0.101 ns
Spike length (cm)		0.623 ***	0.492 ***	0.522 ***	0.015 ns
No. of spikelets/ spike			0.700 ***	0.672 ***	–0.088 ns
No of grains/spike				0.920 ***	0.646 ***
Grain yield of main spike					0.567 ***

*, **, *** Significant at 0.05, 0.01 and 0.001 levels respectively

References

Allan, R.E. 1997. Agronomic performance of plant height near isolines of Nugaines wheat. *Wheat Information Service Japan,* 85: 31-34.

Dalrymple, D.G. 1986. Development and spread of high yielding wheat varieties in developing countries. *Agency for International Development, Washington DC, USA.*

Gale, M.D and S. Youssefian 1985. Dwarfing genes in wheat. *Progress in Plant Breeding*. (Ed.): G.E. Russell. Butterworth, London, 1-35.

Jamali, K.D. and S.A. Ali. 2003. Exploitation of semi-dwarf wheat (*Triticum aestivum* L.) genotypes for high yield. *Proceedings of 10th International wheat Genetics Symposium (1-6, September 2003) at Paestum,* Italy, 727-729.

Law, C.N., J.W. Snape and AJ. Worland. 1978. The genetical relationship between height and yield in wheat. *Heredity,* 40: 133-151.

McIntosh R.A., G.E. Hart, K.M. Devos, M.D. Gale and W.J. Rogers. 1998. Catalogue of gene symbols for wheat. *Proceedings of 9th International Wheat Genetics Symposium*. (Ed.): A.E. Slinkard. Saskatoon, Canada, 2: 234-236.

Richards, R.A. 1992. The effect of dwarfing genes in spring wheat in dry environments. I. Agronomic characteristics. *Aust. J. Agric. Res.,* 43: 517-525.

Zhou, Y., Z.H. He, X.X. Sui, X.C. Xia, X.K. Zhang and G.S. Zhang. 2007. Genetic improvement of grain yield and associated traits in the northern China winter wheat region from 1960 to 2000. *Crop. Sci.,* 47: 245-253.

(Received for publication 14 February 2006)