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EVALUATION OF SEMI-DWARF WHEAT (*TRITICUM AESTIVUM* L.) GENOTYPES FOR YIELD AND ITS COMPONENTS

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Abstract

Yield and its component studies were conducted for semi-dwarf F_6 wheat breeding material. Sixteen genotypes and two checks viz., Sarsabz and Kiran-95 were selected for these studies. The data recorded for days to heading, plant height, 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 plot grain yield. In this yield comparison line 16 had the highest grain yield than the remaining genotypes and varieties. Subsequent lines which had the higher grain yields were 9, 7, 13, 15, 1 and 5. The possible reasons for high grain yield in line 16 could be due to mid-maturing, tall-dwarf plant height, increased number of grains per spike, higher main spike grain yield and increased number of grains per spikelet than the check variety Sarsabz. The high grain yield in line 9 could be due to increased number of gains per spike and spikelet and higher main spike yield. The high yield in line 7 could be due to increased grain weight. The high grain yield in line 13 may also be due to its increased 1000-grain weight (39.84 g). High grain yield in line 15 may be due to its increased spikelet fertility. High grain yield in line 01 may be due to its earliness in days to heading, higher main spike grain yield and increased spikelet fertility. The high grain yield in line 5 may be due to its earliness and tall dwarf plant height.

Introduction

The worldwide adoption of the Norin-10 semi-dwarfing genes in wheat varieties was proceeded in the early 1960, with no precise physiological explanation of their effects on yield. It is clear, however, in winter wheats at least, that in addition to their effects on straw strength, which limit losses due to lodging, the Rht_1 and Rht_2 genes have additional beneficial effects on yield *via* an increase in grain number per ear (Gale & Youssefian, 1985). The semi-dwarf genotypes became particularly important with their concurred response to high doses of chemical fertilizers without lodging. Waddington *et al*., (1986) who studied more recent semi-dwarf cultivars (released after 1975) pointed out the importance of increased kernels per spike and indicated that most recent progress appeared to raise from increased biomass and not increased harvest index. 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 pleiotropic effects of semi-dwarf (Norin-10) genotypes include gibberellic acid insensitivity, cell size and number, root weight, coleoptile length, leaf size, grain yield, yield components, biomass, harvest index, protein content and disease reaction (Gale & Youssefian, 1985, Jamali, 1991). The relative effects of Rht_1 and Rht_2 (semi-dwarf) genotypes and other agronomic traits would be particularly important to plant breeders.

The objectives of this study were to evaluate the effects of semi-dwarfism on grain yield, yield components and several other important agronomic traits.

Table 1. Mean performance of wheat genotypes in F_6 generation.

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 (g/plot)	1000-Grain weight (g)
1	72de	88.2h	11.7cd	17def	52.5bcd	2.03abcde	3.10bcd	512.5abc	38.66abc
2	71e	93.0cd	10.9e	16f	50.1bcd	1.866cdefg	3.14bcd	500abc	38.92abc
3	75.5abcd	91.6gefg	12.15c	16.7ef	53.1bcd	2.06abcd	3.2bcd	487.5bcd	38.89abcd
4	77.5abcd	95.8bc	11.55de	17.4bcdef	52.7bcd	2.02abcde	3.02bcde	350d	38.47abcd
5	72.5cde	100.4a	11.15cde	19ab	51.9bcd	1.97bcdef	2.72ef	512.5abc	37.09abcd
6	77abcd	89.1gh	13.25a	18.5abcd	64.2a	2.30a	3.47a	500abc	37.75abcd
7	76abcde	96.5b	11.95cd	17.6bcde	52.6bcd	2.02abcde	2.99bcde	537.5abc	38.46abcd
8	76.5abcde	93.4cd	13.1ab	19.8a	55.8bc	1.64g	2.85def	462.5bcd	29.39e
9	74.5abcde	92.00def	12.05cd	18.6abcd	56.7b	2.05abcd	3.04bcde	550ab	36.07abcd
10	75.5abcde	99.1a	12.3bc	18.6abcd	48.9cd	1.86cdefg	2.63f	425bcd	38.31abcd
11	78abc	92.6de	12.1cd	18.7abc	52.8bcd	2.26ab	2.82def	425bcd	41.11a
12	77.5abcd	93.6cd	11.9cd	17.3cdef	55.9bc	2.26ab	3.23ab	487.5bcd	40.49a
13	76abcde	93.4cd	12.1cd	17.5bcdef	50.5bcd	2.05abcde	2.89cdef	537.5abc	39.84ab
14	78abcd	89.5fgh	12cd	18.1bcde	46.8d	1.65g	2.57f	462.5bcd	35.34bcd
15	76abcde	89.9efgh	12.5abc	16.6ef	53bcd	1.77fg	3.21abc	537.5abc	33.5de
16	78.5ab	101.7a	12.5cd	18.4abcd	52bcd	1.76defg	2.83def	637.5a	33.97cde
Sarsabz	73.5bcde	89.4fgh	12.1cd	18bcde	46.8d	1.73efg	2.60f	400cd	36.96abcd
Kiran-95	79.5a	87.5h	12.4abc	18.2bcde	57.3b	2.29a	3.14abcd	450bcd	36.05abcd

Table 2. Correlation studies in wheat for Trial-II 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)	–0.161*	0.142 ns	–0.035 ns	–0.056 ns	–0.134 ns
Spike length (cm)		0.55 ***	0.27 ***	0.101 ns	–0.091 ns
No. of spikelets/ spike			0.31 ***	0.169 *	–0.34 ***
No of grains/spike				0.756 ***	0.778 ***
Grain yield of main spike					0.613 ***

*, **, *** Significant at 0.05, 0.01 and 0.001 level respectively.

Materials and Methods

Sixteen F_6 best genotypes derived from a range of different crosses were evaluated for yield and yield component studies. Two check varieties were used for comparison viz., Sarsabz and Kiran-95. The genotypes were planted into six rows each with row length of 3 meters. The genotypes were grown in a randomized complete block design with three replicates. The characters recorded for these studies were days to heading, plant height, spike length, spikelets per spike, number of grains per main spike, grain yield of main spike, 1000 grain weight and plot yield. The data of field experiments were subjected to analysis variance (Steel & Torrie, 1980). Association among some of the characters was examined by pooled correlation analysis.

Results and Discussion

In this yield comparison line 16 had the highest plot grain yield over the remaining genotypes and varieties. The possible reasons for the higher yield in line 16 could be due to its mid-maturity, the tallest plant height (tall dwarf) and better number of grains per spikelet. Plant height has positive effects on grain yield up to certain extent. These results agree with the earlier findings of Law *et al*., (1978) in which yield was positively related to plant height within major dwarfing gene group. However, Busch & Rauch (1993) reported the lack of a positive correlation between plant height and grain yield. Subsequent lines which had the higher grain yields were 9, 7, 13, 15, 1 and 5. The higher grain yield in line 9 could be due to its increased number of grains per spike and spikelet and higher main spike yield. The high grain yield in line 7 could be due to tall dwarf plant height, increased number of grains per spikelet and higher 1000-grain weight. The high grain yield in line 13 may also be due to its increased grain weight. High grain yield in line 15 could be due to its higher number of grains per spikelet. High yield in line 01 may be due to its earliness in days to heading, higher number of grains per spikelet and increased 1000-grain weight.

Combined correlation analysis studies are presented in Table 2. These studies show that plant height was negatively correlated ($r = –0.161$) with spike length at $P= 0.05$ level. These results suggest that an increase in plant height may reduce the spike length. Our results agree with those reported by Villareal *et al*., (1992), that plant height had negative non significant correlation with number of grains per spike. However, plant height had non significant association with number of spikelets per spike and also grain yield of main spike. Our results agree with the previous findings that plant height had non-significant association with number of spikelets per spike and number of grains per spike (Jamali *et al*., 2003). The character spike length was highly and positively correlated ($r =0.55$) with number of spikelets per spike and number of grains per spike ($r =0.27$). Our results contradict the findings reported by Villareal *et al*., (1992), wherein they have shown that spike length had no correlation with grain number per spike with different groups of dwarfing genotypes. However, spike length was not significantly associated with grain yield of main spike and grain number per spikelet. The positive correlation results suggest that an increase in spike length may also increase the number of spikelets per spike and number of grains per spike. Number of spikelets per spike was positively and significantly correlated ($r =0.31$) with number of grains per spike and grain yield of main spike ($r =0.169$), however, it was negatively associated with number of grains per spikelet ($r = –0.34$). These results suggest that an increase in number of spikelets may also increase the number of grains and grain yield per spike. The negative correlation of spikelets per spike with number of grains per spikelet suggest that there may be competition for assimilates between the grains that may cause sterility. Number of grains per spike had positive and significant association (r = 0.756) for main spike grain yield and grains per spikelet (r = 0.778). Number of grains per unit area is one of the yield components. The increase in number of grains per main spike can also increase final yield. Grain yield of main spike had positive association (r = 0.613) with number of grains per spikelet.

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