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EFFECT OF SEMI-DWARFISM ON YIELD AND YIELD COMPONENTS IN WHEAT (*TRITICUM AESTIVUM* L.)

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ABSTRACT

Yield and yield component studies were conducted for semi-dwarf wheat genotypes. The yield comparison showed that line 03 (525 g) had the highest grain yield per plot compared with other lines and tested varieties. This could be due to early heading date and increased number of grains per spikelet. The subsequent lines of higher grain yields were 15 (512.5 g), 01 (462.5 g), 14 (462.5 g), 5 (437.5 g), 9 (412.5 g) and 13 (425 g). The better number of grains per spikelet (fertility) was the second reason beside the early heading date for high grain yield of line 15. The higher grain yield in line 1 could be due to medium heading date, higher number of spikelets per spike and increased number of grains per spike. The combined correlation studies suggested that plant height had positive and highly significant correlation with spike length, number of spikelets per spike and main spike grain yield. Spike length had positive and highly significant correlation with number of spikelets, number of grains per spike and main spike grain yield. Number of spikelets per spike had positive and highly significant correlation with number of grains per spike and main spike grain yield. Number of grains per spikelet had highly significant negative correlation with spike length and number of spikelets per spike. Grain yield of main spike is a very important character which had highly significant positive correlation with characters plant height, spike length, number of spikelets per spike and number of grains per spike.

INTRODUCTION

It is generally agreed that the incorporation of the Norin-10 dwarfing genes (*Rht*$_1$, *Rht*$_2$) has led to the selection of cultivars of spring wheat (*Triticum aestivum* L.) with higher yield potential in low ($<40^o$) latitude environments characterized by autumn-early winter sowing e.g. in India (Jain and Kulshresta, 1976) or northwest Mexico (Fischer *et al.*, 1981). A considerable amount of information regarding the effects of the *Rht*$_1$ and *Rht*$_2$ genes on various agronomical, physiological, morphological and biochemical traits has been elucidated. The effect on yield and yield components has been singled out to be of the most interest of wheat workers. The Norin10 derived GA-insensitive alleles *Rht*-B1b and *Rht*-D1b, reduce plant height by 15% and increase yield by 24% (Gale and Youssefian, 1985, Flintham *et al.*, 1997). According to Borlaug (1968) dwarfing genes are carried by about 90% of the semi-dwarf cultivars worldwide and represent one of the major factors of the “Green Revolution”. Their distribution is restricted to geographical areas that are not subjected to heat stress during ear emergence as this has been demonstrated to reduce plant fertility (Worland and Law, 1985). This study attempts to reveal the effects of the Norin-10 dwarfing genes on grain yield and other agronomical traits on high yielding spring bread wheat germplasm adapted under the growing conditions of Sindh province, Pakistan. Therefore, the high yielding better wheat genotypes for varietal release was aimed.

MATERIALS AND METHODS

Sixteen F_6 best genotypes derived from a range of different crosses were evaluated for yield and yield component studies. Two standard varieties (Sarsabz and Kiran-95) were used as controls. The genotypes were planted with six rows each with row length of three meters. The genotypes were sown in a randomized complete block design with two replicates. The characters recorded for these studies were days to heading, plant height, spike length, number of spikelets per spike, number of grains per spike, main spike grain yield (g), number of grains per spikelet, grain weight and plot grain yield. The combined correlation was calculated on the basis of 180 observations (Steel and Torrie, 1981).

RESULTS AND DISCUSSION

According to yield comparisons line 3 had the highest grain yield compared with other lines and the standard (Control) varieties (Table 1). The possible reasons for the higher yield in line 3 could be due to early heading date. Line 15 had also higher grain yield than the remaining lines and this could be due to early heading and increased number of grains per spikelet (fertility). The subsequent lines, which had higher grain yields, were lines 1 (462.5 g), 14 (462.5 g), 5 ((437.5 g), 9 (412.5 g) and 13 (425 g). Field experiments analyzing near-isogenic lines for GA-insensitive dwarfing genes clearly demonstrate that positive pleiotropic effects on the increased number of grains per spike result in higher yield under most environmental conditions (Börner *et al.*, 1993, Flintham *et al.*, 1997). The high grain yield in line 1 could be due to medium heading date, higher number of spikelets, and increased number of grains per spike. On the other hand, the higher grain yield in line 14 could be due to late heading, and better number of grains per spikelet. Waddington *et al.* (1986) reported that improvement in grain yield in modern wheat cultivars were associated with increasing in grain number per unit area due to higher number of grains per spike.

The higher grain yield in line 5 could be due to early heading date, tall dwarf (increased) plant height, the longest spike length, the highest number of spikelets per spike and increased number of grains per spike and spikelet. The results clearly support the tall-dwarf hypothesis advocated by Law *et al*., (1978) in which yield was positively related to plant height within major dwarfing gene group. The line 5 had also better 1000-grain weight. The higher grain yield in line 9 could be due to medium type of heading date, tall dwarf plant height and better spike fertility. The higher grain yield in line 13 could be due to late heading, longer spikes, higher number of grains per spike and spikelet, higher main spike grain weight and higher 1000-grain weight.

Correlation studies: Plant height was highly correlated (Table 2) with the characters spike length (r = 0.393), number of spikelets per spike (r = 0.215) and main spike grain yield (r = 0.379). Plant height had non-significant association with number of grains per spike and spikelet. The character spike length had highly significant positive association with number of spikelets per spike (r = 0.654), number of grains per spike (r = 0.331) and grain yield of main spike (r = 0.268). However, spike length had highly significant negative correlation with number of grains per spikelet (r = –0.188). The character number of spikelets per spike was positively and highly correlated with number of grains per spike (r = 0.361) and main spike grain yield (r = 0.201). However, number of spikelets per spike was negatively and highly significant correlation with number of grains per spikelet (r = –0.398). Jamali *et al.,* (2003) reported that numbers of spikelets arepositively associated with number of grains per spike and main spike grain yield. Number of grains per spike was highly and positively correlated with grain yield of main spike (r = 0.691) and number of grains per spikelet (r = 0.678). Main spike grain yield was positively and highly correlated with number of grains per spikelet (r = 0.501).

Table-1: Comparative performance of wheat genotypes for yield and yield components

Genotypes	**Days to heading**	**Plant height (cm)**	**Spike length (cm)**	**Spikelets/ spike**	**No: of grains /spike**	**Grain yield of main spike (g)**	**Grains/ spikelet**	**Plot grain yield (g) 3.6\m^2**	**1000-Grain weight (g)**
Tested varieties									
1	77abcd	85j	11.6bcde	19.2ab	56.9ab	1.7de	2.96ab	462.5abc	29.86fg
2	76.5abcd	90ghi	12abcd	19.3ab	60.4a	1.66de	3.13a	350cde	27.01g
3	74d	93ef	12.25abc	18.1bcde	49.2cde	1.5e	2.72b	525a	30.64ef
4	78.5ab	85de	12.6ab	18.8abc	50.9bcde	1.77de	2.71b	350cde	34.75abcd
5	74.5cd	104a	12.9a	20a	55.2abc	2.05abc	2.77ab	437.5abcd	37.28ab
6	76.5abcd	93efg	12.25abc	18.4abcde	54bcd	1.73de	2.94ab	300de	32.04def
7	74.5cd	100c	12.2abc	17.5cdef	54.8abc	1.88bcd	3.14a	350cde	34.35bcd
8	78abc	95de	12.45ab	18.7abcd	54.8abc	1.82cd	3.05ab	262.5e	33.32cde
9	75.5bcd	102bc	11.85bcd	18.2bcde	51.4bcde	1.9bcd	2.83ab	412.5abcde	36.92ab
10	73.5d	90hi	10.4g	15.7g	46.2e	1.63de	2.98ab	387.5abcde	35.42abc
11	79.5ab	96d	11.35cdef	18bcde	51.6bcde	1.89bcd	2.87ab	350cde	36.71ab
12	80.5a	101bc	12.55ab	18.6abcde	54.5abc	2.07abc	2.94ab	312.5cde	38.03a
13	80.5a	103ab	12.25abc	18.3bcde	54.6abc	2.09ab	2.98ab	425abcd	37.27ab
14	80.5a	91fghi	10.8efg	17.1defg	49.4cde	1.68de	2.89ab	462.5abc	34.11bcd
15	78bcd	91fghi	11.2defg	17efg	48.1de	1.69de	2.86ab	512.5ab	35.35abcd
16	79.5ab	89i	10.6fg	16.3fg	49.2cde	1.72de	3.05ab	300de	5.14abcd
Standard varieties (Contorl)									
Sarsabz	73d	92fgh	11.8bcd	18.5abcde	53.6bcd	1.82cd	2.91ab	375abcde	34bcd
Kiran-95	79.5ab	92fgh	12abcd	18.5abcde	52.5bcd	2.16a	2.82ab	362.5bcde	35.50abc

Table-2: Pooled Correlation for yield and yield components.

Characters	Spike length (cm)	Number of spikelets	No. of grains per spike	Main spike yield (g)	No. of grains per spikelet
Plant height (cm)	0.393***	0.215**	0.098 N.S	0.379***	–0.080 N.S
Spike length		0.654***	0.331***	0.268***	–0.188**
Number of spikelets per spike			0.361***	0.201**	–0.398***
No. of grains per spike				0.691***	0.678***
Main spike grain yield (g)					0.501***

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