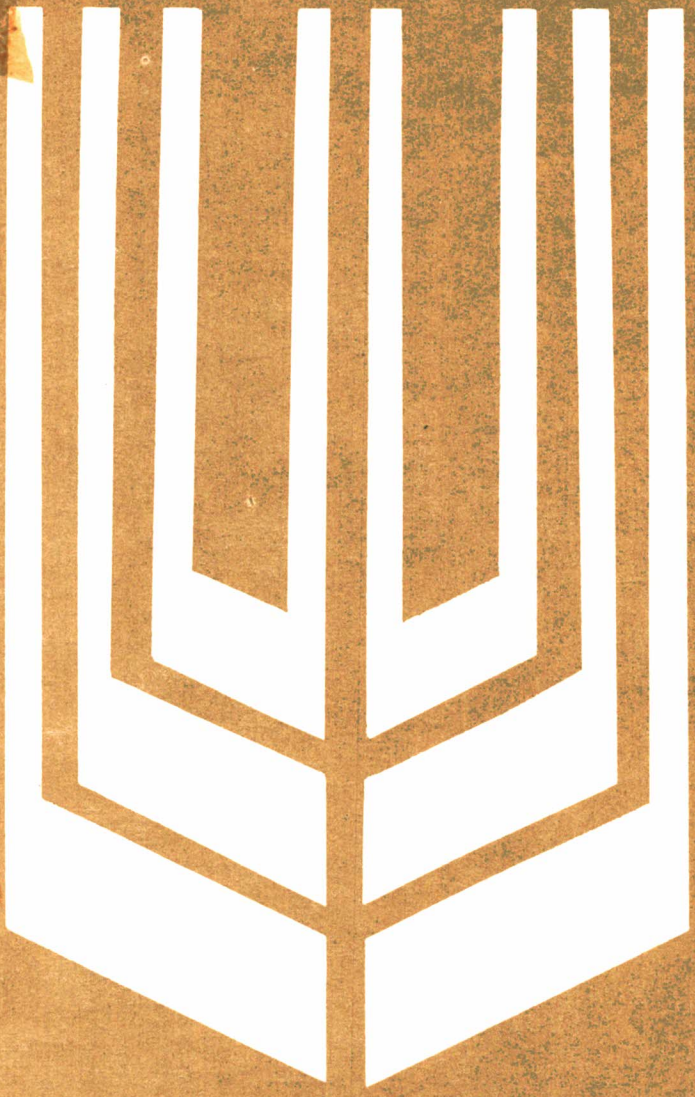

CEREAL RESEARCH COMMUNICATIONS

REPRINT VOL. 11 No. 2 1983.

A CASE OF GRAIN-WEIGHT DEPENDENCE ON THE HEIGHT GENOTYPE IN WHEAT

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SUMMARY

In an F_6 line of spring wheat (Triticum aestivum L.), segregating for the Rht_1 gene controlling semidwarfness, the grain-weight of the tall plants was significantly higher than that of the semidwarf plants. When grown separately in a field trial, the progeny of the tall plants yielded significantly heavier grains than the progeny of the semidwarf plants although these two progenies were quite similar in height and in total grain yield.

Index words: Triticum aestivum L.; wheat; inheritance; grain-weight; semidwarfness.

INTRODUCTION

The semidwarf stature of the 'Norin 10' wheat derivatives is controlled by the Rht_1 and Rht_2 genes (2) which produce four homozygous culm-length genotypes (1). A positive relationship between grain-weight and culm-length, both between the Rht genotypes and within them, has been demonstrated in various studies (1, 2, 4, 5, 6, 7, 8). The nature of this relationship has not yet been clarified. In the present study a unique case is reported in which genotypically tall wheat and genotypically semidwarf wheat, of similar genetic background, did not differ significantly in height yet the tall genotype produced heavier grains than the semidwarf genotype.

MATERIALS AND METHODS

An F_6 line, descending from a single F_3 plant of a cross between the semidwarf cv. Mivhor (selection from CIMMYT cross 8156 Penjamo sib x Gabo 55) and the tall cv. FA8193 (Algerian selection from Florence x Aurore) was grown in eight 3m-long nursery rows at Rehovot. In each row (considered as a replicate) there were 80-100 plants which segregated into two distinct height groups. The 'tall' plants were similar in height to cv. FA8193 whereas the 'semidwarf' plants were similar to cv. Mivhor. The grains of the main-shoot spikes of all the tall plants, and those of all the semidwarf plants, in each row were separately bulked. The grains of each of the two types, in each row, were weighed and counted. Two samples of 40 F_7 seeds, from each of the two types, were subjected to a seedling GA response test (3).

The F_7 progenies of the bulked F_6 plants of the two heights were

compared in a four replicated field test planted at Lakhish on Jan. 2, 1980, which is about 6 weeks later than customary. Each plot consisted of four 12.5 m - long rows, 25 cm apart. Two randomly chosen 1 m - long sections, in each of the two central rows of each plot, were harvested and bulked. Mean grain-weight was determined by counting the grains in 30 g samples of the yield.

RESULTS AND DISCUSSION

The F_6 line was uniform in heading and maturity, as well as in spike morphology, but it segregated for culm-length (Table 1).

Table 1: Performance of F_6 plants of a wheat line segregating for the height genotype and of their respective F_7 bulked progenies.

	Genotypic height group		
	Tall	Semidwarf	S.E.
		F_6 Plants	
% plants	54	46	
Culm length (cm)	90	60	
Heading date	Mar. 22	Mar. 22	
Main-shoot spikes			
Yield per spike (g)	2.03***	1.60	0.038
Grains per spike	36.9**	32.2	0.77
Mean grain wt (mg)	53.3***	47.5	0.54
		F_7 Progenies	
Culm length (cm)	67.5	62.5	1.44
Heading date	Mar. 30	Mar. 30	
Grain yield (gm^{-2})	332	316	21.0
Mean grain wt (mg)	46.7*	41.7	0.87

*, **, *** Significantly exceeding the values obtained for the semidwarf height group, $P<0.05$, $P<0.01$, $P<0.001$, respectively

About half of the plants could be distinctly classified as 'tall' plants whereas the remaining plants resembled the 'semidwarf' type. The seedling GA response test confirmed the classification of the tall plants. The progenies of the semidwarf plants produced 10% GA responsive seedlings, indicating that a certain proportion of these plants (theoretically 40%) had been heterozygous for the Rht gene. Since cv. Mivhor (the semidwarf parent of the line) carries the Rht_1 dwarfing gene (M.D. Gale, personal communication, 1980) the semidwarf segregants are assumed also to carry this gene.

The yield of the F_6 main-shoot spikes as well as the number of grains per spike and the mean grain-weight were all significantly lower in the semidwarf plants than in the tall plants (Table 1). This could have been due to a reduced supply of assimilates caused by the shading of the semidwarf plants by the tall plants, among which they were growing. Indeed, no significant difference in grain yield was obtained between the progenies of the semidwarf F_6 plants and the progenies of the tall F_6 plants, which were grown in separate plots. The mean grain-weight, however, was markedly and significantly higher in the progenies of the tall plants than in those of the semidwarf plants (Table 1). Moreover, these two progenies differed only slightly and not significantly, in culm-length, presumably because of the late planting of this trial. Reduced height of late planted tall wheat had often been observed in this region.

Because of the similarity in total grain yield and the phenotypic similarity in height between the two F_7 progenies in this trial, the advantage in grain-weight of the progeny of the tall plants cannot be attributed to any physiological factor associated with culm-length e.g., a greater photosynthetic active area of the upper stem internodes. Consequently, the present results indicate a genotypic effect of the semidwarf character, controlled by the Rht_1 gene, on grain-weight.

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Received 3rd June, 1983