ISOGENIC ANALYSIS OF CERTAIN IMPORTANT CHARACTERS IN WHEAT

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Isogenic analysis of local and exotic wheats of distinct height levels revealed that different plant height levels were associated with seedling emergence rate index, kernel weight, tillers per plant, spike length, kernels per spike and grain yield per plant. Of particular interest was a direct relationship shown by semi-dwarf stature with grain yield, which indicated the need to breed for intermediate plant height levels in preference to tall or dwarf phenotypes.

INTRODUCTION

The introduction in Pakistan of semi-dwarf wheats from abroad in the recent past opened new vistas of hope. These types are fertilizer-responsive and give enhanced acre yields as compared to tall, indigenous varieties which usually lodge when fertilized liberally. That is why a major effort in wheat breeding is devoted to the evolution of varieties with short, stiff stature resistant to lodging.

The genetic mechanism controlling plant stature in wheat is rather complex and seems to exercise pleiotropic effects on several characteristics of economic values. Chowdhry and Allan (1966) reported from an isogenic analysis that the seedling emergence rate index, seedling emergence and length were positively related with plant height. Similarly, Freeman and Hadley (1962) found that tall (Dwdw) plants produced more tillers and heads and yielded more grains than the dwarf (dwdw) plants in *Sorghum vulgare* L. Isogenic analysis also provides an effective approach for character association studies (Hockett and Eslick, 1968; Quinby and Karper, 1954; Campbell and Cassady, (1969). Near-isogenic lines for different plant height levels were developed and the present study was initiated to ascertain the effects of the dwarfing

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factors on different plant characters and use this information in breeding for different plant height levels in wheat.

MATERIALS AND METHODS

The studies were made in the Department of Plant Breeding and Genetics, University of Agriculture, Lyallpur, during the years 1971-72. The materials consisted of eight near-isogenic lines for plant height, developed in the Department from a reciprocal cross between the tall, indigenous wheat variety C273 and a triple dwarf, AU49, by backcrossing. The isolines with their average heights were as follows :

C273-AU49 × C2734-1;	155.75cm.
C273-AU49 × C2734-2:	125.00cm.
C273-AU49 × C2734-6;	126.06cm.
C273-AU49 × C2734-8;	93.50cm.
AU49-C273 × C2734-3;	139.40cm.
AU49-C273 × C2734-4;	110.95cm.
AU49-C273 × C2734-7;	138.35cm.
AU49-C273 × C2734-12;	115.55cm.

Selections -1, -3 and -7 were classified as tall, selections -2, -4, -6 and -12 as intermediate and selection -8 as short.

These lines flanked by their respective parents were space-planted in a randomized complete block design with four replications. The distance between rows was one foot and between plants within rows six inches. Isogenic analysis of 10 plant characteristics was conducted on 5 randomly chosen plants of each line from each repeat, which provided 20 plants, in all, for each line and this sample was considered appropriate in view of the fact that the isolines had attained considerable homozygosity. The characters were measured on all 8 isogenies as follows;

(1) Emergence rate index (ERI) was recorded by daily counts of the seedlings emerged and the emergence rate index was calculated according to Chowdhry and Allan (1966). (2) Two - month old seedling height was measured in centimeters from the ground level to the tip of the longest leaf of each plant. (3) Adult plant height of the central tiller was measured in centimeters from the ground level to the tip of the spike (excluding awns) of the selected plants. (4) Tiller number was counted at the adult plant stage. (5) Spike length of the selected plants was measured in centimeters (excluding awns). (6) Kernels per spike were determined from the hand threshed spike

of the central tiller. (7) 100-kernel weight in grams was recorded by an electric balance. (8) Grain yield per plant was determined from the total grain produce of the selected plants on a triple beam balance.

RESULTS AND DISCUSSION

Data presented in Table 1 revealed a positive relation between plant height and emergence rate index (ERI) as the tall selections generally gave the highest ERI values. This would suggest that the gene combinations controlling tall stature exerted a positive influence on seedling emergence. Or, conversely, the genes responsible for the dwarfing of plants operated to reduce the emergence rate index either by increasing the germination period or by shortening the coleoptile length. The only exception was dwarf selection-8 whose ERI was similar to that of intermediate selection-2. The findings reported by Chowdhry and Allan (1966), Craddock and Vogel (1955), Livers (1958), Allan (1944) and Allan *et al* (1965) were also of a similar nature.

Further, data in Table 1 revealed a weak association between plant height A distinct relation between these two characters was not evident at this stage. Probably, the effect of the dwarfing mechanism at the seedling stage was not strong enough It became more intense as the growth proceeded and produced distinct plant height levels in the adult stage.

Unlike emergence rate index, number of tillers per plant was negatively associated with plant height since the shortstatuted parent AU49 produced the the maximum number of tillers (43.10) per plant (Table 1). The intermediate group containing both dominant and recessive genes followed AU49 while the tall selections with most dominant genens yielded fewer tillers. In contrast, dwarf selection-8 also produced fewer tillers pet plant (27.70) as compared to the tall selection-7 (32.70), which may be attributed to cytoplsmic effects. These results did not agree to the observations made by Freeman and Hadley (1962) that tall (DwDw) plants produced more tillers than dwarf (dwdw) plants in *Sorghum vulgare* L.

The data on spike length presented in Table 1 revealed no relationship of this character with plant height since the gene combinations producing intermediate plant stature generally yielded longer spikes. The general trend was that the selections with the AU49 cytoplasm e.g.-4-7 and -12, produced longer spikes.

Number of kernels per spike (Table 3) behaved in like manner, as

semidwarf selections -12 and -6 and again yielded larger number of grains per spike.

A perusal of Table 2 revealed a positive relationship of 100-kernel weight with plant height since tall selections produced weightier grains than the dwarf ones. The exception was dwarf selection-8which also produced weighty grains (4.19 gm.) as compared to short parent AU49 (3.27 gm.). This exceptional behaviour might have resulted from the interaction of the dwarfing genes with the cytoplasm of the tall parent C273. The medium statured plants carrying both dominant and recessive genes produced intermediate grain weight. It appeared from these results that the genes responsible for plant height also increased kernel weight.

The data presented in Table 2 indicated a trend toward higher grain yield for semi-dwarf lines such as selections -4, -6 and 12. The higher yielding ability may be related to increased spike length, kernels per spike. and tillers per plant associated generally with semi-dwarf types. This inter-relationship would suggest that the genotypes incorporating both dominant and recessive genes generated a relatively high grain yield in this experiment. It would therefore seem appropriate that in breeding new wheat varieties a greater emphasis should be laid on medium plant stature rather than on tall or dwarf height levls.

TABLE 1 : *Character means with 90% confidence interval of 8 near isogenic lines and their parents-*

Selection	ERI	Seedling height (cm.)		Tillers per plant		Spike length (cm.)	
C273 (Parent)	427	48.10	4.63	25.55	4.40	11.95	0.65
Selection 1	452	43.25	4.26	29.60	8.06	10.90	0.88
Selection 2	412	40.60	3.23	35.95	13.81	12.10	1.08
Selection 6	383	47.09	4.29	32.55	7.06	13.05	1.08
Selection 8	412	30.15	1.94	27.70	7.18	12.55	0.71
Selection 3	307	41.60	6.89	36.85	12.35	13.20	0.77
Selection 4	225	42.26	7.83	39.25	11.67	15.45	1.11
Selection 7	240	38.00	7.98	32.70	8.72	14.54	0.80
Selection 12	206	40.61	7.23	32.75	11.01	14.15	1.28
AU49 (Parent)	195	44.02	5.20	43.10	8.23	14.35	1.31

TABLE 2 : *Character means with 99% confidence interval of 8 near-isogenic lines and two parents.*

Selection	Kernels per spike		200-kernel weight (gm.)		Grain yield (gm.)	
C273 (Parents)	68.75	6.83	4.185	0.115	53.58	4.31
Selection 1	53.85	7.40	3.656	0.194	30.65	8.86
Selection 2	60.30	11.41	4.074	0.308	48.02	19.19
Selection 6	74.30	11.98	3.809	0.357	58.70	19.53
Selection 8	59.20	6.63	4.190	0.180	33.52	7.49
Selection 3	60.20	8.62	8.996	0.237	49.05	16.33
Selection 4	68.75	9.55	4.069	0.271	74.85	25.83
Selection 7	17.75	7.55	4.450	0.240	60.87	18.30
Selection 12	83.70	13.01	3.472	0.343	59.67	18.13
AU49 (Parent)	54.05	6.37	3.279	0.180	50.12	12.50

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