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COMPARISON OF SOME SELECTION CRITERIA IN TWO SPRING WHEAT CROSSES

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ABSTRACT

The F_2 populations of two spring wheat crosses (WH 283 x WH 280 and NP 846 x WH 291) were subjected to individual plant selections based on visual appearance for yield potential, No. of tillers per plant, grain number per spike, 1000-grain weight, grain yield per plant, and harvest index. All the selection criteria were found equal in influencing the average grain yield of F_3 progenies. The effect of selection in F_2 generation was not reflected in F_3. Number of tillers per plant and grains per spike showed high correlation with grain yield per plant. Visual selections based on general plant vigour, number of tillers per plant and spike length was found to be effective for improving grain yield and its component traits. The selection based on harvest index produced considerably low proportion of high yielding lines as compared to other selection criteria.

Key words: Wheat, selection criteria.

Basically, the breeding of self-pollinating crops involves two important selection phases, the selection of parents for hybridization and selection in segregating generations. The low heritability of yield makes it difficult to select effectively for yield per se in early generations. Component breeding and the modification of plant architecture offer possibilities in developing more efficient systems leading to increased grain yield potential and this approach will be most effective if the components involved are highly heritable, genetically independent or positively correlated and physiologically unrelated or related in a positive manner. The present study aims to compare the effectiveness of six selection criteria in two spring wheat crosses.

MATERIALS AND METHODS

The material for the present study was generated from space-planted F_2 populations (each consisting of 3000 plants) of two wheat crosses, viz. WH 283 x WH 280 and NP 846 x Wh 291. Three hundred plants were randomly tagged in each population and were subjected to six independent selection criteria, e.g. visual selection, tillers/plant,

grains/spike, 1000-grain weight, grain yield/plant, and harvest index. Twenty top ranking plants in each selection group were used to raise 120 F_3 lines from each of the two populations in randomized block design with three replications. Each F_3 family was grown in a single-row plot of 3 m length spaced 30 cm apart with the plant-to-plant distance of 10 cm. The observations were recorded on five competitive plants from each F_3 progeny row for the traits mentioned above. The results were analysed statistically.

RESULTS AND DISCUSSION

The F_3 lines differed significantly for all the traits in both populations. Significant differences were observed between lines under each selection criterion for all the traits in the cross NP 846 x WH 291 except for grains/spike in the lines on the basis of harvest index and visual selection. In cross Wh 283 x WH 280, the lines differed significantly for 1000-grain weight in all the selection criteria except for visual selection for grains spike in visual selection tillers/plant, grains/spike and grain weight; for harvest index in tillers/plant, grain yield and harvest index; and for tillers/plant and grain yield in harvest index and grains/spike.

The selection criteria differed significantly for grains/spike and 1000-grain weight in the cross WH 283 x WH 280 and for all the traits except for grain yield in cross NP 846 x WH 291. Visual vs. nonvisual selection differed significantly for 1000-grain weight and harvest index in both the crosses. Selection for grain yield by weight vs. visual selection showed significant differences only for grain weight and harvest index in the cross NP 846 x WH 291. The F_3 lines derived from the F_2 selections for grain yield differed significantly from the lines derived through selection based on tillers/plant, grains/spike, grain weight, and harvest index and 1000-grain weight in cross WH 283 x WH 280. Significant differences were observed between grain yield and grains/spike selection criteria for grains/spike in both the crosses. The selection based on yield and harvest index showed significant differences for tillers/plant in the cross NP 846 x WH 291.

The selection criteria affected the character means of the F_2 populations for all the characters considerably. However, the mean value of a particular trait in F_2 of both the crosses was highest when that particular trait was taken as the basis of selection. For example, selection based on grain number/spike was more effective than other selection criteria for improving number of grains/spike in both the crosses. Grain yield/plant, except the direct selection itself, was mostly affected by the selection based on number of tillers/plant, followed by visual selection and grains/spike. Similarly, number of tillers/plant was affected most by selection for yield/plant, followed by visual selection and grains/spike; number of grains/spike by selection for yield/plant, followed by tillers per plant and visual selection; grain weight by selection through visual selection, followed by harvest index and grains/spike, and harvest index by selection for grain weight followed by grains/spike and yield/plant. Thus, selection based on number of grains/spike was most

effective for improving all the characters. Also, visual selection for per se performance was effective for improving all the five characters except harvest index.

The effect of selection in F_2 generation was generally not reflected in F_3 generation for most of the characters. A comparison of progeny means in F_3 generation revealed that the selection criteria did not differ in their direct and indirect selection responses in a systematic way. Such a nondetectable trend, which was also observed by [1], may be due to the oscillatory expression of yield components in response to environmental condition. Progenies from different selection criteria showed statistically comparable mean performance for grain yield in both the crosses. This indicates ineffe-tiveness of selection in F_2 generation for improving grain yield in both the crosses. Low heritability of grain yield in F_2 generation appears to have rendered the selection for yield ineffective. Moreover, genotype x environment interaction may have influenced selection in early generations by masking the additive gene effects.

The correlations between yield and its component characters (Table 1) suggest that grain yield could be increased by selecting F_2 plants on the basis of tillers/plant and grains/spike. Interestingly, harvest index showed negative association with grain yield. A negative association bet- ween yield and harvest index in rice was reported by [2].

Table 1. Correlation coefficients (r) between all possible character pairs in two crosses of wheat

Character	Cross	Grains per spike	1000-grain weight	Harvest index	Yield per plant
Tillers/plant	WH 283 x WH 280	0.52**	- 0.08	- 0.43**	0.87**
	NP 846 x WH 291	0.14*	0.06	- 0.63**	0.75**
Grains/spike	WH 283 x WH 280		0.04	- 0.10	0.45**
	NP 846 x WH 291		0.09	- 0.04	0.36**
1000-grain wt.	WH 283 x WH 280			- 0.15*	- 0.03
	NP 846 x WH 291			- 0.28**	0.21**
Harvest index	WH 283 x WH 280				- 0.26**
	NP 846 x WH 291				- 0.30**

*P = 0.05, **P = 0.01.

The selection criteria generally did not show considerable differences among them as regards the production of lines yielding higher than the local check except the selection for harvest index which produced considerably low proportion of high yielding lines as compared to the other criteria (Table 2). Selection for tillers/plant also produced low proportion of such lines in the cross WH 283 x WH 280.

In both crosses, no progeny was selected simultaneously through all the six selection criteria. However, in the cross WH 283 x WH 280, two progenies were selected simultaneously on the basis of tillers/plant, grains/spike, grain yield/plant and visual selection; two progenies on the basis of tillers/plant, grain yield/plant and visual selection; one progeny through grain yield/plant, harvest index and visual selection; nine progenies

through tillers/plant and grain yield/plant; four progenies based on 1000-grain weight and harvest index; and one progeny on the basis of tillers/plant and grains/spike. Similarly, in the cross NP 846 x WH 291, one progeny was selected simultaneously on the basis of tillers/plant, grains/spike, grain yield/plant and visual selection; two progenies through tillers/plant, grain yield/plant and visual selection; one progeny through tillers/plant, grains/spike and visual selection; one progeny through tillers/plant, grains/spike and grain yield/plant; ten progenies through tillers/plant and grain yield/plant; one progeny based on grains/spike and 1000-grain weight; and one progeny on the basis of 1000-grain weight and harvest index. The presence of different plant types of varying productivity in F_2 may be the reason for the ineffectiveness of harvest index as a criterion for selection of high yielding lines in F_3 generation [3]. Negative association between harvest index and grain yield in F_2 may be another reason for its poor efficiency as a basis for selection.

Table 2. Effect of selection criteria on the number of selected lines with significantly higher yield potential than the local check in two wheat crosses

Selection criterion	Number of lines yielding more than check	
	WH 283 x WH 280	NP 846 x WH 291
Visual appearance	9	9
Tillers/plant	5	9
Grains/spike	7	12
1000-grain weight	10	10
Grain yield/plant	9	10
Harvest index	5	4

Since the genetic potential of crosses is determined essentially in F_2 or F_3 generations [4], the breeding efficiency largely depends on the selection system followed in early generations. The efficiency of early generation selection is greatly increased if the yield potential of plants is correctly assessed by visual observations. The visual selection in the spaced F_2 population based on general plant vigour, number of tillers/plant and spike length in the present investigation was quite effective. This calls for use of simultaneous selection criteria for different yield components to improve grain yield.

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