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Selection Indices in Bread Wheat (*Triticum aestivum* L.) Under Very Late Sown Condition

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ABSTRACT

The discriminant-function technique was used to construct selection indices in 48 genotypes of bread wheat (Triticum aestivum L.) under very late sown condition. Thirty-one selection indices involving grain yield per plant and its four components were constructed using discriminant function technique. The efficiency of selection increased with inclusion of more number of characters in the selection index. The index based on five characters viz., grain yield per plant, number of productive tiller per plant, plant height, biological yield per plant and harvest index recorded the highest genetic gain and relative efficiency followed by index based on four characters viz., grain yield per plant, plant height, biological yield per plant and harvest index The use of these indices is advocated for selecting high yielding genotypes of bread wheat.

Keyword: *Selection indices, discriminant function, relative efficiency and bread wheat.*

INTRODUCTION

Wheat is a crop of global significance grown in diversified environments. It is an important cereal crop of cool climate and play an important role in food and nutritional security of world. Yield is governed by a polygenic system and is highly influenced by the fluctuations in the environment. Hence, selection of plant based directly on yield would not be very reliable in many cases. The effectiveness of component approach to selection breeding is well appreciated. An application of discriminant function developed by Fisher[3]. and first applied by Smith[10] helps to identify important combination of yield components useful for selection by formulating suitable selection indices. Selection indices aimed at determining the most valuable genotype as well as the most suitable combinations of traits with the intention of indirectly improving the yield. Therefore, the object of the present study was to construct and assesses the efficiency of selection indices in bread wheat.

MATERIAL AND METHODS

A field trial was conducted using fourty-eight diverse genotypes of bread wheat during *Rabi* 2016-17 in a Randomized Block Design with three replications at Wheat Research Station, Junagadh Agricultural University, Junagadh.

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The characters studied were days to 50 % heading, days to anthesis, days to maturity, grain filling period, number of productive tillers per plant, plant height, spike length, number of spikelets per spike, number of grains per spike, 1000-grain weight, grain yield per plant, biological yield per plant, harvest index, flag leaf area, chlorophyll content and canopy temperature depression. For constructing the selection indices, the characters which had high and positive correlation with grain yield per plant and direct effects on grain yield were considered. In this context, grain yield per plant (X_1), number of productive tillers per plant (X_2), plant height (X_3), biological yield per plant (X_4) and harvest index (X_5) were identified and considered in late and very late sown conditions. The model suggested by Robinson *et al.*[8] was used for the construction of selection indices and the development of required discriminant function. A total of 31 selection indices were constructed using five traits. The respective genetic advance through selection was also calculated as per the formula suggested by Robinson *et al*[8]. The relative efficiency of different discriminant functions in relation to straight selection for grain yield were assessed and compared, assuming the efficiency of selection for grain yield per plant as 100%.

RESULTS AND DISCUSSION

Selection indices for grain yield per plant and other characters were constructed and examined to identify their relative efficiency in the selection of superior genotypes. The results on selection indices, discriminant functions, expected genetic gain and relative efficiency are presented in Table 1. The results showed that the genetic advance and relative efficiency assessed for different indices were higher than straight selection when the selection was based on component characters which further increased considerably with the inclusion of two or more characters. The highest efficiency was noted when five or four characters were considered. Selection indices are, thus, more realistic for selecting desirable genotypes since they are constructed by giving proper weightage on the characters associated with yield. Robinson *et al.*[8] in corn recorded a progressive increase in efficiency of selection indices with inclusion of every additional character in the index formula. Hazel and Lush[4] stated that the superiority of selection based on index increases with an increase in the number of characters under selection and Mcvetty and Evans[6] and Esheghi *et al.*[1] also suggested that the selection index to be superior to direct selection in wheat.

The maximum relative efficiency of 100.00% was registered by the grain yield per plant. This efficiency increased up to 268.42% in two character combination (grain yield per plant and biological yield per plant); 396.94% in three character combination (grain yield per plant, plant height and biological yield per plant) and 495.85% in four character combination (grain yield per plant, plant height, biological yield per plant and harvest index) and 500.98% in case of five characters (grain yield per plant, number of productive tillers per plant, plant height, biological yield per plant and harvest index). Fredous *et al.*[2], Kemelew and Muhe[5] and Shah *et al.*[9], were also with the same opinion that an increase in characters resulted in an increase in genetic gain and that the selection indices improve the efficiency than the straight selection for grain yield per plant.

Further, it was observed that the straight selection for grain yield was not that much rewarding (GA = 7.21g, RI = 100%) as it was through its components like number of productive tillers per plant, plant height, biological yield per plant and harvest index or in their combinations. The maximum efficiency in selection for grain yield was exhibited by a discriminant function involving grain yield per plant, number of productive tillers per plant, plant height, biological yield per plant and harvest index, which had a genetic advance and relative efficiency of 36.17g and 500.98%, respectively, followed by an index of four characters (grain yield per plant, plant height, biological yield per plant and harvest index) with 35.80g genetic advance and 495.85% relative efficiency. High efficiency in selection based on grain yield per plant, biological yield per plant, days to maturity and number of effective tillers per plant or in combination of all these four characters has been reported by Patel[7].

The present study showed consistent increase in the relative efficiency of the succeeding index with simultaneous inclusion of each character. However, in practice the plant breeder might be interested in maximum gain with minimum number of characters. In this context, the selection index consisting grain yield per plant, plant height, biological yield per plant and harvest index could be advantageously exploited in the wheat breeding programmes. The present study also revealed that the discriminant function method of making selections in plants appeared to be the most useful as compared to the straight selection for grain yield alone and hence, due weightage should be given to the important selection indices while making selection for yield advancement in wheat.

Table 1: Selection index, discriminant function, expected genetic advance in grain yield and relative efficiency from the use of different selection indices in very late sown condition of bread wheat

Sr. no.	Selection index	Discriminant function	Expected genetic advance	Relative efficiency (%)
(1)	(2)	(3)	(4)	(5)
1	X_1 :Grain yield per plant	0.9655 X_1	7.21	100.00
2	X_2 :Number of productive tillers per plant	0.8122 X_2	1.00	13.85
3	X_3:Plant height	0.632 X_3	6.32	87.54
4	X_4:Biological yield per plant	0.286 X_4	4.67	64.68
5	X_5:Harvest index	0.749 X_5	5.97	82.69
6	X_1 X_2	0.919 X_1+0.729 X_2	7.73	107.08
7	X_1 X_3	1.412 X_1+0.040 X_3	13.95	193.17
8	X_1 X_4	2.042 X_1 -0.112 X_4	19.38	268.42
9	X_1 X_5	1.115 X_1 +0.370 X_5	15.29	211.74
10	X_2 X_3	1.186 X_2 +0.120 X_3	6.68	92.46
11	X_2 X_4	1.271 X_2 +0.488 X_4	5.12	70.97
12	X_2 X_5	0.409 X_2 +0.096 X_5	6.66	92.30
13	X_3 X_4	0.381 X_3 +0.591 X_4	8.76	121.32
14	X_3 X_5	0.059 X_3 +0.122 X_5	18.40	254.89
15	X_4 X_5	0.073 X_4 +1.206 X_5	15.62	216.31
16	X_1 X_2 X_3	1.429 X_1 +0.677 X_2 +0.309 X_3	14.36	198.95
17	X_1 X_2 X_4	2.440 X_1 -0.413 X_{2+}0.036 X_4	19.81	274.32
18	X_1 X_2 X_5	2.052 X_1 +1.098 X_{2+}0.123 X_5	15.81	219.00
19	X_1 X_3 X_4	2.459 X_1 +0.788 X_3+0.088 X_4	28.66	396.94
20	X_1 X_3 X_5	3.088 X_1 +0.215 X_3 -0.518 X_5	21.78	301.62
21	X_1 X_4 X_5	3.535 X_1+0.048 X_4-0.153 X_5	27.46	380.27
22	X_2 X_3 X_4	1.772 X_2+0.974 X_3+0.156 X_4	19.45	269.42
23	X_2 X_3 X_5	1.677 X_2+0.390 X_3+0.565 X_5	11.19	154.98
24	X_2 X_4 X_5	0.712 X_2+0.074 X_4+1.212 X_5	15.99	221.49
25	X_3 $X_4$$X_5$	0.937 X_3+0.123 X_4+1.095 X_5	24.83	343.84
26	X_1 X_2 X_3 X_4	2.512 X_1+0.083 X_2+0.786 X_3+0.087 X_4	29.00	401.59
27	X_1 X_2 X_3 X_5	3.093 X_1+1.077 X_2+0.221 X_3-0.526 X_5	22.24	308.05
28	X_1 X_2 X_4 X_5	3.578 X_1-0.007 X_2+0.056 X_4-0.155 X_5	27.88	386.20
29	X_1 X_3 X_4 X_5	4.073 X_1+0.686 X_3+0.123 X_4-0.501 X_5	35.80	495.85
30	X_2 X_3 X_4 X_5	1.525 X_2+0.944 X_3+0.127 X_4+1.070 X_5	25.20	349.01
31	X_1 X_2 X_3 X_4 X_5	4.100 X_1+0.544 X_2+0.688 X_3+0.123 X_4-0.503 X_5	36.17	500.98

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