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Selection indices for grain yield improvement in durum wheat [*Triticum turgidum* L. subsp. *durum* (Desf.) Husn.]

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Abstract

The plant breeder has certain desired plant characteristics in his mind while selecting for particular genotypes and for this he/she applies various weight to different traits for arriving at decisions. This suggests the use of a selection index that gives proper weight to each of the two or more characters to be considered. Among forty genotypes of durum wheat thirty-one selection indices, involving grain yield per plant and four yield contributing components, were constructed using the discriminant function technique. The superiority of selection based on index increases with an increase in the number of characters under selection. The selection index constructed based on five characters *viz.,* grain yield per plant, days to maturity, plant height, biological yield per plant and harvest index exhibited maximum relative efficiency and selection efficiency. The plant breeder might be interested in maximum genetic gain with minimum number of characters. The maximum relative efficiency per character was observed in selection index comprised of days to maturity and plant height ($X_3 + X_4$) followed by plant height and biological yield per plant ($X_3 + X_4$).

Key words: Durum wheat, selection indices, discriminant function, relative efficiency, expected genetic advance

1. Introduction

Wheat is the staple food for a large part of the world population including India with 31.45 million hectares of land 107.59 million metric tonnes production and 3421 kg per hectare productivity. While Gujarat, accounted for 1.02 million hectares of land, 3.21 million metric tonnes of production and 3155 kg per hectare of productivity (Anon., 2020). It is now well recognized that grain yield is a complex polygenic character and depends upon the action and interaction of a number of factors. It is felt that progress can be accelerated if simultaneous selection for most of the economic characters contributing to grain yield is considered. For this purpose, the utilization of an appropriate multiple selection criteria based on the selection indices would be more desirable. An application of discriminant function developed by Fisher (1936) and first applied by Smith (1936) helps to identify important combination of yield components useful for selection by formulating suitable selection indices. Therefore, the object of the present study was to construct and assesses the efficiency of selection indices in durum wheat.

2. Materials & Methods

The experimental material consisted of 40 diverse genotypes of durum wheat [*Triticum turgidum* L. subsp. *durum* (Desf.) Husn]. The pure seeds of these genotypes were obtained from the Wheat Research Station, Junagadh Agricultural University, Junagadh. Application of discriminant function as a basis for making selection on several characters simultaneously is aimed at discriminating the desirable genotypes from undesirable ones on the basis of their phenotypic performance. The concept of selection index was first proposed by Smith (1936) on the basis of discriminant function of Fisher (1936). The model suggested by Robinson

et al. (1951) was used for the construction of selection indices and development of a required discriminant function. Fourty genotypes of durum wheat were sown on 25th November, 2020 in a Randomized Block Design with three replications at Wheat Research Station, College of Agriculture, Junagadh Agricultural University, Junagadh. Each genotype was sown in a single row plot of 2.0 m length with a spacing of 22.5 cm × 10 cm. The genotypes were randomly allotted to the plots in each replication. For constructing the selection indices, the characters which had highly significant correlation with grain yield per plant and positive direct effect on grain yield were considered. In this context, grain yield per plant (X_1) along with its four components *viz*., days to maturity (X_2), plant height (X_3), biological yield per plant (X_4) and harvest index (X_5) were identified and considered for the construction of selection indices. Their respective genetic advance was calculated and relative efficiency of different discriminant functions in relation to straight selection for grain yield was compared. The data on selection indices, discriminant functions, genetic advance, relative efficiency and relative efficiency per character are presented in Table 1.1 assuming the efficiency of selection for grain yield per plant as 100%.

Selection indices for grain yield and other characters were constructed and examined to identify their relative efficiency in the selection of superior genotypes. The results on selection indices, discriminant function, expected genetic gain and relative efficiency are presented in Table 1. The basis for the development of the selection indices has been provided by Smith (1936), Hazel and Lush (1943) and Robinson *et al.* (1951). Hazel and Lush (1943) stated that the superiority of selection based on index increases with an increase in the number of characters under selection and Mc Vetty and Evans (1980) and Esheghi *et al.* (2011) also suggested that the selection index to be superior to direct selection in wheat.

3. Results & Discussion

The results suggested that the selection efficiency was higherover straight selection when the selection was based on component character, which further increased with the inclusion of two or more characters. The highest efficiency was noted when five characters were considered together.

Character *viz*., grain yield per plant (X_1), days to maturity (X_2), plant height (X_3), biological yield per plant (X_4) and harvest index (X_5) were identified and considered for construction of selection indices. When the relative efficiency of single character index was measured, it was noted that the maximum efficiency of 533.51 % was exhibited by plant height followed by days to maturity (507.22 %), biological yield per plant (487.63 %), harvest index (407.73 %) and grain yield per plant (100.00 %).

The maximum relative efficiency in single character discriminant function was 533.51% for plant height. However, it increased up to 740.72% in two character combinations (days to maturity and plant height); 900.00% in three characters combinations (days to maturity, plant height and biological yield per plant); 982.47 % in four characters combinations (days to maturity, plant height, biological yield per plant and harvest index) and 1048.97% in five characters combinations (grain yield per plant, days to maturity, plant height, biological yield per plant and harvest index) Thus, there was an increase in relative efficiency with an increase in the character combinations.

Table 1.1: Selection index, discriminant function, expected genetic advance in yield and relative efficiency from the use of different selection indices in durum wheat

Sr. No.	Selection index	Discriminant function	Expected genetic advance	Relative efficiency (%)	R. E. per character (%)
1	X_1	0.9002 X_1 (Grain yield per plant)	1.94	100.00	100.00
2	X_2	0.8945 X_2 (Days to maturity)	9.84	507.22	507.22
3	X_3	0.8892 X_3 (Plant height)	10.35	533.51	533.51
4	X_4	0.9200 X_4 (Biological yield per plant)	9.46	487.63	487.63
5	X_5	0.8939 X_5 (Harvest index)	7.91	407.73	407.73
6	$X_1 + X_2$	1.1065 X_1 + 0.8901 X_2	10.74	553.61	276.80
7	$X_1 + X_3$	1.2252 X_1 + 0.8746 X_3	11.50	592.78	296.39
8	$X_1 + X_4$	0.9709 X_1 + 0.9219 X_4	9.95	512.89	256.44
9	$X_1 + X_5$	0.9993 X_1 + 0.6575 X_5	7.34	378.35	189.18

10	X_2+ X_3	0.8962 X_2 + 0.8907 X_3	14.37	740.72	370.36
11	X_2 + X_4	0.8980 X_2 + 0.9245 X_4	13.85	713.92	356.96
12	X_2 + X_5	0.8925 X_2 + 0.8907 X_5	12.50	644.33	322.16
13	X_3 + X_4	0.8834 X_3 + 0.9128 X_4	14.01	722.16	361.08
14	X_3 + X_5	0.8777 X_3 + 0.8739 X_5	12.84	661.86	330.93
15	X_4 + X_5	0.9189 X_4 + 0.8929 X_5	12.23	630.41	315.21
16	X_1 + X_2 + X_3	1.5028 X_1 + 0.8693 X_2 + 0.8557 X_3	15.72	810.31	270.10
17	X_1 + X_2 + X_4	1.1786 X_1 + 0.8894 X_2 + 0.9213 X_4	14.70	757.73	252.58
18	X_1 + X_2 + X_5	1.1510 X_1 + 0.8854 X_2 + 0.8850 X_5	13.38	689.69	229.90
19	X_1 + X_3 + X_4	1.3091 X_1 + 0.8699 X_3 + 0.9160 X_4	15.20	783.51	261.17
20	X_1 + X_3 + X_5	1.2653 X_1 + 0.8729 X_3 + 0.8873 X_5	14.15	729.38	243.13
21	X_1 + X_4 + X_5	1.0063 X_1 + 0.9199 X_4 + 0.8916 X_5	12.78	658.76	219.59
22	X_2 + X_3 + X_4	0.8996 X_2 + 0.8921 X_3 + 1.9268 X_4	17.46	900.00	300.00
23	X_2 + X_3 + X_5	0.8941 X_2 + 0.8920 X_3 + 0.8929 X_5	16.35	842.78	280.93
24	X_2 + X_4 + X_5	0.8959 X_2 + 0.9234 X_4 + 0.8898 X_5	15.78	813.40	271.13
25	X_3 + X_4 + X_5	0.8920 X_3 + 0.9213 X_4 + 0.8951 X_5	16.17	833.51	277.84
26	X_1 + X_2 + X_3 + X_4	1.5902 X_1 + 0.8679 X_2 + 0.8509 X_3 + 0.9144 X_4	18.75	966.49	241.62
27	X_1 + X_2 + X_3 + X_5	1.5595 X_1 + 0.8638 X_2 + 0.8529 X_3 + 0.8750 X_5	17.67	910.82	227.71
28	X_1 + X_2 + X_4 + X_5	1.2262 X_1 + 0.8845 X_2 + 0.9190 X_4 + 0.8818 X_5	16.66	858.76	214.69
29	X_1 + X_3 + X_4 + X_5	1.3527 X_1 + 0.8680 X_3 + 0.9138 X_4 + 0.8836 X_5	17.23	888.14	222.04
30	X_2 + X_3 + X_4 + X_5	0.8975 X_2 + 0.8934 X_3 + 0.9257 X_4 + 0.8920 X_5	19.06	982.47	245.62
31	X_1 + X_2 + X_3 + X_4 + X_5	1.6512 X_1 + 0.8621 X_2 + 0.8477 X_3 + 0.9117 X_4 + 0.8712 X_5	20.35	1048.97	209.79

The maximum efficiency in selection for seed yield was exhibited by a discriminant function involving grain yield per plant, days to maturity, plant height, biological yield per plant and harvest index (X_1+X_2+X_3+X_4+X_5) possessed the highest genetic gain and relative efficiency (20.35g and 1048.97 %). However, in practice the plant breeder might be interested in maximum gain with minimum number of characters. In this context, the selection index consisting days to maturity and plant height (X_2+X_3) with the 14.37 g genetic advance and 740.72% relative efficiency could be advantageously exploited in the durum wheat breeding programmes.

In five character combinations, the highest relatively efficiency (1048.97 %) was observed by combinations of characters X_1+X_2+X_3+X_4+X_5 (grain yield per plant, days to maturity, plant height, biological yield per plant and harvest index). Kumar *et al.,* (2019), Raiyani *et al.* (2015), Patel *et al.* (2018) and Patel and Kulkarni (2020) 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 that the straight selection for grain yield alone.

In four character combinations, the highest relative efficiency (982.47%) was observed by combinations of characters X_2+X_3+X_4+X_5 (days to maturity, plant height, biological yield per plant and harvest index). Adsul and Monpara (2014) were also with the same opinion in soybean 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 seed yield alone.

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 breeders might be interested in maximum gain with minimum number of characters. With this view, relative efficiency per character was also worked out for each

selection index. It was observed that maximum relative efficiency per character was observed in selection index comprised of days to maturity and plant height (X_2+X_3) followed by plant height and biological yield per plant (X_3+X_4). It was interesting to note that plant height was combined with construction of selection index of two, three, four and five characters systems where relative efficiency of selection increased. Therefore, due weightage should be given to plant height while formulating selection index of wheat crop.

The present study also revealed that the discriminant function method of making selections in plants appears to be the most useful than the straight selection for grain yield alone and hence, due weightage should be given to the important selection indices while making selection for grain yield advancement in wheat crop.

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Author contributions

Conceptualization of research (JSU, SBC & HVB); Designing of the experiments (JSU, SBC & HVB); Contribution of experimental materials (JSU, SBC & HVB); Execution of field/lab experiments and data collection (JSU, SBC & HVB); Analysis of data and interpretation (JSU, SBC & HVB); Preparation of the manuscript (JSU, SBC & HVB).

Conflict of interest: No

Declaration

The authors declare no conflict of interest.

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References

1. Adsul HR and BA Monpara. 2014. Genetic variability and selection indices for improving seed yield in soybean [*Glycine max* (L.) Merrill]. *Electron. J. Plant Breed.*, **5**(4): 807-811.
2. Anonymous. (2020). Pocket Book on Agriculture Statistics 2020. Ministry of Agricultural & Farmers Welfare, Department of Agriculture and Cooperation & Farmer Welfare, Government of India, New Delhi. Available at http://ends.dacnet.nic.in accessed on 31th march, 2021.
3. Fisher RA. 1936. The use of multiple measurements in taxonomic problems. *Ann. Eugen.*, **7**: 179.
4. Esheghi R, O Javid and S Samira. Genetic gain through selection indices in hulless barley. *Internat. J. Agric. & Biol.,* 2011; **13:** 191-197.
5. Hazel LN and JL Lush. 1943. The genetic basis for constructing selection indexes. *Genetics,* **28**(6): 476-490.
6. Kumar S, G Sandhu, SS Yadav, V Pandey, O Prakash, A Verma, SC Bhardwaj, R Chatrath and GP Singh. 2019. Agro-morphological and Molecular Assessment of Advanced Wheat Breeding Lines for Grain Yield, Quality and Rust Resistance. *Journal of Cereal Research* 11(2): 131-139.
7. Mc Vetty PB and LE Evans. 1980. Breeding methodology in wheat. II. Productivity, harvest index and height measured on F_2 spaced plants for yield selection in spring wheat. *Crop Sci.,* **20:** 587-589.
8. Patel DP. and GU Kulkarni. 2020. Selection indices for yield improvement in breadwheat (*Triticum aestivum* L.). *Journal of Pharmacognosy and Phytochemistry*, **9**(5): 3288-3290.
9. Patel NS, L Raval and SH Shah. 2018. Selection indices in bread wheat (*Triticum aestivum* L.) under very late sown condition. *International Journal of Pure & Applied Biosciences.* **6**(5): 426-429.
10. Raiyani GD, K Patel, RM Javia, VJ Bhatiya and VV Ramani. 2015. Selection indices for yield improvement in bread wheat under late sown condition. *Asian J. Bio. Sci.*, **10**(2):148-152.
11. Robinson HF, RE Comstock and PH Harvey. 1951. Genotypic and phenotypic correlations in corn and their implications in selection. *Agron. J.*, **43**: 282- 287.
12. Smith HF. 1936. A discriminant function for plant selection. *Ann. Eugen.*, **7**: 240-250.