➔DOI : 10.15740/HAS/AJBS/10.2/148-152
e ISSN-0976-8343 | ■ Visit us : *www.researchjournal.co.in*
ASIAN JOURNAL OF BIO SCIENCE
Volume **10** | Issue 2 | October, 2015 | 148-152

RESEARCH PAPER

Selection indices for yield improvement in bread wheat under late sown condition

G.D. RAIYANI[1], KOMAL PATEL[1], **R.M. JAVIA[2]**, V.J. BHATIYA[1] AND V.V. RAMANI[2]

[1]Department of Genetics and Plant Breeding, Junagadh Agricultural University, JUNAGADH (GUJARAT) INDIA
[2]Pulses Research Station (J.A.U.), JUNAGADH (GUJARAT) INDIA
Email : rmjavia@gmail.com

Article Info : Received : 01.07.2015; Revised : 25.08.2015; Accepted : 11.09.2015

Investigation was carried-out to assess the selection indices in 40 genotypes of wheat (*Triticum aestivum* L.) in limited irrigation under late sowing condition. Sixty-three selection indices, involving grain yield per plant and five yield components, were constructed using the discriminant function technique. The efficiency of selection increased with the inclusion of more number of characters in the index. The selection index based on six characters *viz.*, grain yield per plant, days to maturity, number of productive tillers per plant, number of grain per main spike, biological yield per plant and harvest index under limited irrigated condition exhibited maximum gain and relative efficiency. It is expected that grain yield could be improved if due consideration is given to these traits in future breeding programme of wheat.

Key words : Wheat, Discriminant function, Relative efficiency, Selection indices, Expected genetic advance

How to cite this paper : Raiyani, G.D., Patel, Komal, Javia, R.M., Bhatiya, V.J. and Ramani, V.V. (2015). Selection indices for yield improvement in bread wheat under late sown condition. *Asian J. Bio. Sci.,* **10** (2) : 148-152.

INTRODUCTION

Wheat (*Triticum aestivum* L.) is the staple food for a large part of the world population including India. India accounts an area, production and a productivity of 29.9 million h, 93.9 million metric tonnes and 3140 kg/h, respectively (Anonymous, 2012). The wheat belongs to the genus *Triticum* of the family Poaceae and its origin is believed to be Middle East Region of Asia (Lupton, 1987). Three species of wheat *viz*., *Triticum aestivum* L.(bread wheat), *Triticum durum* Desf. (macaroni wheat) and *Triticum dicoccum* Schulb. (emmer wheat) are presently grown as commercial crop in India, covering 86, 12, and 2 per cent of the total area, respectively. The bread wheat, a hexaploid with chromosome number 2n=6x=42 is cultivated in all the wheat growing areas of the country, the macaroni or durum wheat (tetraploid, 2n=28) is mostly grown in the northern (Punjab) and southern states, while the emmer wheat (tetraploid, 2n=28) is confined to the Southern states (mainly Karnataka) and some parts of Gujarat.

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 Smith (1936) helps to identify important combination of yield components useful for selection by formulating suitable selection indices. Therefore, the objective of the present study was to construct and assess the efficiency of selection indices in wheat.

RESEARCH METHODOLOGY

The experimental material consisted of 40 diverse genotypes of wheat (*Triticum aestivum* L.) were sown at late under limited irrigation condition in a Randomized Block Design with three replications during *Rabi* 2013-14 at Wheat Research Station, Junagadh Agricultural University, Junagadh. Under limited irrigated condition, irrigation was skipped after anthesis growth stage. Each entry was accommodated in a single row of 2.0 m length with a spacing of 22.5 cm. Five competitive plants per genotype in each replication were selected randomly and observations were recorded on different characters and their averages were used for statistical analysis except days to 50 per cent flowering and days to maturity while taken as plot basis. For constructing the selection indices, the characters which had highly significant with grain yield per plant were considered. In this context, the grain yield per plant (X_1) along with five components *viz.*, days to maturity (X_2), number of productive tillers per plant (X_3), number of grain per main spike (X_4), biological yield per plant (X_5) and harvest index (X_6) under limited irrigated condition were identified and considered. Sixty-three selection indices were constructed in all possible combinations of the five yield contributing characters and grain yield per plant. Their respective genetic advance was calculated and relative efficiency of different discriminant functions in relation to straight selection for grain yield was compared, assuming the efficiency of selection for seed yield as 100 per cent.

RESEARCH FINDINGS AND ANALYSIS

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 for limited irrigated condition. Hazel and Lush (1943) showed that the selection based on such an index is more efficient than selecting individually for the various characters. The basis for the development of the selection indices has been provided by Smith (1936), Hazel (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. In the present study also the expected genetic advance and relative efficiency assessed for different indices increased considerably when selection was based on two or more characters. The maximum genetic advance (GA) and relative efficiency (RI) in single character discriminant function was 15.37g and 985.26 per cent under limited irrigation, respectively for number of grain per main spike which however, increased upto 18.01g and 1154.30 per cent, respectively in two character combinations but 20.08g and 1287.02 per cent, respectively in three character combination under limited irrigated condition. Thus, there was an increase in the genetic gain as well as relative efficiency with an increase in the character combinations.

In four character combinations, the highest genetic advance and relative efficiency were 21.15g and 1355.94 per cent, respectively. Whereas, the maximum genetic advance and relative efficiency in five character combination were 22.43g and 1437.63 per cent, respectively under limited irrigated condition. Ferdous *et al*. (2011) and Kemelew (2011) were also with the same opinion that an increase in characters result in an increase in genetic gain and that the selection indices improve the efficiency than the straight selection for grain yield alone.

Further, it was observed that the straight selection for grain yield was not that much rewarding (GA=1.56g, RI=100%) as it was through its component like days to maturity (GA=5.94g, RI=380.77%), number of productive tiller per plant (GA=1.07g, RI=68.59%), number of grain per main spike (GA=15.37g, RI=985.26%), biological yield per plant (GA=2.98g, RI=191.03%), harvest index (GA=5.52g, RI=353.85%) in their combinations.

The maximum efficiency in selection for grain yield was exhibited by a discriminant function involving grain yield per plant, days to maturity, number of productive tillers per plant, number of grain per main spike, biological yield per plant and harvest index which had a genetic advance and relative efficiency of 22.92g and 1469.01 per cent, respectively followed by an index of five characters (grain yield per plant, days to maturity, number of grain per main spike, biological yield per plant and harvest index) with the 22.43g genetics advance and 1437.63 per cent relative efficiency. High efficiency in selection based on grain yield per plant, days to maturity, number of grain per main spike, biological yield per spike and harvest index or in combination of all these five characters. Singh and Diwivedi (1999) suggested that number of effective tillers per plant, number of grains per spike, grain weight per spike, biological yield per plant and harvest index to be included in selection criteria for

Table 1 : Selection index, discriminant function, expected genetic advance in grain yield and relative efficiency from the use of different selection indices in limited irrigated wheat under late shown condition

Sr. No.	Selection index	Discriminant function	Expected genetic advance	Relative efficiency (%)
1	2	3	4	5
1.	X_1 (Grain yield per plant)	$0.784X_1$	1.56	100.00
2.	X_2 (Days to maturity)	$0.924X_2$	5.94	380.77
3.	X_3 (Number of productive tillers per plant)	$0.911X_3$	1.07	68.59
4.	X_4 (Number of grain per main spike)	$0.912X_4$	15.37	985.26
5.	X_5 (Biological yield per plant)	$0.764X_5$	2.98	191.03
6.	X_6 (Harvest index)	$0.469X_6$	5.52	353.85
7.	$X_1.X_2$	$0.814X_1 + 0.938X_2$	6.65	426.50
8.	$X_1.X_3$	$0.674X_1 + 1.232X_3$	2.55	163.40
9.	$X_1.X_4$	$0.881X_1 + 0.915X_4$	16.16	1035.99
10.	$X_1.X_5$	$1.071X_1 + 0.651X_5$	4.53	290.07
11.	$X_1.X_6$	$1.887X_1 + 0.354X_6$	7.02	449.74
12.	$X_2.X_3$	$0.924X_2 + 1.047X_3$	6.31	404.41
13.	$X_2.X_4$	$0.966X_2 + 0.913X_4$	18.01	1154.30
14.	$X_2.X_5$	$0.959X_2 +0.773X_5$	7.58	486.14
15.	$X_2.X_6$	$0.987X_2 + 0.467X_6$	8.69	557.33
16.	$X_3.X_4$	$0.864X_3 +0.912X_4$	15.42	988.38
17.	$X_3.X_5$	$1.575X_3 + 0.631X_5$	3.95	253.42
18.	$X_3.X_6$	$2.602X_3 + 0.433X_6$	6.55	419.89
19.	$X_4.X_5$	$0.921X_4 + 0.906X_5$	17.37	1113.44
20.	$X_4.X_6$	$0.886X_4 + 0.416X_6$	15.74	1009.00
21.	$X_5.X_6$	$1.163X_5 + 0.488X_6$	7.71	494.12
22.	$X_1.X_2.X_3$	$0.642X_1 + 0.939X_2 + 1.387X_3$	7.20	461.45
23.	$X_1.X_2.X_4$	$0.881X_1 + 0.972X_2 + 0.915X_4$	18.86	1209.01
24.	$X_1.X_2.X_5$	$1.046X_1 + 0.972X_2 + 0.666X_5$	8.70	557.88
25.	$X_1.X_2.X_6$	$1.952X_1 + 0.920X_2 + 0.348X_6$	10.05	644.49
26.	$X_1.X_3.X_4$	$0.891X_1 + 0.938X_3 + 0.914X_4$	16.29	1044.35
27.	$X_1.X_3.X_5$	$0.953X_1 + 1.836X_3 + 0.517X_5$	5.51	353.38
28.	$X_1.X_3.X_6$	$1.172X_1 + 2.462X_3 + 0.390X_6$	7.90	506.72
29.	$X_1.X_4.X_5$	$0.360X_1 + 0.928X_4 + 1.098X_5$	18.33	1175.18
30.	$X_1.X_4.X_6$	$2.811X_1 + 0.805X_4 + 0.212X_6$	17.16	1099.86
31.	$X_1.X_5.X_6$	$7.146X_1 + -1.493X_5 +-0.033X_6$	9.26	593.55
32.	$X_2.X_3.X_4$	$0.970X_2 + 0.947X_3 + 0.912X_4$	18.14	1162.79
33.	$X_2.X_3.X_5$	$0.962X_2 + 1.713X_3 + 0.611X_5$	8.24	527.96
34.	$X_2.X_3.X_6$	$0.927X_2 + 2.742X_3 + 0.430X_6$	9.58	614.42
35.	$X_2.X_4.X_5$	$0.973X_2 + 0.921X_4 + 0.910X_5$	20.08	1287.02
36.	$X_2.X_4.X_6$	$1.060X_2 +0.878X_4 + 0.411X_6$	18.60	1192.19
37.	$X_2.X_5.X_6$	$0.951X_2 + 1.177X_5 + 0.487X_6$	10.86	696.44
38.	$X_3.X_4.X_5$	$0.872X_3 + 0.920X_4 + 0.920X_5$	17.56	1125.70
39.	$X_3.X_4.X_6$	$2.700X_3 + 0.885X_4 + 0.377X_6$	16.15	1035.13
40.	$X_3.X_5.X_6$	$2.881X_3 + 0.772X_5 + 0.459X_6$	8.73	559.50
41.	$X_4.X_5.X_6$	$0.837X_4 + 1.489X_5 + 0.422X_6$	18.33	1175.03
42.	$X_1.X_2.X_3.X_4$	$0.813X_1 + 0.974X_2 + 1.105X_3 + 0.918X_4$	19.06	1221.97
43.	$X_1.X_2.X_3.X_5$	$2.212X_1 + 1.036X_2 + 1.597X_3 + -0.106X_5$	9.53	610.60

Contd.... Table 1

Table 1 contd...

44.	$X_1.X_2.X_3.X_6$	$1.165X_1 + 0.922X_2 + 2.616X_3 + 0.387X_6$	10.87	696.61
45.	$X_1.X_2.X_4.X_5$	$0.327X_1 + 0.989X_2 + 0.926X_4 + 1.113X_5$	21.07	1350.62
46.	$X_1.X_2.X_4.X_6$	$2.812X_1 + 0.981X_2 + 0.804X_4 + 0.210X_6$	19.97	1280.35
47.	$X_1.X_2.X_5.X_6$	$7.090X_1 +0.950X_2 + -1.456X_5 + -0.030X_6$	12.29	787.55
48.	$X_1.X_3.X_4.X_5$	$0.322X_1 + 1.434X_3 + 0.940X_4 + 0.989X_5$	18.59	1191.52
49.	$X_1.X_3.X_4.X_6$	$2.704X_1 + 1.100X_3 + 0.809X_4 + 0.222X_6$	17.50	1121.57
50.	$X_1.X_3.X_5.X_6$	$7.831X_1 + 3.362X_3 + -2.269X_5 + -0.124X_6$	10.33	662.26
51.	$X_1.X_4.X_5.X_6$	$8.072X_1 + 0.831X_4 + -1.546X_5 + -0.173X_6$	19.63	1258.08
52.	$X_2.X_3.X_4.X_5$	$0.976X_2 + 1.034X_3 + 0.923X_4 + 0.881X_5$	20.33	1303.05
53.	$X_2.X_3.X_4.X_6$	$0.996X_2 + 2.763X_3 + 0.883X_4 + 0.373X_6$	19.04	1220.40
54.	$X_2.X_3.X_5.X_6$	$0.951X_2 + 3.033X_3 + 0.756X_5 + 0.456X_6$	11.77	754.76
55.	$X_2.X_4.X_5.X_6$	$1.002X_2 + 0.835X_4 + 1.483X_5 + 0.419X_6$	21.15	1355.94
56.	$X_3.X_4.X_5.X_6$	$1.862X_3 + 0.859X_4 + 1.257X_5 + 0.412X_6$	18.73	1200.55
57.	$X_1.X_2.X_3.X_4.X_5$	$0.260X_1 + 0.986X_2 + 1.606X_3 + 0.943X_4 + 0.973x6$	21.38	1370.51
58.	$X_1.X_2.X_3.X_4.X_6$	$2.577X_1 + 0.982X_2 + 1.293X_3 + 0.814X_4 + 0.230x6$	20.35	1304.66
59.	$X_1.X_2.X_3.X_5.X_6$	$7.832X_1 + 0.947X_2 + 3.514X_3 + -2.284X_5 + -0.128x6$	13.26	850.11
60.	$X_1.X_2.X_4.X_5.X_6$	$5.266X_1 + 1.006X_2 + 0.834X_4 + -0.386X_5 + 0.059x6$	22.43	1437.63
61.	$X_1.X_3.X_4.X_5.X_6$	$8.114X_1 + 2.402X_3 + 0.866X_4 + -1.928X_5 + -0.195x6$	20.09	1287.58
62.	$X_2.X_3.X_4.X_5.X_6$	$0.994X_2 + 2.027X_3 + 0.861X_4 + 1.214X_5 + 0.408x6$	21.58	1383.48
63.	$X_1.X_2.X_3.X_4.X_5.X_6$	$7.993X_1 + 0.986X_2 + 2.572X_3 + 0.869X_4 +-1.919x5 + -0.190x6$	22.92	1469.01

improvement of grain yield in wheat.

The present study showed consistent increase in the relative efficiency of the succeeding index with simultaneous inclusion of each character. Therefore, improvements of grain yield through these selection indices are suggested. However, in practice, the plant breeder might be interested in maximum gain with minimum number of characters. In such a case, selection index consisting of four traits *viz*., grain yield per plant, number of grain per spike, 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 selection in plant 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 breeding programme.

LITERATURE CITED

Anonymous (2012). Progress report of All India Co-ordinated Wheat and Barly Improvement Project. Directorate of Wheat Research, Karnal (Haryana) India.

Esheghi, R., Javid, O. and Samira, S. (2011). Genetic gain through selection indices in hulless barley. *Internat. J. Agric. & Biol.,* **13** : 191-197.

Ferdous, M., Nath, U.K. and Islam, A. (2011). Genetic divergence and genetic gain in bread wheat through selection practices. *J. Bangladesh Agric. Univ.,* **9** : 1-4.

Hazel, L.N. (1943). The genetic basis for constructing selection indices. *Genetics,* **28** : 476-490.

Hazel, L.N. and Lush, J.L. (1943). The efficiency of three method of selection. *J. Hered.,* **33** : 393-399.

Kemelew, M. (2011). Selection index in durum wheat (*Triticum turgidum* var. durum) variety development. *Academic J. Pl. Sci.,* **4** : 77-83.

Lupton, F.G.H. (1987). *Wheat breeding: Its scientific basis*. Chapman and Hall Ltd., London, UNITED KINGDOM.

Mc Vetty, P.B. and Evans, L.E. (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.

Robinson, H.F., Comstock, R.E. and Harvey, P.H. (1951). Genotypic and phenotypic correlation in corn and their implication in selection. *Agron. J.,* **43** : 282-287.

Singh, S.P. and Diwivedi, V.K. (1999). Character association and path analysis in wheat (*Triticum aestivum* L.). *New Botanist*., **26** : 135-140.

Smith, H.F. (1936). A discriminant function for plant selection. *Ann. Eugen.,* **7** : 240-250.