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Formulation of selection index in foxtail millet [*Setaria italica* (L.) Beauv.]

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Abstract
The present study was initiated on sixty foxtail millet germplasm to formulate suitable selection index using equal economic weights as well as inverse of means as their economic weights for simultaneous selection of different yield and nutritional components viz., days to 50% flowering, plant height, panicle length, productive tillers per plant, days to maturity, test weight, protein, carbohydrate, calcium, iron, zinc, copper, manganese, phosphorus and grain yield per plant. It was observed that maximum estimate of genetic advance over grain yield per plant was obtained when all the fifteen characters under study are included in the construction of selection index compared to all 32767 possible combinations. From this, it became evident that the best possible construct in case of foxtail millet for selecting superior genotypes should include maximum number of characters that are considered for investigation. And addition of characters one by one in the selection index constructs resulted in increasing trend of genetic advance values. The best construct was same, when both types of economic weights are used. Further the increasing trend of genetic advance with addition of traits was also similar when both types of economic weights are used.

Keywords: Selection index, expected genetic advance, relative efficiency, foxtail millet

Introduction

Selection of plants indiscriminately from a field on the basis of phenotypic expressions might lead to disappointing results. It is not the phenotypic character but the genotypic value that should be accounted to form the basis for selecting plants. Thus, index based on economic characters should give weightage to the phenotypic expression in terms of genotype by eliminating environmental variation. Such an index was first proposed by Smith (1936) [16] utilizing the concept given by Fisher (1936) [5]. The adoption of discriminate function solves the problem of apportioning the total effect by discriminating environmental effect and also by assigning relative economic weights to each of the yield components based on its genotypic contribution. These economic weights can be assigned primarily in three different ways. One: by assigning equal economic weights for all the characters under study. Two: by taking inverse of means of the traits as their respective economic weights and three: by assigning weights by the breeder himself based on the economic importance of different traits under study. In the present study, we planned to formulate suitable selection index in foxtail millet by assigning economic weights in two ways *i.e.*, one by equal economic weights and second by assigning inverse of means of respective trait of as their economic weights. The main objective of this study is to develop suitable selection index for simultaneous selection of different quantitative and nutritional characters.

Materials and Methods

The experiment was carried out at RARS, Lam, Guntur, Andhra Pradesh, which is located at 16.10^0 N latitude, 28.29^0 E longitude and 31.5 m altitude with 60 foxtail millet [*Setaria italica* (L.) Beauv.] germplasm including checks during *kharif*, 2018-19. The trial was laid out in a Augmented Randomised Complete Block Design (Federer, 1956) [4] with four checks *viz.,* Suryanandi, Prasad, Co 7 and Krishnadevaraya in each block. Each genotype was grown in a two rows of 4 m length with a spacing of 22.5 cm between the rows and 10 cm between the plants. Data were collected on five randomly selected plants per treatment for plant height, panicle length, productive tillers per plant and grain yield per plant. However data on days to 50% flowering, days to maturity, test weight, protein, carbohydrate, calcium, iron, zinc, copper, manganese and phosphorus were recorded on plot basis. Seed protein was estimated using Micro kjeldhal Distillation Method (Sadasivam and Manickam, 1996) [13]. Carbohydrate content was estimated using the procedure given by Sadasivam and Manickam (1997) [14]. Iron, Zinc, Copper and Manganese was estimated with the help of Atomic Absorption Spectrophotometer (AAS) as per Tandon (1999) [19]. Similary seed phosphorus content was also estimated as per procedure given by Tandon (1999) [19]. While calcium content was estimated using Versanate titration method (Jackson, 1967) [6].

The restricted selection indices were computed as per Kempthrone and Nordskog (1959) [7], which enables us to restrict the change (improvement) in characters of breeder's choice without affecting the other characters. A series of constructs to the tune of 32767 were formulated using all the fifteen characters considered the genetic advance as the judging index as per the procedure given by Singh and Chaudhary (1977) [15]. In this process of formulating suitable selection index for simultaneous selection, both equal economic weights and inverse of means were assigned as the respective economic weights for the fifteen characters and all the possible 32767 constructs were developed.

Results and Discussion

The selection indices which gave higher estimates of genetic advance when equal economic weights as well as inverse of means are used, compared to the direct selection were presented in table 1 and table 2, respectively and were discussed here under. Among the selection indices constructed using equal economic weights and inverse of means as their economic weights, 32112 constructs out of 32767 possible indices resulted in higher genetic advance than direct selection on yield alone.

Construction of Selection Indices when equal economic weights are used as economic weight

When independent characters were considered for construction of index, the indices having plant height (13.52, 310.08%) recorded highest genetic advance and relative gain over grain yield per plant respectively, followed by days to 50% flowering (8.76, 200.91%) and days to maturity (7.14, 163.76%).

Among two character combinations, grain yield per plant + plant height (17.07, 391.50%) recorded highest genetic advance and relative gain over grain yield per plant respectively, followed by plant height + carbohydrate (16.90, 387.60%) and plant height + panicle length (16.87, 386.91%).

In case of selection indices constructed using three character, the construct with the combination, grain yield per plant + plant height + carbohydrate (20.80, 477.05%) had highest genetic advance and relative gain over grain yield per plant respectively, followed by the combinations *viz.*, plant height + panicle length + carbohydrate (20.58, 472.00%) and grain yield per plant + plant height + panicle length (20.40, 467.87%).

Among four character combinations, grain yield per plant + plant height + panicle length + carbohydrate (24.38, 559.16%) recorded highest values of genetic advance and relative gain over grain yield per plant respectively, followed by the combinations *viz.*, grain yield per plant + plant height + productive tillers per plant + carbohydrate (21.60, 495.40%) and plant height + panicle length + productive tillers per plant + carbohydrate (21.33, 489.20%).

When five characters were used for construction of index, the construct, grain yield per plant + plant height + panicle length + productive tillers per plant + carbohydrate (25.19, 577.73%) recorded highest genetic advance and relative gain over grain yield per plant respectively, followed by the constructs *viz.*, grain yield per plant + plant height + panicle length + test weight + carbohydrate (24.77, 568.10%) and grain yield per plant + plant height + panicle length + days to maturity, carbohydrate (24.50, 561.91%).

When six characters were used in construction of index, the combination, grain yield per plant + days to 50% flowering + plant height + panicle length + days to maturity + carbohydrate (26.61, 610.30%) recorded highest genetic advance and relative gain over grain yield per plant respectively, followed by the constructs *viz.*, grain yield per plant + plant height + panicle length + productive tillers per plant + test weight + carbohydrate (25.58, 586.68%) and grain yield per plant + plant height + panicle length + productive tillers per plant + days to maturity + carbohydrate (25.34, 581.17%).

In case of seven character combinations, the combination, grain yield per plant + days to 50% flowering + plant height + panicle length + productive tillers per plant + days to maturity + carbohydrate (27.38, 627.96%) recorded highest genetic advance and relative gain over grain yield per plant respectively, followed by the combinations *viz.*, grain yield per plant + days to 50% flowering + plant height + panicle length + days to maturity + test weight + carbohydrate (26.97, 618.56%) and grain yield per plant + days to 50% flowering + plant height + panicle length + days to maturity + carbohydrate + calcium (26.88, 616.49%).

When eight characters were employed in constructing selection index, the combination, grain yield per plant + days to 50% flowering + plant height + panicle length + productive tillers per plant + days to maturity + test weight + carbohydrate (27.75, 636.45%) recorded highest genetic advance and relative gain over grain yield per plant respectively, followed by the combinations *viz.*, grain yield per plant + days to 50% flowering + plant height + panicle length + productive tillers per plant + days to maturity + carbohydrate + calcium (27.66, 634.38%) and grain yield per plant + days to 50% flowering + plant height + panicle length + productive tillers per plant + days to maturity + protein + carbohydrate (27.57, 632.32%).

In case of nine character combinations, the construct, grain yield per plant + days to 50% flowering + plant height + panicle length + productive tillers per plant + days to maturity + test weight + carbohydrate + calcium (28.02, 642.64) recorded highest genetic advance and relative gain over grain yield per plant respectively, followed by the constructs *viz.*, grain yield per plant + days to 50% flowering + plant height + panicle length + productive tillers per plant + days to maturity + test weight + protein + carbohydrate (27.93, 640.57) and grain yield per plant + days to 50% flowering + plant height + panicle length + productive tillers per plant + days to maturity + test weight + carbohydrate + manganese (27.85, 638.74%).

When selection indices was constructed using ten character combinations, the combination, grain yield per plant + days to 50% flowering + plant height + panicle length + productive tillers per plant + days to maturity + test weight + protein + carbohydrate + calcium (28.18, 646.33%), recorded highest genetic advance and relative gain over grain yield per plant respectively, followed by other combinations *viz.*, grain yield per plant + days to 50% flowering + plant height + panicle length + productive tillers per plant + days to maturity + test weight + carbohydrate + calcium + manganese (28.16, 645.85) and grain yield per plant + days to 50% flowering + plant height + panicle length + productive tillers per plant + days to maturity + test weight + carbohydrate + calcium + phosphorus (28.02, 642.64).

Among the indices constructed using eleven character combinations, the combination, grain yield per plant + days to 50% flowering + plant height + panicle length + productive tillers per plant + days to maturity + test weight + protein + carbohydrate + calcium + manganese (28.22, 647.29%) recorded highest genetic advance and relative gain over grain yield per plant respectively, followed by the combinations *viz.*, grain yield per plant + days to 50% flowering + plant height + panicle length + productive tillers per plant + days to maturity + test weight +protein + carbohydrate + calcium + phosphorus (28.19, 646.54%) and grain yield per plant + days to 50% flowering + plant height + panicle length + productive tillers per plant + days to maturity + test weight + carbohydrate + calcium + copper + phosphorus (28.18, 646.33%).

When twelve characters were included in developing selection index, the combination without iron, zinc and copper (28.24, 647.72%) recorded highest genetic advance and relative gain over grain yield per plant respectively, followed by constructs, without zinc, copper and phosphorus (28.24, 647.72%) and without iron, copper and phosphorus (28.23, 647.46%).

Among the selection indices constructed using thirteen characters, the constructs, without zinc and copper (28.26, 648.16%) and the one without iron and copper (28.26, 648.16%) recorded highest genetic advance and relative gain over grain yield per plant respectively, followed by the combination, without copper and phosphorus (28.25, 647.93%).

When fourteen characters were included, the combination without copper (28.30, 649.23%) recorded highest genetic advance and relative gain over grain yield per plant respectively, followed by constructs, without zinc (28.29, 648.93%) and without iron (28.27, 648.39%).

The index constructed using all the fifteen characters, recorded maximum expected genetic advance (28.31) and relative gain over grain yield per plant (649.31%) compared to all 32767 possible combinations.

Construction of Selection Indices when inverse of means are used as economic weight

When independent characters were considered for construction of index, the index with days to 50% flowering (0.18, 450%) recorded highest genetic advance and relative gain over grain yield per plant respectively, followed by panicle length (0.06, 150%) and days to maturity (0.05, 125%).

Among two character combinations, days to 50% flowering + calcium (0.34, 850%) recorded highest genetic advance and relative gain over grain yield per plant respectively, followed by the combinations *viz.*, days to 50% flowering + iron (0.25, 625%) and grain yield per plant + days to 50% flowering (0.22, 550%).

In case of selection indices, constructed using three character combinations, the combination, days to 50% flowering + productive tillers per plant + calcium (0.39, 975%) recorded highest genetic advance and relative gain over grain yield per plant respectively, followed by grain yield per plant + days to 50% flowering + calcium (0.38, 950%) and grain yield per plant + days to 50% flowering + panicle length (0.35, 875%).

Among four character combinations, the combination, grain yield per plant + days to 50% flowering + panicle length + calcium (0.44, 1100%) recorded highest genetic advance and relative gain over grain yield per plant respectively, followed by the combinations *viz.*, grain yield per plant + days to 50% flowering + productive tillers per plant + calcium (0.43, 1075%) and grain yield per plant + days to 50% flowering + panicle length + productive tillers per plant (0.40, 1000%).

When five characters were used for construction of index, the construct grain yield per plant + days to 50% flowering + panicle length + carbohydrate + calcium (0.50, 1250%) recorded highest genetic advance and percent gain over grain yield per plant respectively, followed by grain yield per plant + days to 50% flowering + panicle length + productive tillers per plant + calcium (0.49, 1225%) and grain yield per plant + days to 50% flowering + panicle length + productive tillers per plant + carbohydrate (0.46, 1150%).

When six characters were used in constructing selection index, the combination grain yield per plant + days to 50% flowering + panicle length + productive tillers per plant + carbohydrate + calcium (0.54, 1350%) recorded highest genetic advance and relative gain over grain yield per plant respectively, followed by the combinations *viz.*, grain yield per plant + days to 50% flowering + plant height + panicle length + productive tillers per plant + calcium (0.52, 1300%) and grain yield per plant + days to 50% flowering + panicle length + productive tillers per plant + test weight + calcium (0.51, 1275%).

In case of seven character combinations, the combination, grain yield per plant + days to 50% flowering + plant height + panicle length + productive tillers per plant + carbohydrate + calcium (0.55, 1375%) recorded highest genetic advance and relative gain over grain yield per plant respectively, followed by the combinations *viz.*, grain yield per plant + days to 50% flowering + plant height + panicle length + test weight + carbohydrate + calcium (0.55, 1375%) and grain yield per plant + days to 50% flowering + plant height + productive tillers per plant + test weight + carbohydrate + calcium (0.54, 1350%).

When eight characters were employed in constructing selection index, the combination, grain yield per plant + days to 50% flowering + plant height + panicle length + productive tillers per plant + days to maturity + carbohydrate + calcium (0.57, 1425%) recorded highest genetic advance and relative gain over grain yield per plant respectively, followed by the combinations *viz.*, grain yield per plant + days to 50% flowering + plant height + panicle length + productive tillers per plant + days to maturity + test weight + calcium (0.56, 1400%) and grain yield per plant + days to 50% flowering + plant height + panicle length + productive tillers per plant + days to maturity + test weight + carbohydrate (0.56, 1400%).

In case of nine character combinations, the construct, grain yield per plant + days to 50% flowering + plant height + panicle length + productive tillers per plant + days to maturity + test weight + calcium + iron (0.61, 1525%) recorded highest genetic advance and relative gain over grain yield per plant respectively, followed by the constructs *viz.*, grain yield per plant + days to 50% flowering + plant height + panicle length + productive tillers per plant + days to maturity + test weight + protein + iron (0.59, 1475%) and grain yield per plant + days to 50% flowering + plant height + panicle length + productive tillers per plant + days to maturity + test weight + carbohydrate + calcium (0.58, 1450%).

When selection indices was constructed using ten character combinations, the combination, grain yield per plant + days to

50% flowering + plant height + panicle length + productive tillers per plant + days to maturity + test weight + protein + iron + calcium (0.64, 1600%) recorded highest genetic advance and relative gain over grain yield per plant respectively, followed by other combinations *viz.*, grain yield per plant + days to 50% flowering + plant height + panicle length + productive tillers per plant + days to maturity + test weight + carbohydrate + iron + copper (0.63, 1575%) and grain yield per plant + days to 50% flowering + plant height + panicle length + productive tillers per plant + days to maturity + test weight + carbohydrate + calcium+ iron (0.63, 1575%).

Among the selection indices constructed using eleven character combinations, the combinations, grain yield per plant + days to 50% flowering + plant height + panicle length + productive tillers per plant + days to maturity + test weight + protein + carbohydrate + iron + copper (0.66, 1650%) and the other combination grain yield per plant + days to 50% flowering + plant height + panicle length + productive tillers per plant + days to maturity + test weight + protein + carbohydrate + calcium + iron (0.66, 1650%) recorded highest genetic advance and per cent gain over grain yield per plant respectively, followed by the combination, grain yield per plant + days to 50% flowering + plant height + panicle length + productive tillers per plant + days to maturity + test weight + protein + carbohydrate + copper + manganese (0.65, 1625%).

When twelve characters were included in developing selection index, the construct, grain yield per plant + days to 50% flowering + plant height + panicle length + productive tillers per plant + days to maturity + test weight + protein + carbohydrate + calcium + iron + copper (0.68, 1700%) recorded highest genetic advance and relative gain over grain yield per plant respectively, followed by constructs *viz.*, grain yield per plant + days to 50% flowering + plant height + panicle length + productive tillers per plant + days to maturity + test weight + protein + carbohydrate + calcium + iron + manganese (0.67, 1675%) and grain yield per plant + days to 50% flowering + plant height + panicle length + productive tillers per plant + days to maturity + test weight + protein + carbohydrate + calcium + copper + manganese (0.67, 1675%).

Among the selection indices constructed using the thirteen characters, the constructs, without zinc and phosphorus (0.69, 1725%) and the other combination without manganese and phosphorus (0.69, 1725%) recorded highest genetic advance and relative gain over grain yield per plant respectively, followed by the combination without copper and phosphorus (0.68, 1700%).

When fourteen characters were included, the combination without phosphorus (0.73, 1825%) recorded highest genetic advance and relative gain over grain yield per plant respectively, followed by constructs, without manganese (0.72, 1800%) and without copper (0.70, 1750%).

The index constructed using all the fifteen characters recorded maximum expected genetic advance (0.74) and relative gain over grain yield per plant (1850%) compared to all 32767 possible combinations.

These results clearly indicate that selection based on index value is efficient than direct selection on yield alone. Similar conclusions were drawn by Prasanna *et al.* (2012) [11] in foxtail millet; Basavaraja and Sheriff (1992) [2], Bhat and Shariff (1994) [3], Padmaja *et al.* (2006) [9], Padmaja *et al.* (2007) [10], Srilakshmi *et al.* (2017) [17] and Srilakshmi and Babu (2017) [18] in finger millet; Kumar *et al.* (2012) [8] in sorghum and Priya and Babu (2018) [12] in paddy.

The addition of characters one by one in the construction of selection index resulted in the increased estimates of genetic advance. These findings are in tune with the results of Basavaraja and Sheriff (1992) [2], Bhat and Shariff (1994) [3], Padmaja *et al.* (2007) [10], Srilakshmi *et al.* (2017) [17] and Srilakshmi and Babu (2017) [18] in finger millet and Priya and Babu (2018) [12] in rice. And the maximum estimates of genetic gain and relative advantage of grain yield per plant was observed when all the characters under study are included in the construction of the index. Such results were also reported by Bhat and Shariff (1994) [3], Padmaja *et al.* (2006) [9], Padmaja *et al.* (2007) [10], Srilakshmi *et al.* (2017) [17] and Srilakshmi and Babu (2017) [18] in finger millet; Ammu (2011) [1] and Priya and Babu (2018) [12] in rice. From the above result it is evident that the best possible construct in case of foxtail millet for selecting superior genotypes should include all the fifteen characters are considered for this investigation.

The maximum estimates of genetic advance and relative gain over grain yield per plant when all characters under study are included in the construction of selection index was observed in both the cases *i.e.*, when equal economic weights are used (table 1) and inverse of means are used as economic weights of the respective characters (table 2). This indicates that, both ways of assigning weights were equally effective in obtaining the suitable selection index construct. Such similarity in the efficiency of both ways of assigning of economic weights was earlier reported by Srilakshmi and Babu (2017) [18] in finger millet.

Conclusion

In the process of constructing the suitable selection index for selection of superior genotypes in foxtail millet, maximum estimate of genetic advance over grain yield per plant was obtained when all the fifteen characters under study are included in the construction of selection index. From this, it became evident that the best possible construct in case of foxtail millet for selecting superior genotypes should include maximum number of characters that are considered for investigation. And addition of characters one by one in the selection index constructs resulted in increasing trend of genetic advance values. The best construct was same, when both types of economic weights are used. Further the increasing trend of genetic advance with addition of traits was also similar when both types of economic weights are used.

Table 1: Expected genetic advance and relative efficiency over grain yield per plant of different constructs formulated using equal economic weights

S. No	Selection Index	Expected Genetic Advance	Relative efficiency
1.	X_1	4.36	100.00
2.	X_6	7.14	163.76
3.	X_2	8.76	200.91
4.	X_3	13.52	310.08
5.	X_3+ X_4	16.87	386.91
6.	X_3+ X_9	16.90	387.60

7.	$X_1 + X_3$	17.07	391.50
8.	$X_1 + X_3 + X_4$	20.40	467.87
9.	$X_3 + X_4 + X_9$	20.58	472.00
10.	$X_1 + X_3 + X_9$	20.80	477.05
11.	$X_3 + X_4 + X_5 + X_9$	21.33	489.20
12.	$X_1 + X_3 + X_5 + X_9$	21.60	495.40
13.	$X_1 + X_3 + X_4 + X_9$	24.38	559.16
14.	$X_1 + X_3 + X_4 + X_6 + X_9$	24.50	561.91
15.	$X_1 + X_3 + X_4 + X_7 + X_9$	24.77	568.10
16.	$X_1 + X_3 + X_4 + X_5 + X_9$	25.19	577.73
17.	$X_1 + X_3 + X_4 + X_5 + X_6 + X_9$	25.34	581.17
18.	$X_1 + X_3 + X_4 + X_5 + X_7 + X_9$	25.58	586.68
19.	$X_1 + X_2 + X_3 + X_4 + X_6 + X_9$	26.61	610.30
20.	$X_1 + X_2 + X_3 + X_4 + X_6 + X_9 + X_{10}$	26.88	616.49
21.	$X_1 + X_2 + X_3 + X_4 + X_6 + X_7 + X_9$	26.97	618.56
22.	$X_1 + X_2 + X_3 + X_4 + X_5 + X_6 + X_9$	27.38	627.96
23.	$X_1 + X_2 + X_3 + X_4 + X_5 + X_6 + X_8 + X_9$	27.57	632.32
24.	$X_1 + X_2 + X_3 + X_4 + X_5 + X_6 + X_9 + X_{10}$	27.66	634.38
25.	$X_1 + X_2 + X_3 + X_4 + X_5 + X_6 + X_7 + X_9$	27.75	636.45
26.	$X_1 + X_2 + X_3 + X_4 + X_5 + X_6 + X_7 + X_9 + X_{14}$	27.85	638.74
27.	$X_1 + X_2 + X_3 + X_4 + X_5 + X_6 + X_7 + X_8 + X_9$	27.93	640.57
28.	$X_1 + X_2 + X_3 + X_4 + X_5 + X_6 + X_7 + X_9 + X_{10}$	28.02	642.64
29.	$X_1 + X_2 + X_3 + X_4 + X_5 + X_6 + X_7 + X_9 + X_{10} + X_{15}$	28.02	642.64
30.	$X_1 + X_2 + X_3 + X_4 + X_5 + X_6 + X_7 + X_9 + X_{10} + X_{14}$	28.16	645.85
31.	$X_1 + X_2 + X_3 + X_4 + X_5 + X_6 + X_7 + X_8 + X_9 + X_{10}$	28.18	646.33
32.	$X_1 + X_2 + X_3 + X_4 + X_5 + X_6 + X_7 + X_9 + X_{10} + X_{14} + X_{15}$	28.18	646.33
33.	$X_1 + X_2 + X_3 + X_4 + X_5 + X_6 + X_7 + X_8 + X_9 + X_{10} + X_{15}$	28.19	646.54
34.	$X_1 + X_2 + X_3 + X_4 + X_5 + X_6 + X_7 + X_8 + X_9 + X_{10} + X_{14}$	28.22	647.29
35.	$X_1 + X_2 + X_3 + X_4 + X_5 + X_6 + X_7 + X_8 + X_9 + X_{10} + X_{12} + X_{14}$	28.23	647.46
36.	$X_1 + X_2 + X_3 + X_4 + X_5 + X_6 + X_7 + X_8 + X_9 + X_{10} + X_{11} + X_{14}$	28.24	647.72
37.	$X_1 + X_2 + X_3 + X_4 + X_5 + X_6 + X_7 + X_8 + X_9 + X_{10} + X_{14} + X_{15}$	28.24	647.72
38.	$X_1 + X_2 + X_3 + X_4 + X_5 + X_6 + X_7 + X_8 + X_9 + X_{10} + X_{11} + X_{12} + X_{14}$	28.25	647.93
39.	$X_1 + X_2 + X_3 + X_4 + X_5 + X_6 + X_7 + X_8 + X_9 + X_{10} + X_{12} + X_{14} + X_{15}$	28.26	648.16
40.	$X_1 + X_2 + X_3 + X_4 + X_5 + X_6 + X_7 + X_8 + X_9 + X_{10} + X_{11} + X_{14} + X_{15}$	28.26	648.16
41.	$X_1 + X_2 + X_3 + X_4 + X_5 + X_6 + X_7 + X_8 + X_9 + X_{10} + X_{12} + X_{13} + X_{14} + X_{15}$	28.27	648.39
42.	$X_1 + X_2 + X_3 + X_4 + X_5 + X_6 + X_7 + X_8 + X_9 + X_{10} + X_{11} + X_{13} + X_{14} + X_{15}$	28.29	648.93
43.	$X_1 + X_2 + X_3 + X_4 + X_5 + X_6 + X_7 + X_8 + X_9 + X_{10} + X_{11} + X_{12} + X_{14} + X_{15}$	28.30	649.23
44.	$X_1 + X_2 + X_3 + X_4 + X_5 + X_6 + X_7 + X_8 + X_9 + X_{10} + X_{11} + X_{12} + X_{13} + X_{14} + X_{15}$	28.31	649.31

Where X_1 = Grain yield per plant, X_2 = Days to 50% flowering, X_3 = Plant height, X_4 = Panicle length, X_5 = Productive tillers per plant, X_6 = Days to maturity, X_7 = Test weight, X_8= Protein, X_9 = Carbohydrate, X_{10} = Calcium, X_{11} = Iron, X_{12} = Zinc, X_{13} = Copper, X_{14} = Manganese, X_{15} = Phosphorus

Table 2: Expected genetic advance and relative efficiency over grain yield per plant of different constructs formulated using inverse of means

S. No	Selection Index	Expected Genetic Advance	Relative efficiency
1.	X_1	0.04	100
2.	X_6	0.05	125
3.	X_4	0.06	150
4.	X_2	0.18	450
5.	$X_1 + X_2$	0.22	550
6.	$X_2 + X_{11}$	0.25	625
7.	$X_2 + X_{10}$	0.34	850
8.	$X_1 + X_2 + X_4$	0.35	875
9.	$X_1 + X_2 + X_{10}$	0.38	950
10.	$X_2 + X_5 + X_{10}$	0.39	975
11.	$X_1 + X_2 + X_4 + X_5$	0.40	1000
12.	$X_1 + X_2 + X_5 + X_{10}$	0.43	1075
13.	$X_1 + X_2 + X_4 + X_{10}$	0.44	1100
14.	$X_1 + X_2 + X_4 + X_5 + X_9$	0.46	1150
15.	$X_1 + X_2 + X_4 + X_5 + X_{10}$	0.49	1225
16.	$X_1 + X_2 + X_4 + X_9 + X_{10}$	0.50	1250
17.	$X_1 + X_2 + X_4 + X_5 + X_7 + X_{10}$	0.51	1275
18.	$X_1 + X_2 + X_3 + X_4 + X_5 + X_{10}$	0.52	1300
19.	$X_1 + X_2 + X_4 + X_5 + X_9 + X_{10}$	0.54	1350
20.	$X_1 + X_2 + X_3 + X_5 + X_7 + X_9 + X_{10}$	0.54	1350
21.	$X_1 + X_2 + X_3 + X_4 + X_7 + X_9 + X_{10}$	0.55	1375
22.	$X_1 + X_2 + X_3 + X_4 + X_5 + X_9 + X_{10}$	0.55	1375
23.	$X_1 + X_2 + X_3 + X_4 + X_5 + X_6 + X_7 + X_9$	0.56	1400
24.	$X_1 + X_2 + X_3 + X_4 + X_5 + X_6 + X_7 + X_{10}$	0.56	1400

25.	$X_1+X_2+X_3+X_4+X_5+X_6+X_9+X_{10}$	0.57	1425
26.	$X_1+X_2+X_3+X_4+X_5+X_6+X_7+X_9+X_{10}$	0.58	1450
27.	$X_1+X_2+X_3+X_4+X_5+X_6+X_7+X_8+X_{11}$	0.59	1475
28.	$X_1+X_2+X_3+X_4+X_5+X_6+X_7+X_{10}+X_{11}$	0.61	1525
29.	$X_1+X_2+X_3+X_4+X_5+X_6+X_7+X_9+X_{10}+X_{11}$	0.63	1575
30.	$X_1+X_2+X_3+X_4+X_5+X_6+X_7+X_9+X_{11}+X_{13}$	0.63	1575
31.	$X_1+X_2+X_3+X_4+X_5+X_6+X_7+X_8+X_{11}+X_{10}$	0.64	1600
32.	$X_1+X_2+X_3+X_4+X_5+X_6+X_7+X_8+X_9+X_{13}+X_{14}$	0.65	1625
33.	$X_1+X_2+X_3+X_4+X_5+X_6+X_7+X_8+X_9+X_{10}+X_{11}$	0.66	1650
34.	$X_1+X_2+X_3+X_4+X_5+X_6+X_7+X_8+X_9+X_{11}+X_{13}$	0.66	1650
35.	$X_1+X_2+X_3+X_4+X_5+X_6+X_7+X_8+X_9+X_{10}+X_{13}+X_{14}$	0.67	1675
36.	$X_1+X_2+X_3+X_4+X_5+X_6+X_7+X_8+X_9+X_{10}+X_{11}+X_{14}$	0.67	1675
37.	$X_1+X_2+X_3+X_4+X_5+X_6+X_7+X_8+X_9+X_{10}+X_{11}+X_{13}$	0.68	1700
38.	$X_1+X_2+X_3+X_4+X_5+X_6+X_7+X_8+X_9+X_{10}+X_{11}+X_{12}+X_{14}$	0.68	1700
39.	$X_1+X_2+X_3+X_4+X_5+X_6+X_7+X_8+X_9+X_{10}+X_{11}+X_{12}+X_{13}$	0.69	1725
40.	$X_1+X_2+X_3+X_4+X_5+X_6+X_7+X_8+X_9+X_{10}+X_{11}+X_{13}+X_{14}$	0.69	1725
41.	$X_1+X_2+X_3+X_4+X_5+X_6+X_7+X_8+X_9+X_{10}+X_{11}+X_{12}+X_{14}+X_{15}$	0.70	1750
42.	$X_1+X_2+X_3+X_4+X_5+X_6+X_7+X_8+X_9+X_{10}+X_{11}+X_{12}+X_{13}+X_{15}$	0.72	1800
43.	$X_1+X_2+X_3+X_4+X_5+X_6+X_7+X_8+X_9+X_{10}+X_{11}+X_{12}+X_{13}+X_{14}$	0.73	1825
44.	$X_1+X_2+X_3+X_4+X_5+X_6+X_7+X_8+X_9+X_{10}+X_{11}+X_{12}+X_{13}+X_{14}+X_{15}$	0.74	1850

Where X_1 = Grain yield per plant, X_2 = Days to 50% flowering, X_3 = Plant height, X_4 = Panicle length, X_5 = Productive tillers per plant, X_6 = Days to maturity, X_7 = Test weight, X_8= Protein, X_9 = Carbohydrate, X_{10} = Calcium, X_{11} = Iron, X_{12} = Zinc, X_{13} = Copper, X_{14} = Manganese, X_{15} = Phosphorus

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