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Formulation of Selection Index by Assigning Inverse of Means as Economic Weights in Finger Millet [*Eleusine coracana* (L.) Gaertn]

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ABSTRACT

This study was initiated in finger millet with the prime objective of formulating suitable selection index using inverse of means as their respective economic weights for simultaneous selection of different quantitative and nutritional traits viz., Seed calcium content, seed protein content, plant height, days to 50% flowering, days to maturity, number of productive tillers per plant, fingers per ear, finger length, ear weight per plant, 1000-seed weight, and seed yield per plant. It was observed that addition of characters one by one in the construction of selection index resulted in the increased estimates of genetic advance. Finally the index constructed using all the eleven characters, recorded maximum expected genetic advance and percent gain over seed yield per plant compared to all 2047 possible combinations. From this it became evident that the best possible construct in case of finger millet for selecting superior genotypes should include maximum number of characters that are considered for investigation.

Key words: *Selection Index, Economic weights, Inverse of Means, Finger millet.*

INTRODUCTION

Selection is the basic step in any breeding programme depending up on the objective. In majority of cases breeder wants improvement of different characters simultaneously instead of one or two characters at a time. But it is very difficult to take up selection in many characters simultaneously for their simultaneous improvement at one go. This commonly faced problem can be solved to a greater extent by formulating a selection index. Such an index was first proposed by Smith[13] utilizing the concept of discriminant function developed by Fisher[4] in 1936. This construction of selection index had an important step in the form of assigning economic weights to different traits to be improved simultaneously. These economic weights can be assigned primarily in different three ways. One: by assigning equal economic weights for all the characters under study. Two: by taking inverse of means of the traits as their as their respective economic eights and three: by assigning weights by the breeder himself based on the economic importance of different traits under study.

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In the present investigation we planned to develop a suitable selection index in finger millet by assigning inverse of means as their respective economic weights of the characters considered in this study. This study was initiated with the prime objective of formulating suitable selection index using inverse of means as their respective economic weights for simultaneous selection of different quantitative and nutritional traits.

MATERIALS AND METHODS

A total of forty three genotypes of finger millet for this study were obtained from Agricultural Research Station, Vizianagaram. The experiment was laid down in Randomized Complete Block Design (RCBD) with three replications, each entry consisting of five rows of three meter length with 30cm between and 10cm within the row spacing at Agricultural College farm, Bapatla, located at an altitude of 5.4 m from MSL, 15^0 54' N latitude and $80^0$90' E longitude. Eleven different yield and nutritional traits *viz.,* seed protein content, seed calcium content, plant height, days to 50% flowering, days to maturity, number of productive tillers per plant, fingers per ear, finger length, ear weight per plant, 1000-seed weight, and seed yield per plant were taken up for formulation of suitable selection index for simultaneous selection. Ten randomly selected plants per treatment per replication were used for record of observations and their means were used for statistical analysis. For the traits, days to 50% flowering, days to maturity, 1000-seed weight and seed protein and seed calcium content data was recorded on plot basis. Versenate titration method[5] was employed for estimation of seed calcium content, while protein content (%) was estimated as described by Sadasivam and Manickam[11].

The restricted selection indices were computed as per Kempthorne and Nordskog[6] 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 2047 were formulated using all the eleven traits considered the genetic advance as the judging index as per the procedure given by Singh and Chaudhary[12]. In this process of formulating and identifying suitable index for simultaneous selection, inverse of means were assigned as the respective economic weights for the eleven characters (one of the three possible ways of assigning weights) and all possible 2047 constructs were developed.

RESULTS AND DISCUSSION

Among the selection indices constructed considering the inverse of means as economic weights, 2034 constructs out of 2047 possible indices resulted in higher genetic advance than the direct selection on yield alone.

When single characters were considered for construction of index, the indices having seed protein content (0.41, 145.61%), seed calcium content (0.33, 116.78%) and 1000-seed weight (0.31, 110.47%) recorded higher genetic advance and relative gain over seed yield per plant, respectively.

Among two character combinations, 50 out of 55 possible combinations recorded higher genetic advance and relative gain over seed yield per plant, out of which, seed yield per plant + 1000-seed weight (0.61, 213.40%), seed protein content + seed calcium content (0.58, 204.94%) and finger length + seed protein content (0.57, 201.90%) recorded higher genetic advance and percent gain over seed yield per plant, respectively.

In case of selection indices, constructed using three character combinations, 165 out of 165 possible indices recorded higher genetic advance and relative gain over seed yield per plant. Among them, the combinations *viz.*, seed yield per plant + finger length + 1000-seed weight (0.81, 287.31%), seed yield per plant + productive tillers per plant + 1000-seed weight (0.79, 279.93%), seed yield per plant + ear weight per plant + 1000-seed weight (0.78, 276.04%) recorded higher genetic advance and percent gain over seed yield per plant, respectively.

Among four character combinations, all the possible 330 indices recorded higher genetic advance and relative gain over seed yield per plant. Among them, the combinations *viz.*, seed yield per plant + productive tillers per plant + finger length + 1000-seed weight (1.01, 356.95%), seed yield per plant + productive tillers per plant + ear weight per plant + 1000-seed weight (0.99, 347.76%), seed yield per plant + finger length + ear weight per plant + 1000-seed weight (0.98, 347.07%) recorded higher genetic advance and relative gain over seed yield per plant, respectively.

In case of five character combinations, all the 462 possible indices recorded higher genetic advance and relative gain over seed yield per plant. Among them, the constructs *viz.,* seed yield per plant + productive tillers per plant + finger length + ear weight per plant + 1000-seed weight (1.19, 421.18%), seed yield per plant + productive tillers per plant + fingers per ear + finger length + 1000-seed weight (1.19, 418.48%), seed yield per plant + productive tillers per plant + fingers per ear + ear weight per plant + 1000-seed weight (1.16, 409.78%) recorded higher genetic advance and percent gain over seed yield per plant, respectively.

When six characters are involved, all the possible 462 combinations recorded higher genetic advance and relative gain over seed yield per plant. Among them, the combinations *viz.*, seed yield per plant + productive tillers per plant + fingers per ear + finger length + ear weight per plant + 1000-seed weight (1.36, 481.07%), seed yield per plant + productive tillers per plant + finger length + ear weight per plant + 1000-seed weight + seed calcium content (1.33, 470.29%), seed yield per plant + productive tillers per plant + fingers per ear + finger length + 1000-seed weight + seed calcium content (1.30, 459.89%) recorded higher genetic advance and relative gain over seed yield per plant, respectively.

In case of selection indices constructed using seven character combinations, all the possible 330 indices recorded higher genetic advance and relative gain over seed yield per plant. Among them, the combinations *viz.*, seed yield per plant + productive tillers per plant + fingers per ear + finger length + ear weight per plant + 1000-seed weight + seed calcium content (1.50, 528.28%), seed yield per plant + productive tillers per plant + fingers per ear + finger length + ear weight per plant + 1000-seed weight + seed protein content (1.46, 516.14%), seed yield per plant + days to 50% flowering + productive tillers per plant + fingers per ear + finger length + ear weight per plant + 1000-seed weight (1.45, 509.69%) recorded higher genetic advance and percent gain over seed yield per plant, respectively.

All the possible 165 indices constructed using eight character combinations recorded higher genetic advance and relative gain over seed yield per plant. Among them, the combinations, without plant height, days to 50% flowering and days to maturity (1.61, 566.79%), the combination without plant height, days to maturity and seed protein content (1.56, 551.54%), the one without plant height, days to maturity and seed calcium content (1.54, 543.48%) recorded higher genetic advance and relative gain over seed yield per plant, respectively.

When nine characters are considered together, all the possible 55 combinations recorded higher genetic advance and relative gain over seed yield per plant. Among them, the combinations without plant height and days to maturity (1.69, 594.56%), the combination without plant height and days to 50% flowering (1.65, 583.16%) and the one without plant height and seed protein content (1.64, 576.96%) recorded higher genetic advance and percent gain over seed yield per plant, respectively.

Among the selection indices constructed using the ten characters, 11 out of 11 possible indices recorded higher genetic advance and relative gain over seed yield per plant. Among them, the combinations which does not include the plant height (1.74, 613.99%), days to maturity (1.72, 605.00%), days to 50% flowering (1.69, 594.35%) registered higher estimates of genetic advance and relative gain over seed yield per plant respectively.

These results clearly indicate that selection based on index value is efficient than direct selection on yield alone. Similar conclusions were drawn by Basavaraja and Sheriff[2], Bhat and Shariff[3], Padmaja *et al*[8]., Padmaja *et al*[9]., Kumar *et al*[7]., and Prasanna *et al*[10].

In present study, 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[2], Bhat and Shariff[3] and Padmaja *et al*[9]. And the maximum estimates of genetic gain and relative advantage of seed yield per plant was observed when all the eleven characters under study are included in the construction of the index. Such results were also reported by Bhat and Shariff[3], Padmaja *et al*[8]., Padmaja *et al*[9]., and Ammu[1]. From this it became evident that the best possible construct in case of finger millet for selecting superior genotypes should include maximum number of characters that are considered for investigation.

These results matched with the findings observed earlier even when equal weights are assigned to all the eleven characters considered in present study[14]. This similar trend in both cases indicate that both the ways of assigning the weights *i.e.*, by taking equal economic weights and using inverse of means of respective characters as economic weights are equally effective and resulted in similar conclusions.

Table 1: Expected genetic advance and Relative efficiency over seed yield per plant of different constructs

S.No.	Selection index	Expected genetic advance	Relative efficiency over X_1
1	X_1	0.28	100.00
2	X_9	0.31	110.47
3	X_{11}	0.33	116.78
4	X_{10}	0.41	145.61
5	X_7+X_{10}	0.57	201.90
6	$X_{10}+X_{11}$	0.58	204.94
7	X_1+X_9	0.61	213.40
8	$X_1+X_8+X_9$	0.78	276.04
9	$X_1+X_5+X_9$	0.79	279.93
10	$X_1+X_7+X_9$	0.81	287.31
11	$X_1+X_7+X_8+X_9$	0.98	347.07
12	$X_1+X_5+X_8+X_9$	0.99	347.76
13	$X_1+X_5+X_7+X_9$	1.01	356.95
14	$X_1+X_5+X_6+X_8+X_9$	1.16	409.78
15	$X_1+X_5+X_6+X_7+X_9$	1.19	418.48
16	$X_1+X_5+X_7+X_8+X_9$	1.19	421.18
17	$X_1+X_5+X_6+X_7+X_9+X_{11}$	1.30	459.89
18	$X_1+X_5+X_7+X_8+X_9+X_{11}$	1.33	470.29
19	$X_1+X_5+X_6+X_7+X_8+X_9$	1.36	481.07
20	$X_1+X_5+X_7+X_8+X_9+X_{10}+X_{11}$	1.45	509.69
21	$X_1+X_5+X_6+X_7+X_8+X_9+X_{10}$	1.46	516.14
22	$X_1+X_5+X_6+X_7+X_8+X_9+X_{11}$	1.50	528.28
23	$X_1+X_3+X_5+X_6+X_7+X_8+X_9+X_{10}$	1.54	543.48
24	$X_1+X_3+X_5+X_6+X_7+X_8+X_9+X_{11}$	1.56	551.54
25	$X_1+X_5+X_6+X_7+X_8+X_9+X_{10}+X_{11}$	1.61	566.79
26	$X_1+X_2+X_5+X_6+X_7+X_8+X_9+X_{10}+X_{11}$	1.64	576.96
27	$X_1+X_4+X_5+X_6+X_7+X_8+X_9+X_{10}+X_{11}$	1.65	583.16
28	$X_1+X_3+X_5+X_6+X_7+X_8+X_9+X_{10}+X_{11}$	1.69	594.56
29	$X_1+X_2+X_4+X_5+X_6+X_7+X_8+X_9+X_{10}+X_{11}$	1.69	594.35
30	$X_1+X_2+X_3+X_5+X_6+X_7+X_8+X_9+X_{10}+X_{11}$	1.72	605.00
31	$X_1+X_3+X_4+X_5+X_6+X_7+X_8+X_9+X_{10}+X_{11}$	1.74	613.99
32	$X_1+X_2+ X_3+X_4+X_5+X_6+X_7+X_8+X_9+X_{10}+X_{11}$	1.77	625.32

Where, X_1=Seed yield per plant, X_2=Plant height, X_3=Days to 50% flowering, X_4=Days to maturity, X_5=Productive tillers per plant, X_6= Fingers per ear, X_7= Finger length, X_8= Ear weight per plant, X_9=1000-seed weight, X_{10}= Seed protein content & X_{11}= Seed calcium content

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