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Selection Indices for Yield Components in Mung Bean (*Vigna radiata* (L.) R. Wilczek) During *Kharif* Season

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Abstract Fifty diverse genotypes of mung bean were evaluated in a randomized block design with three replication for the study of selection indices during *kharif* 2014. Thirty -one selection indices involving seed yield per plant (X_1) and four yield components viz., biological yield per plant (X_2) , number of primary branches per plant (X_3), length of pod (X_4) and plant height (X_5) were constructed using the discriminant function analysis. Discriminant function analysis indicated that selection efficiency of the function was improved by increasing the number of characters in the index. Among the single character indices, biological yield per plant exhibited higher genetic advance and relative efficiency over straight selection for seed yield per plant. The index based on five characters viz., seed yield per plant, biological yield per plant, number of primary branches per plant, length of pod and plant height recorded the highest genetic advance as well as relative efficiency and selection efficiency. These characters chosen on the basis of their positive correlation with seed yield per plant and have positives direct effects. The superiority of selection based on index increases with an increase in the number of characters under selection.

Keywords Discriminant function, Relative efficiency, Mung bean, Selection indices.

Introduction

Mung bean (*Vigna radiata* (L.) R. Wilczek) known as mung bean is one of the most important pulse crops of India. Mung bean is considered as hardiest of all pulse crops. It is a self-pollinated crop. India produces 1.19 million tons of mung bean from an area of 2.75 million hectare [1]. In Gujarat, mung bean production is 1.25 million tons from an area of 0.57 million hectare [2]. However, the productivity of mung bean is only around 350 kg per hectare [3]. The low productivity of this crop can be attributed to narrow genetic base resulting in low yield potential and susceptibility to biotic and abiotic stresses

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as well as lack of suitable plant types for different cropping situations. It is a photo and thermo insensitive crop and is grown in *kharif* and summer seasons in northern India. Mung bean provides about 25% protein, restores and maintains the soil fertility by fixing atmospheric nitogen and also fits well in different cropping systems. High protein, easy digestibility and low flatulence production made the crop aceptable to the people world over [4]. Keeping in mind the dietary importance of this crop and its low productivity, there is ample scope of genetic improvement in this crop. However, it has been observed that mung bean yield in summer season is relatively less as compared to *kharif* season mung bean. The cultivation of summer mung is more sensitive to increase in temperature because in the month of May and June when temperature goes above 46°C in Western Indo-Gangetic plains, the flower drop also increases leading to failure of crop [5]. The yield is a complex character and the multiplicative end product of many quantitative traits [6].

The different components of yield very often exhibit considerable degree of association among themselves and with yield. Thus, selection for yield alone will not be desirable. However, such an improvement would be more reliable if indirect selection was made based on another correlated trait. Path analysis permits the examination of direct effects of various characters on yield as well as their indirect effects via other component traits. Certain desired plant characteristics are considered while selecting for particular genotype with varying given to different traits for arriving on decisions. The better way of exploiting genetic correlation with several traits having high heritability is to construct an index which combines information on all the characters associated with yield. This suggest the use of selection index, which gives proper weight to each of the two or more characters to be considered . Selection index was proposed for the first time by Smith [7] on the basis discriminant function of Fisher [8]. Hazel and Lush [9] and Robinson et al. [10] showed that the selection based on such an index is more efficient than selecting individually for the various characters. Keeping these facts in view, the present study was undertaken in order to construct selection indices for efficient selection in mung bean breeding program.

Materials and Methods

The experimental material for the present study consisted of 50 mung bean genotypes received from Central Arid Zone Research Institute (CAZRI), Jodhpur. The experiment was carried out at Instructional Farm, College of Agriculture, J. A. U., Junagadh (Gujarat) during *kharif* 2014. The genotypes were evaluated in randomized block design (RBD) with three replications. Each entry was planted as a single row of 3 m length, keeping plant to plant distance of 10 cm and row to row spacing of 30 cm. The recommended cultural practices were adopted for the proper growth and stand of the crop. The data were recorded five randomly selected plants from each replication for plant height, number of primary branches per plant, number of clusters per plant, number of pods per plant, length of pod, number of seeds per pod, 100-seed weight (g), biological yield per plant (g), harvest index (%) and seed yield per plant (g). Discriminant function analysis described by Dabholkar [11] was used to construct the selection indices involving six characters, seed yield per plant (X_1), number of primary branches per plant (X_2), 100- seed weight (X_3) , biological yield per plant (X_4), harvest index (X_5) and days to maturity (X_6). For computing selection index, seed yield per plant was considered as the dependent variable with the relative efficiency of 100%. The model suggested by Robinson et al. [10] was used for the construction of genetic advance as well as selection indices and development of a required discriminant function using six characters along with seed yield per plant.

Results and Discussion

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 earlier [7, 10, 12]. Hazet and Lush [9] stated that the superiority of selection based on index in-

Table 1. Selection index, discriminant function and expected genetic advance in yield and relative efficiency from the use of different selection indices in mung bean in *kharif* season.

Sl. No.	Selection index	Discriminant function	Expected genetic advance	Relative efficiency (%)
1	2	3	4	5
1	X_1 Seed yield per plant (gm)	$0.9094\,X_1$	1.34	100.00
2	X_2 Biological yield per plant (gm)	$0.9103\,X_2$	12.58	940.51
3	X_3 Number of primary branches per plant	$0.963\,X_3$	1.23	92.08
4	X_4 Length of pod (cm)	$0.9770\,X_4$	4.01	299.85
5	X_5 Plant height (cm)	$0.9046\,X_5$	1.71	127.65
6	X_1, X_2	$1.400\,X_1 + 0.884\,X_2$	13.51	1009.94
7	X_1, X_3	$0.886\,X_1 + 1.050\,X_3$	2.38	178.03
8	X_1, X_4	$0.920\,X_1 + 0.996\,X_4$	5.05	377.80
9	X_1, X_5	$0.974\,X_1 + 0.919\,X_5$	2.82	210.69
10	X_2, X_3	$0.845\,X_2 + 2.086\,X_3$	13.57	1014.28
11	X_2, X_4	$0.767\,X_2 + 1.599\,X_4$	16.34	1221.56
12	X_2, X_5	$0.860\,X_2 + 1.546\,X_5$	14.00	1046.49
13	X_3, X_4	$-3.084\,X_3 + 1.849\,X_4$	4.89	365.40
14	X_3, X_5	$1.186\,X_3 + 0.892\,X_5$	2.84	212.41
15	X_4, X_5	$1.026\,X_4 + 0.842\,X_5$	5.49	410.24
16	X_1, X_2, X_3	$1.052\,X_1 + 0.841\,X_2 + 2.086\,X_3$	14.51	1084.68
17	X_1, X_2, X_4	$0.968\,X_1 + 0.763\,X_2 + 1.617\,X_4$	17.29	1292.23
18	X_1, X_2, X_5	$1.225\,X_1 + 0.848\,X_2 + 1.503\,X_5$	14.95	1117.19
19	X_1, X_3, X_4	$0.920\,X_1 + 1.071\,X_3 + 0.975\,X_4$	6.16	460.46
20	X_1, X_3, X_5	$0.954\,X_1 + 1.082\,X_3 + 0.891\,X_5$	3.81	285.05
21	X_1, X_4, X_5	$0.978\,X_1 + 1.027\,X_4 + 0.852\,X_5$	6.55	489.16
22	X_2, X_3, X_4	$0.769\,X_2 + 1.132\,X_3 + 1.557\,X_4$	17.33	1295.29
23	X_2, X_3, X_5	$0.819\,X_2 + 1.941\,X_3 + 1.370\,X_5$	14.98	1119.21
24	X_2, X_4, X_5	$0.765\,X_2 + 1.576\,X_4 + 1.064\,X_5$	17.76	1327.21
25	X_3, X_4, X_5	$1.012\,X_3 + 1.022\,X_4 + 0.837\,X_5$	6.55	489.39
26	X_1, X_2, X_3, X_4	$0.952\,X_1 + 0.765\,X_2 + 1.158\,X_3 + 1.571\,X_4$	18.29	1366.97
27	X_1, X_2, X_3, X_5	$0.952\,X_1 + 0.816\,X_2 + 1.982\,X_3 + 1.395\,X_5$	15.94	1191.03
28	X_1, X_2, X_4, X_5	$0.971\,X_1 + 0.761\,X_2 + 1.589\,X_4 + 1.080\,X_5$	18.72	1399.03
29	X_1, X_3, X_4, X_5	$0.985X_1 + 1.029\,X_3 + 1.019\,X_4 + 0.846\,X_5$	7.613	568.98
30	X_2, X_3, X_4, X_5	$0.768\,X_2 + 1.141\,X_3 + 1.532\,X_4 + 1.062\,X_5$	18.74	1400.75
31	X_1, X_2, X_3, X_4, X_5	$0.954\,X_1 + 0.764\,X_2 + 1.169\,X_3 + 1.539\,X_4 + 1.082\,X_5$	19.72	1473.47

creases with an increase in the number of characters under selection. A total of thirty one selection indices (Table 1) based on five characters constructed in all possible combinations revealed that the selection efficiency was high over straight selection when selection was based on individual components. The selection based on individual yield contributing character like biological yield per plant was more rewarding than straight selection for seed yield during summer season. It gave higher expected genetic advance and relative efficiency (GA = 12.58g; RI=940.51%, as compared to that for seed yield for which the genetic advance and relative efficiency (GA =1.34g; RI =100.00%) was considerably lower in *kharif* season. The best selection index identified for four characters viz, seed yield per plant, biological yield per plant, length of pod and plant height followed by an index of three characters viz., bio-

Table 2. Average selection efficiency of different combination of characters in mung bean.

No. of characters in the index	Selection efficiency (%)
One	312.02
Two	604.68
Three	895.98
Four	1185.35
Five	1473.47

logical yield per plant, length of pod and plant height and an index of two characters viz., involving biological yield per plant and length of pod. The discriminant function method of making selection in plants appeared to be the most useful than the straight selection for seed yield alone and hence, due weightage should be given to the important selection indices while making selection for yield advancement in mung bean. The observations from the study of [13—15] support the above conclusions.

Thus, the current study revealed that the index which includes more than one characters, gave high genetic advance, suggesting the utility of constructing of selection indices for effecting simultaneous improvement in several characters. Hazel and Lush. [9] stated that the superiority of selection based on index increases with an increase in the number of characters under selection. Inclusion of characters one by one in the function resulted in increasing genetic advance and the selection indices improve the efficiency than the straight selection for yield alone were also reported earlier [7,16—19].

It is interesting to note that selection efficiency (Table 2) improved with an increase in number of characters in combination with yield. For example, average selection efficiency of 312.02%, when one character was included in selection function. Similarly, the selection efficiency was 604.68% for two characters, 895.98% for three characters, 1185.35% for four characters and 1473.47% for five characters selection indices improve the selection efficiency than the straight selection for yield alone with an increase in the number of characters under selection.

Table 3. Highest selection efficiency with characters combination in mung bean.

Sl. No.	Characters	Selection efficiency (%)
1	Biological yield per plant	940.51
2	Biological yield per plant + Length of pod	1221.56
3	Biological yield per plant + Plant height	1046.49
4	Biological yield per plant + Length of pod + Plant height	1327.21
5	Biological yield per plant + Number of primary branches per plant +Length of pod	1295.29
6	Biological yield per plant + Number of primary branches per plant + Length of pod + Plant height	1400.75
7	Seed yield per plant + Biological yield per plant + Length of pod + Plant height	1399.03
8	Seed yield per plant + Biological yield per plant + Number of primary branches per plant + Length of pod +Plant height	1473.47

The relative efficiency (RE%) of various selection indices presented in Table 3 indicated that when relative efficiency of single character index was measured over straight selection for seed yield per plant, the efficiency was declined to less than 100% . This observation indicated that the indirect selection through individual traits over straight selection for seed yield per plant alone would not be effective.

Conclusion

Keeping in view, the basic idea of saving time and labor in a selection program, it would be desirable to base the selection of few characters. In the present study, selection index based on five characters gave maximum genetic gain and high efficiency over straight selection, but practically it is more cumbersome to use in the selection exercise. However, in practice, the plant breeder might be interested in maximum gain with minimum number of characters. Selection index were made by taking these characters and showed their best possible combinations for mung bean. In the present study, selection index based on three characters (Biological yield per plant + Number primary branches per plant + Pod length) showing genetic gain (17.33%) and selection efficiency (1295.29%) comparable to some extent of

those based on four or more characters, which is more desirable and practically possible to use breeder than the index that includes more number of characters. Therefore, from this investigation, it is concluded that improvement of seed yield in mung bean could be achieved by selecting the parents with these three characters; Biological yield per plant + Number primary branches per plant + Pod length.

In the conclusion, based on the discriminant function analysis for selection indices suggested that the selection efficiency in general was higher over straight selection, when the selection was based on yield contributing characters and not directly for seed yield per plant. The relative selection efficiency further increased with the inclusion of two or more characters. The best relative efficiency was obtained with four character combinations. It was noted that biological yield per plant was part of the all the character combinations formulated for selection in mung bean.

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