JOURNAL OF PURE AND APPLIED MICROBIOLOGY, Dec. 2016. Vol. **10**(4), p. 2937-2941

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

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http://dx.doi.org/10.22207/JPAM.10.4.60

(Received: 04 July 2016; accepted: 20 September 2016)

Fifty diverse genotypes of mung bean were evaluated in a randomized block design with three replication for the study of selection indices during summer2014. 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), number of Seed per 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 could be advantageously exploited in the green gram breeding programmes.

Keywords: Discriminant function, Relative efficiency, Selection indicesand Mung bean.

Mung bean (*Vigna radiata* (L.) R.Wilczek) known as green-gram is one of the most important pulse crops of India. Mung bean is considered as hardiest of all pulse crops. It is a self-polli-nated crop.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 nitrogen, and also fits well in different cropping systems. High protein, easy digestibility and low flatulence production made the crop acceptable to the people world over (Prasanna *et al*. 2013). Keeping in mind the dietary importance of this crop and its low productivity, there is ample scope of genetic improvement in this crop. Cultivation of summer mung bean is now becoming more and more popular with farmers in northern India as their practices enable them to use the land and the water resources which otherwise would have remained unutilized during summer season. Moreover, summer mung can be fitted very well in different cropping systems. (Rao *et al*. 2009). The yield is a complex character and the multiplicative end product of many quantitative traits (Whitehouse *et al*. 1958). 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. And construct suitable selection indices for obtaining high genetic gain for seed

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yield per plant.This can be done using selection index, which is multiple regressions of genotypic values on phenotypic values of several traits (Falconer, 1989). The use of selection index is superior in improving complex traits (Hazel and Lush, 1943).

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 (1936) on the basis discriminant function of Fisher (1936). Hazel and Lush (1943) and Robinson *et al.*(1951) 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 programme.

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 summer 2014. The genotypes were evaluated in randomized block design (RBD) with three replications. Each entry was planted as a single row of 3m 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 (1992) 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 per cent. The model suggested by Robinson *et al*. (1951) 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 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. 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.,biological 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

Table 1. Selection index, Discriminant function, Expected genetic advance in yield and Relative efficiency from the use of different Selection indices in mung bean in summer season.

S. No.	Selection Index	Discriminant Function	Expected Genetic Advance	Relative Efficiency (%)
1	2	3	4	5
1	X_1 Seed yield per plant (gm)	0.7628 X_1	1.26	100.00
2	X_2 Biological yield per plant (gm)	0.8745 X_2	9.25	736.47
3	X_3 Number of primary branches per plant	0.8672 X_3	0.77	61.31
4	X_4 Number of seed per pod	0.9089 X_4	2.44	194.19
5	X_5 Plant height	0.8646 X_5	4.74	377.23
6	$X_1.X_2$	0.954 X_1 +0.872 X_2	10.15	808.36
7	$X_1.X_3$	0.690 X_1+1.225 X_3	2.00	159.08
8	$X_1.X_4$	0.593 X_1+1.057 X_4	3.62	288.30
9	$X_1.X_5$	1.089 X_1+0.861 X_5	5.81	462.18
10	$X_2.X_3$	0.842 X_2+1.831 X_3	9.78	778.82
11	$X_2.X_4$	0.860 X_2+1.043 X_4	10.77	857.64
12	$X_2.X_5$	0.885 X_2+0.948 X_5	12.23	973.81
13	$X_3.X_4$	1.467 X_3+0.865 X_4	3.23	256.93
14	$X_3.X_5$	1.015 X_3+0.860 X_5	5.10	406.21
15	$X_4.X_5$	1.217 X_4+0.799 X_5	7.02	559.16
16	$X_1.X_2.X_3$	0.625 X_1+0.852 X_2+2.204 X_3	10.74	854.78
17	$X_1.X_2.X_4$	0.735 X_1+0.867 X_2+1.112 X_4	11.79	939.01
18	$X_1.X_2.X_5$	1.163 X_1+0.866X_2+0.946 X_5	13.30	1059.24
19	$X_1.X_3.X_4$	0.498 X_1+1.394 X_3+1.028 X_4	4.26	339.49
20	$X_1.X_3.X_5$	1.141 X_1+0.865 X_3+0.857 X_5	6.25	497.77
21	$X_1.X_4.X_5$	0.646 X_1+1.336 X_4+0.821 X_5	8.14	648.01
22	$X_2.X_3.X_4$	0.838 X_2+2.014 X_3+0.902 X_4	11.35	903.82
23	$X_2.X_3.X_5$	0.862 X_2+1.740 X_3+0.917 X_5	12.75	1015.13
24	$X_2.X_4.X_5$	0.856 X_2+1.121 X_4+0.904 X_5	14.18	1128.82
25	$X_3.X_4.X_5$	0.693 X_3+1.286 X_4+0.790 X_5	7.45	593.55
26	$X_1.X_2.X_3.X_4$	0.441 $X_1$1.034 X_4+0.847 X_2+2.385 X_3	12.41	988.38
27	$X_1.X_2.X_3.X_5$	0.962 $X_1$0.934 X_5+0.854 X_2+1.797 X_3	13.85	1102.55
28	$X_1.X_2.X_4.X_5$	0.892 $X_1$0.943 X_5+0.859 X_2+1.164 X_4	15.29	1217.36
29	$X_1.X_3.X_4.X_5$	0.732 $X_1$0.829 X_5+0.942 X_3+1.271 X_4	8.60	684.95
30	$X_2.X_3.X_4.X_5$	0.843 $X_2$0.901 X_5+1.684 X_3+1.119 X_4	14.72	1171.66
31	$X_1.X_2.X_3.X_4.X_5$	0.691 X_1+0.846 X_2+1.946 X_3 1.116 X_4+0.936 X_5	15.85	1262.10

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

No. of characters in the index	Selection efficiency (%)
One	293.84
Two	555.05
Three	797.96
Four	1032.98
Five	1262.10

making selection for yield advancement in mung bean.The observations from the study of Sable *et al.* (2001), Patel *et al.* (2007), Bertini *et al.* (2010) and Ullah *et al.* (2012) 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 (1943) stated that the superiority

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

S. No.	Characters	Selection efficiency (%)
1	Biological yield per plant	940.51
2	Biological yield per plant + Plant height	973.81
3	Biological yield per plant + Number of seed per pod	857.64
4	Biological yield per plant + Number of seed per pod + Plant height	1128.82
5	Seed yield per plant + Biological yield per plant + Plant height	1059.24
6	Seed yield per plant + Biological yield per plant + Number of seed per pod + Plant height	1217.36
7	Biological yield per plant + Number of primary branches per plant + Number of seed per pod + Plant height	1171.66
8	Seed yield per plant + Biological yield per plant + Number of primary branches per plant + Number of seed per pod + Plant height	1262.10

of selection based on index increases with an increase in the number of characters under selection. Smith (1936), Rao (1974), Dobariya *et al.* (2008), Babariya *et al.* (2014) and Gupta *et al.* (2015) also were with the same opinion that 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.

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 per cent. This observation indicated that the indirect selection through individual traits over straight selection for seed yield per plant alone would not be effective.

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 293.84%, when one character included in selection function. Similarly, the selection efficiency was 555.05% for two characters, 797.96 for three characters, 1032.98% for four characters and 1262.10% 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.

Some of the selection indices with high relative efficiency listed in Table 1 indicated that the highest efficiency was observed with a combination of five characters (1262.10%). Selection indices with five characters, *i.e.*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), number of Seed per pod (X_4) and plant height (X_5), therefore, appear to be more useful. It can be seen that seed yield per plant, biological yield per plant and number of seed per pod were the characters being commonly involved in more number of the combinations, the next being number of primary branches per plant and plant height in order (Table 3).

Keeping in view, the basic idea of saving time and labour in a selection programme, 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. In the present study, selection index based on three characters (Biological yield per plant + Number of seed per pod + Plant height) showing genetic gain (14.18%) and selection efficiency (1128.82%) 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.

CONCLUSION

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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