SELECTION INDICES IN GROUNDNUT (*Arachis hypogaea* L.)

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ABSTRACT

Seventy diverse genotypes of groundnut were evaluated in a randomized block design with three replications for the study of selection indices during summer 2015. Thirty-one selection indices involving pod yield per plant (X_1) and four yield components viz., number of mature pods per plant (X_2), sound mature kernels (X_3), 100 pod weight (X_4) and harvest index (X_5) were identified and considered for the construction of selection indices. 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, 100 pod weight exhibited higher genetic advance and relative efficiency over straight selection for pod yield per plant. The index based on five characters viz., pod yield per plant, number of mature pods per plant, sound mature kernel, 100 pod weight and harvest index recorded the highest genetic advance as well as relative efficiency and selection efficiency. These characters could be advantageously exploited in the groundnut breeding programmes.

KEY WORDS: Discriminant function, groundnut, relative efficiency, selection indices

INTRODUCTION

Groundnut (*Arachis hypogaea* L.) is one of the most economic oilseed crops of the world. It is also a major oilseed legume crop in India and meets about 30 per cent of the edible oil requirements in the country. It is considered as the world's fourth largest source of edible oil and third most important source of vegetable protein (Desai *et al.,* 1999). Yield in crops is a quantitative trait and has a complex genetic control mechanism and hence, direct selection is not much effective on it. Since the economic part of groundnut known as pod is developed under the soil, the prediction of its performance based on aerial morphological characters is almost difficult (Weiss, 2000). The most desirable approach to improve characteristics such as pod yield is simultaneous selection based on related traits (Bos and Caligari, 2007). 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, 1942). Furthermore, the selection indices approach aimed at determining the most suitable combination of traits with the intention of indirectly improving the pod yield in groundnut was well documented (Dobariya *et al*., 2008). Certain desired plant characteristics are considered while selecting for particular genotype with varying weightage given to different traits for arriving on decisions. The better way of exploiting genetic correlations with several traits having high heritability is to construct an index which combines information on all the characters associated with yield. This suggests 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. Few studies on selection indices in groundnut have been carried out earlier by Dobariya *et al*. (2008); Babariya *et al*. (2014) and Gupta *et al*. (2015). However, in order to have a more comprehensive knowledge about genetic variability for yield and its attributing traits and to find out a suitable selection indices for the improvement of pod yield in groundnut, the present study was undertaken in order to construct selection indices for efficient selection in groundnut breeding programme.

MATERIAL AND METHODS

Seventy genotypes of groundnut were sown in a Randomized Block Design (RBD) with three replications during *summer* 2015. Each genotype was accommodated in a single row of 2.0 m length with a spacing of 30 cm between rows and 10 cm between plants within the row. The experimental plot was surrounded by two guard rows to avoid damage and border effects. The fertilizers in the experimental area was applied at the rate of 25.0 kg N_2, 50.0 kg P_2O_5, and 50.0 kg K_2O per hectare, as it is a recommended dose for summer cultivation of groundnut in the region. Other recommended agronomical practices *in vogue* were followed for reaping good crop. Data were recorded on randomly selected five plants from each genotype and average value was used for the statistical analysis for 14 characters *viz*., days to 50 per cent flowering, days to maturity, plant height, number of branches per plant, number of mature pods per plant, sound mature kernels, pod yield per plant, 100 pod weight, kernel yield per plant, 100 kernel weight, biological yield per plant, shelling out-turn, harvest index and oil content. Discriminant function analysis described by Dabholkar (1992) was used to construct the selection indices involving pod yield per plant (X_1) and four yield components viz., number of mature pods per plant (X_2), sound mature kernels (X_3), 100 pod weight (X_4) and harvest index (X_5). For computing selection indices, 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 five characters along with pod yield per plant.

RESULTS AND DISCUSSION

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. 100 pod weight showed a genetic advance of 22.7 per cent, which was higher than those calculated for other characters including pod yield per plant suggested that 100 pod weight proved to be better selection index based on one character.

The highest genetic gain (Table 1) of 32.19 per cent was obtained when selection was simultaneously based on discriminant function of two characters, *e.g*. 100 pod weight (X_4) and harvest index (X_5). When three characters, *e.g.* sound mature kernels (X_3), 100 pod weight (X_4) and harvest index (X_5) were taken together, the genetic advance increased to 40.53 per cent. Index based on combination of four characters, *i.e.* number of mature pods per plant (X_2), harvest index, sound mature kernels (X_3), 100 pod weight (X_4) and harvest index (X_5) recorded high genetic gain of 43.32 per cent. The maximum gain of 47.13 per cent was achieved by taking five characters at a time, *i.e.* pod yield per plant (X_1), number of mature pods per plant (X_2), sound mature kernels (X_3), 100 pod weight (X_4) and harvest index (X_5).

Thus, the current study revealed that the index, which includes more than one character, 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 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 that 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 pod 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 pod 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 276.86 per cent, when one character was included in selection function. Similarly, the selection efficiency was 533.39 per cent for two characters, 758.93 per cent for three characters, 1001.97 per cent for four characters and 1246.16 per cent 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 (1246.16 %) *i.e*. pod yield per plant (X_1), number of mature pods per plant (X_2), sound mature kernels (X_3), 100 pod weight (X_4) and harvest index (X_5). It can be seen that pod yield per plant (X_1), 100 pod weight (X_4) and harvest index (X_5) were the characters being commonly involved in more number of the combinations, the next being number of mature pods per plant (X_2) and sound mature kernels (X_3) 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 (sound mature kernels + 100 pod weight + harvest index) showing genetic gain (40.53 %) and selection efficiency (1071.70 %) 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

From the investigation, it is concluded that improvement of pod yield in groundnut could be achieved by selecting the parents with these three characters; sound mature kernels + 100-pod weight + harvest index.

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Table 1: Selection index, discriminant function, expected genetic advance in yield and relative efficiency from the use of different selection indices in groundnut

Sr. No.	Selection Index	Discriminant Function	Expected Genetic Advance	Relative Efficiency (%)
1	X_1 Pod yield/plant (g)	0.5563 X_1	3.782	100.00
2	X_2 Number of mature pods per plant	0.5454 X_2	3.264	86.30
3	X_3 Sound mature kernel (%)	0.5829 X_3	11.396	301.32
4	X_4 100- pod weight (g)	0.7421 X_4	22.705	600.34
5	X_5 Harvest index (%)	0.8808 X_5	10.452	276.36
6	$X_1.X_2$	0.583 X_1 + 0.580 X_2	5.382	142.30
7	$X_1.X_3$	0.593 X_1 + 0.587 X_3	12.190	322.31
8	$X_1.X_4$	1.304 X_1 + 0.684 X_4	27.780	734.53
9	$X_1.X_5$	0.047X_1 + 1.168 X_5	13.998	370.12
10	$X_2.X_3$	1.153 X_2 + 0.571 X_3	15.221	402.45
11	$X_2.X_4$	0.904 X_2 + 0.746 X_4	25.047	662.26
12	$X_2.X_5$	0.502 X_2 + 0.934 X_5	12.164	321.62
13	$X_3.X_4$	0.508 X_3 + 0.742 X_4	26.618	703.80
14	$X_3.X_5$	0.794 X_3 + 1.974 X_5	31.142	823.42
15	$X_4.X_5$	0.665 X_4 + 1.373 X_5	32.191	851.16
16	$X_1.X_2.X_3$	0.599 X_1 + 1.187 X_2 + 0.572 X_3	16.005	423.18
17	$X_1.X_2.X_4$	1.341 X_1 + 1.014 X_2 + 0.676 X_4	29.828	788.68
18	$X_1.X_2.X_5$	-0.031X_1 + 0.394 X_2 + 1.262 X_5	15.530	410.64
19	$X_1.X_3.X_4$	0.939 X_1 + 0.746 X_3 + 0.814 X_4	35.278	932.78
20	$X_1.X_3.X_5$	-0.440 X_1 + 0.506 X_3 + 1.604 X_5	21.947	580.30
21	$X_1.X_4.X_5$	0.228 X_1 + 0.758 X_4 + 1.451 X_5	36.745	971.57
22	$X_2.X_3.X_4$	1.227 X_2 + 0.726 X_3 + 0.803 X_4	34.593	914.67
23	$X_2.X_3.X_5$	1.020 X_2 + 0.586 X_3 + 1.069 X_5	22.296	589.52
24	$X_2.X_4.X_5$	0.737 X_2 + 0.681 X_4 + 1.366 X_5	34.275	906.26
25	$X_3.X_4.X_5$	0.712 X_3 + 0.732 X_4 + 1.429 X_5	40.532	1071.70
26	$X_1.X_2.X_3.X_4$	1.036 X_1 + 1.265 X_2 + 0.731 X_3 + 0.784 X_4	38.236	1010.99
27	$X_1.X_2.X_3.X_5$	-0.367 X_1 + 0.915 X_2 + 0.529 X_3 + 1.556 X_5	24.698	653.04
28	$X_1.X_2.X_4.X_5$	0.101 X_1 + 0.553 X_2 + 0.790 X_4 + 1.496 X_5	38.658	1022.15
29	$X_1.X_3.X_4.X_5$	-0.531 X_1 + 0.615 X_3 + 0.900 X_4 + 1.74 X_5	44.555	1178.08
30	$X_2.X_3.X_4.X_5$	1.064 X_2 + 0.716 X_3 + 0.732 X_4 + 1.399 X_5	43.328	1145.63
31	$X_1.X_2.X_3.X_4.X_5$	-0.504 X1 + 0.787 X_2 + 0.649 X_3 + 0.908 X_4 + 1.720 X_5	47.137	1246.16

Table 2: Average selection efficiency of different combination of characters in groundnut

Number of Characters in the Index	Selection Efficiency (%)
One	276.86
Two	533.39
Three	758.93
Four	1001.90
Five	1246.16

Table 3: Highest selection efficiency with character combinations in groundnut

Sr. No.	Character	Selection Efficiency (%)
1.	100-pod weight	600.34
2.	100-pod weight + Harvest index	851.16
3.	Sound mature kernel + Harvest index	823.42
4.	Sound mature kernel + 100-pod weight + Harvest index	1071.70
5.	Pod yield/plant + 100-pod weight + Harvest index	932.70
6.	Pod yield/plant + Sound mature kernel + 100-pod weight + Harvest index	1178.08
7.	Number of mature pods per plant + Sound mature kernel + 100-pod weight + Harvest index	1145.63
8.	Pod yield/plant + Number of mature pods per plant + Sound mature kernel + 100-pod weight + Harvest index	1246.16

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