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**Research Note**

# Selection indices in groundnut (*Arachis hypogaea* L.)

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**Abstract**
Fifty diverse genotypes of groundnut were evaluated in a randomized block design with three replications for the study of selection indices during summer 2014. Thirty-one selection indices involving pod yield per plant ($X_1$) and four yield components *viz.*, kernel yield per plant ($X_2$) harvest index ($X_3$), number of mature pods per plant ($X_4$) and biological yield per plant ($X_5$) were constructed using the discriminant function technique. 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 pod yield per plant. The index based on five characters *viz.*, pod yield per plant, kernel yield per plant, harvest index, number of mature pods per plant and biological yield per plant 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, relative efficiency, selection indices and groundnut

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Groundnut (*Arachis hypogaea* L.) is one of the most economic oilseed crops of the world. 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 Caligri, 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 (Hasel 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. Keeping these facts in view, the present study was undertaken in order to construct selection indices for efficient selection in groundnut breeding programme.

Fifty genotypes of groundnut were sown in a Randomized Block Design (RBD) with three replications during summer 2014. Each genotype was accommodated in a single row of 3.0 m length with a spacing of 45 cm between rows and 15 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 $N_2$ $ha^{-1}$ and 50.0 kg $P_2O_5$ $ha^{-1}$ 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 15 characters *viz*., days to 50% flowering, days to maturity, plant height, number of primary branches per plant, number of mature pods per plant, sound mature kernel, pod yield per plant, 100-pod weight, kernel yield per plant, 100-kernel weight, biological yield per plant, shelling out-turn, harvest index, oil content and protein content. 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 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 six characters along with seed yield per plant

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. Biological yield per plant (g) showed a genetic advance of 22.8%, which was higher than those calculated for other characters including pod yield per plant suggested that biological yield per plant (g) proved to be better selection index based on one character.

The highest genetic gain (Table 1) of 28.8% was obtained when selection was simultaneously based on discriminant function of two characters, *e.g.* number of mature pods per plant ($X_4$) and biological yield per plant ($X_5$). When three characters, *e.g.* pod yield per plant ($X_1$), number of mature pods per plant ($X_4$) and biological yield per plant ($X_5$) were taken together, the genetic advance increased to 35.2%. Index based on combination of four characters, *i.e.* pod yield per plant ($X_1$), harvest index ($X_3$), number of mature pods per plant ($X_4$) and biological yield per plant ($X_5$) recorded high genetic gain of 40.6%. The maximum gain of 46.6% was achieved by taking five characters at a time, *i.e.* pod yield/plant ($X_1$), kernel yield/plant ($X_2$), harvest index ($X_3$), number of mature pods per plant ($X_4$) and biological yield per plant ($X_5$).

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), Dhumale *et al.* (1992), 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 143.1%, when one character was included in selection function. Similarly, the selection efficiency was 250.9% for two characters, 347.3% for three characters, 439.1% for four characters and 528.8% 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 (528.8%). Selection indices with five characters, *i.e.* pod yield/plant ($X_1$), kernel yield/plant ($X_2$), harvest index ($X_3$), number of mature pods/plant ($X_4$) and biological yield/plant ($X_5$), therefore, appear to be more useful. It can be seen that pod yield/plant ($X_1$), number of mature pods/plant ($X_4$) and biological yield/plant ($X_5$) were the characters being commonly involved in more number of the combinations, the next being kernel yield /plant ($X_2$) and harvest index ($X_3$) 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 (pod yield/plant + number of mature pods/plant + biological yield/plant) showing genetic gain

(35.2%) and selection efficiency (399.1%) 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 pod yield in groundnut could be achieved by selecting the parents with these three characters; pod yield/plant + number of mature pods/plant + biological yield/plant.

**References**


Bos, I. and Caligari, P. 2007. *Selection methods in plant breeding*. (2nd edition), Germany: Springer Science & Business Media B. V.

Babariya, C. A., Dobariya, K. L., Sapovadiya, M. H. and Vavdiya, P. A. 2014. Discriminant function method of selection in groundnut (*Arachis hypogaea* L.). *Electronic Journal of Plant Breeding*, **5**(1):112-116.

Dabholkar, A. R. 1992. *Elements of Biometrical Genetics*. Concept Publishing Company, New Delhi, pp. 444-478.

Desai, B. B., Kotecha, P. M. and Salunkhe, D. K. 1999. Science and Technology of Groundnut: Biology, Production, Processing and Utilization. Naya Prokash, Calcutta. pp. 2- 4.

Dobariya, K. L., Odedra, R. K., Jivani, L. L., Ponkia, H. P. and Khanpara, M. D. 2008. Selection indices for yield improvement in groundnut (*Arachis hypogaea* L.). *Intl. J. of Bioscience Reporter*, **6**(2): 299-330.

Falconer, D. S. 1989. *Introduction to quantitative genetics*, 3rd Ed., John Wiley and Sons. Inc., New York.

Gupta, R. P., Vachhani, J. H., Kachhadia, V. H., Vaddoria, M. A. and Praveen Kumar 2015. Selection indices in Virginia groundnut (*Arachis hypogaea* L.). *Electronic Journal of Plant Breeding*, **6**(2):560-565.

Fisher, R. A.1936. The use of multiple measurements in taxonomic problems. *Ann. Eugen*.,**7**:179.

Hasel, L. N. and J. L. Lush. 1942. The efficiency of three methods of selection. *J. Hered.*, **33**(11): 393-399.

Hazel, L. N. and Lush, J. L. 1943. The genetic basis for constructing selection indexes. *Genetics*, **28**(6): 476-490.

Rao, L. 1974. Analysis of genetic variability and formulation of selection indices for yield in soybean [*Glycine max* (L.) Merrill]. *Mysore J. agric. Sci.*, **8**(1):156.

Robinson, H. F., Comstock, R. E. and Harvey, V. H. 1951. Genotypic and phenotypic correlations in corn and their implications in selection. *Agron. J.*, **41**: 353-359.

Smith, H. F. 1936. A discriminant function for plant selection. *Ann.Eugen.*,**7:** 240-250.

Weiss, E. A. 2000. *Oilseed Crops*. (Second Ed.), Black Wellm Science Ltd., London. pp.53-92.

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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

| S. No. | Selection Index | Discriminant Function | Expected Genetic Advance (%) | Relative Efficiency (%) |
|---|---|---|---|---|
| 1 | $X_1$ Pod yield/plant (g) | 0.944 $X_1$ | 8.830 | 100.00 |
| 2 | $X_2$ Kernel yield/plant (g) | 0.936 $X_2$ | 6.210 | 70.30 |
| 3 | $X_3$ Harvest index (%) | 0.963 $X_3$ | 16.390 | 185.83 |
| 4 | $X_4$ No. of mature pods/plant | 0.943 $X_4$ | 8.900 | 100.91 |
| 5 | $X_5$ Biological yield/plant (g) | 0.954 $X_5$ | 22.820 | 258.73 |
| 6 | $X_1.X_2$ | 1.067 $X_1$ + 0.772 $X_2$ | 15.041 | 170.53 |
| 7 | $X_1.X_3$ | 0.913 $X_1$ + 0.979 $X_3$ | 23.436 | 265.71 |
| 8 | $X_1.X_4$ | 0.952 $X_1$ + 0.940 $X_4$ | 17.335 | 196.54 |
| 9 | $X_1.X_5$ | 0.915 $X_1$ + 0.958 $X_5$ | 28.046 | 317.98 |
| 10 | $X_2.X_3$ | 0.890 $X_2$ + 0.980 $X_3$ | 21.242 | 240.84 |
| 11 | $X_2.X_4$ | 0.925 $X_2$ + 0.956 $X_4$ | 14.708 | 166.76 |
| 12 | $X_2.X_5$ | 0.913 $X_2$ + 0.958 $X_5$ | 26.246 | 297.57 |
| 13 | $X_3.X_4$ | 0.971 $X_3$ + 0.918 $X_4$ | 22.447 | 254.50 |
| 14 | $X_3.X_5$ | 0.943 $X_3$ + 0.944 $X_5$ | 24.052 | 272.70 |
| 15 | $X_4.X_5$ | 0.936 $X_4$ + 0.958 $X_5$ | 28.816 | 326.71 |
| 16 | $X_1.X_2.X_3$ | 1.048 $X_1$ + 0.745 $X_2$ + 0.984 $X_3$ | 29.010 | 328.91 |
| 17 | $X_1.X_2.X_4$ | 1.173 $X_1$ + 0.650 $X_2$ + 0.927 $X_4$ | 23.399 | 265.30 |
| 18 | $X_1.X_2.X_5$ | 0.638 $X_1$ + 1.343 $X_2$ + 0.989 $X_5$ | 32.626 | 369.91 |
| 19 | $X_1.X_3.X_4$ | 0.953 $X_1$ + 0.973 $X_3$ + 0.913 $X_4$ | 30.460 | 345.35 |
| 20 | $X_1.X_3.X_5$ | 0.932 $X_1$ + 0.952 $X_3$ + 0.946 $X_5$ | 32.353 | 366.81 |
| 21 | $X_1.X_4.X_5$ | 0.828 $X_1$ + 1.053 $X_4$ + 0.952 $X_5$ | 35.208 | 399.18 |
| 22 | $X_2.X_3.X_4$ | 0.909 $X_2$ + 0.979 $X_3$ + 0.934 $X_4$ | 28.017 | 317.65 |
| 23 | $X_2.X_3.X_5$ | 1.047 $X_2$ + 0.910 $X_3$ + 0.925 $X_5$ | 29.839 | 338.31 |
| 24 | $X_2.X_4.X_5$ | 0.860 $X_2$ + 0.992 $X_4$ + 0.956 $X_5$ | 33.120 | 375.51 |
| 25 | $X_3.X_4.X_5$ | 0.920 $X_3$ + 1.003 $X_4$ + 0.929 $X_5$ | 32.309 | 366.32 |
| 26 | $X_1.X_2.X_3.X_4$ | 1.184 $X_1$ + 0.620 $X_2$ + 0.979 $X_3$ 0.903 $X_4$ | 36.316 | 411.75 |
| 27 | $X_1.X_2.X_3.X_5$ | 0.624 $X_1$ + 1.327 $X_2$ + 0.974 $X_3$ 0.959 $X_5$ | 38.321 | 434.48 |
| 28 | $X_1.X_2.X_4.X_5$ | 0.609 $X_1$ + 1.257 $X_2$ + 1.056 $X_4$ 0.953 $X_5$ | 40.199 | 455.77 |
| 29 | $X_1.X_3.X_4.X_5$ | 0.900 $X_1$ + 0.935 $X_3$ + 1.027 $X_4$ 0.932 $X_5$ | 40.689 | 461.33 |
| 30 | $X_2.X_3.X_4.X_5$ | 0.994 $X_2$ + 0.912 $X_3$ + 0.989 $X_4$ 0.924 $X_5$ | 38.135 | 432.37 |
| 31 | $X_1.X_2.X_3.X_4.X_5$ | 0.657 $X_1$ + 1.234 $X_2$ + 0.957 $X_3$ 1.027 $X_4$ + 0.945 $X_5$ | 46.646 | 528.87 |

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**Table 2.** Average selection efficiency of different combination of characters in groundnut

| No. of characters in the index | Selection efficiency (%) |
|---|---|
| One | 143.15 |
| Two | 250.98 |
| Three | 347.33 |
| Four | 439.14 |
| Five | 528.87 |

**Table 3.** Highest selection efficiency with character combinations in groundnut

| S. N. | Character | Selection Efficiency (%) |
|---|---|---|
| 1 | Biological yield/plant | 258.73 |
| 2 | Number of mature pods/plant + Biological yield/plant | 326.71 |
| 3 | Pod yield/plant + Biological yield yield/plant | 317.98 |
| 4 | Pod yield/plant + Number of mature pods/plant + Biological yield/plant | 399.18 |
| 5 | Kernel yield/plant + Number of mature pods/plant + Biological yield/plant | 375.51 |
| 6 | Pod yield/plant + Harvest index + Number of mature pods/plant + Biological yield/plant | 461.33 |
| 7 | Pod yield/plant + Kernel yield/plant + Number of mature pods/plant + Biological yield/plant | 455.77 |
| 8 | Pod yield/plant + Kernel yield/plant + Harvest index + Number of mature pods/plant + Biological yield/plant | 528.87 |