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# Discriminant function method of selection in vegetable cowpea [*Vigna unguiculata* (L.) Walp.]

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**Abstract**
Fifty four diverse genotypes of vegetable cowpea were evaluated for fourteen characters in order to construct selection indices. The characters, which had desirable correlation as well as moderate to high direct effect on green pod yield per plant were considered as selection index criterion. The green pod yield per plant (X1) along with its four components *viz*., number of pods per plant, number of clusters per plant, ten pod weight and pod length were utilized for the construction of selection indices. The discriminant function had higher genetic gain and relative efficiency over straight selection for green pod yield per plant alone. Among all the 31 selection indices (Table 1.2), the index based on five characters *viz.*, green pod yield per plant, number of pods per plant, number of clusters per plant, ten pod weight and pod length ($X_1+X_2+X_3+X_4+X_5$) possessed the highest genetic gain and relative efficiency (89.89g and 140.62%) as compared to straight selection for green pod yield per plant followed by four characters *viz* green pod yield per plant, number of pods per plant, and ten pod weight and pod length ($X_1+X_2+X_4+X_5$) and green pod yield per plant, number of pods per plant, and number of cluster per plant and ten pod weight ($X_1+X_2+X_3+X_4$) possessed the highest genetic gain and relative efficiency (88.68g and 138.84%) and (88.43 g and 138.46%) respectively.

**Keywords:** Discriminant function method, vegetable cowpea, *Vigna unguiculata* (L.) Walp.

## Introduction
Vegetable cowpea (*Vigna unguiculata* L. Walp) is one of the important food legumes and a valuable component of the traditional cropping systems in the semiarid tropics (Singh *et al*., 2002; Ayisi *et al*., 2000). The crop is adaptable to harsh environments and withstands extreme temperatures, water limiting conditions and poor soil fertility. It yields well in harsh environments where other food legumes do not thrive. Due to adaptation versatility, ability to fix atmospheric nitrogen and considerable level of seed protein, minerals and vitamin contents cowpea should significantly contribute as viable and alternative crop in low input farming systems. The economic worth of a plant depends upon several characters so while selecting a desirable plant from a segregating population the plant breeder has to give due consideration to characters of economic importance. Selection index is one such method of selecting plants for crop improvement based on several characters of importance. Thus selection index refers to a linear combination of characters associated with yield. The best known selection indices involve discriminant functions based on the relative economic importance of various characters. The discriminant function analysis measures the efficiency of various character combinations in selection. Selection index leads to simultaneous manipulation of several characters for genetic improvement of economic yield. This technique provides information on yield components and thus aids in indirect selection for the genetic improvement.

## Material and Method
The experiment was carried out in Randomized Block Design with three replications. The present study comprised of 54 genotypes of cowpea at Cotton Research Station, Junagadh Agriculture University, Junagadh during *Kharif* 2016. Each genotype was accommodated in a single row of 3 m length with a spacing of 60 cm × 30 cm. The recommended agronomical practices and plant protection measures were followed for the successful raising of the crop. Data was recorded on five randomly selected competitive plants per replication for 14 parameters *viz.*, Days to 50 per cent flowering, Days to first green pod picking, Number of primary branches per plant, Plant height (cm), Pod length (cm), Pod width (cm) Number of pods per plant, Number of cluster per plant, Number of seeds per pod, Number of pods per

cluster, Leaf chlorophyll content, Ten pod weight (g), Hundred fresh seeds weight(g) and Green pod yield per plant(g).

**Result and discussion**

The plant breeder has certain desired plant characteristics in his mind while selecting for particular genotype and for this he applies various weights 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. Yield is a complex character influenced by number of factors. Direct selection on the basis of yield may not be effective because many component traits affect it. To make an effective selection for higher yield, it is necessary to determine the relative efficiency of selection through discriminant function technique over straight selection. This discriminant function technique over suitable selection indices was developed by Fisher (1936) and was first time successfully employed in plant breeding selection programme by Smith (1936) [6] Keeping these facts in view the present study was undertaken in order to construct selection indices for efficient selection in vegetable cowpea breeding programme.

Thirty one selection indices were constructed in all possible combinations of the four yield contributing characters and green pod yield per plant. Their respective genetic advances were calculated and relative efficiency of different discriminant functions in relation to the straight selection for green pod yield was compared. The data on selection indices, discriminant functions, genetic gain and relative efficiency are given in Table 1.2, assuming the efficiency of straight selection for green pod yield as 100%.

The results suggested that the selection efficiency was higher, in general, over straight selection when the selection was based on component character, which further increased with the inclusion of two or more characters. The highest efficiency was noted when four or five characters were considered together. Singh and Mehndiratta (1970) [4], Kumar *et al.* (1976) [3] and Tikka *et al.* (1978) [7] were also with the same opinion that an increase in characters results in an increase in genetic gain and that the selection indices improve the efficiency of selection than the straight selection for yield alone.

When the relative efficiency of single character index was measured, it was noted that the maximum efficiency of 100% was exhibited by green pod yield per plant followed by ten pod weight (35.23%), number of pods per plant (29.68%), pod length (8.86%) and number of clusters per plant (5.79%).

Among the combinations involving two component characters, green pod yield per plant and number of pods per plant ($X_1$+$X_2$) exhibited maximum relative efficiency of 123.10% followed by green pod yield per plant and ten pod weight [($X_1$+$X_4$), 114.86%], green pod yield per plant and pod length [($X_1$+$X_5$), 102.46%], green pod yield per plant and number of clusters per plant [($X_1$+$X_3$), 102.11%]. Number of pods per plant and ten pod weight [($X_2$+$X_4$), 49.27%], ten pod weight and pod length [($X_4$+$X_5$), 38.08%], number of clusters per plant and ten pod weight ($X_3$+$X_4$) and number of pods per plant and number of clusters per plant ($X_2$+$X_3$) and having relative efficiency of 35.90% and 31.51%, respectively, number of pods per plant and pod length ($X_2$+$X_5$) exhibited moderate relative efficiency 30.95%. Number of clusters per plant and pod length ($X_3$+$X_5$) having low relative efficiency of 9.46%.

The selection index based on three character combinations indicated that a discriminant function with green pod yield per plant, number of pods per plant and ten pod weight ($X_1$+$X_2$+$X_4$) possessed maximum relative efficiency of 136.57% followed by green pod yield per plant, number of pods per plant and number of clusters per plant [($X_1$+$X_2$+$X_3$), 125.13%], green pod yield per plant, number of pods per plant and pod length [($X_1$+$X_2$+$X_5$),125.09 %], green pod yield per plant, ten pod weight and pod length[($X_1$+$X_4$+$X_5$),117.59 %], and green pod yield per plant, number of clusters per plant, and ten pod weight [($X_1$+$X_3$+$X_4$), 116.76%], green pod yield per plant, number of clusters per plant and pod length [($X_1$+$X_3$+$X_5$), 104.43%], number of pods per plant, ten pod weight and pod length [($X_2$+$X_4$+$X_5$), 51.35%]. While number of pods per plant, number of clusters per plant and ten pod weight [($X_2$+$X_3$+$X_4$), 50.54%], number of clusters per plant, ten pod weight and pod length ($X_3$+$X_4$+$X_5$) and number of pods per plant, number of clusters per plant and pod length ($X_2$+$X_3$+$X_5$) having moderate relative efficiency of 38.42 and 32.37 respectively.

The selection index based on all the four characters *viz.*, green pod yield per plant, number of pods per plant, ten pod weight and pod length ($X_1$+$X_2$+$X_4$+$X_5$) exerted have higher 138.84% relative efficiency followed by green pod yield per plant, number of pods per plant, and number of clusters per plant and ten pod weight [($X_1$+$X_2$+$X_3$+$X_4$) 138.46%], green pod yield per plant, number of pods per plant, and number of clusters per plant and pod length [($X_1$+$X_2$+$X_3$+$X_5$) 127.02%], green pod yield per plant, number of clusters per plant, ten pod weight and pod length [($X_1$+$X_3$+$X_4$+$X_5$) 119.34%]. While number of pods per plant, number of clusters per plant, ten pod weight and pod length [($X_2$+$X_3$+$X_4$+$X_5$) 52.36%].

The selection index based on all the five characters *viz.*, green pod yield per plant, number of pods per plant, number of clusters per plant, ten pod weight and pod length ($X_1$+$X_2$+$X_3$+$X_4$+$X_5$) exerted highest 140.62% relative efficiency.

Among all the 31 selection indices (Table 1.2), the index based on five characters *viz.*, green pod yield per plant, number of pods per plant, number of clusters per plant, ten pod weight and pod length ($X_1$+$X_2$+$X_3$+$X_4$+$X_5$) possessed the highest genetic gain and relative efficiency (89.89g and 140.62%) as compared to straight selection for green pod yield per plant. Other two important indices based on four characters *viz* green pod yield per plant, number of pods per plant, and ten pod weight and pod length ($X_1$+$X_2$+$X_4$+$X_5$) and green pod yield per plant, number of pods per plant, and number of cluster per plant and ten pod weight ($X_1$+$X_2$+$X_3$+$X_4$) possessed the highest genetic gain and relative efficiency (88.68g and 138.84%) and (88.43 g and 138.46%) respectively.

In the present study, it was also observed that, the straight selection for yield was not that much rewarding (GA=63.87g, RI=hundred.00%) as it was through its components like number of pods per plant (GA=78.62g, RI=123.97%), number of cluster per plant (GA=65.22g, RI=102.11%), ten pod weight (GA=73.36g, RI=114.84% ) and pod length (GA=65.44g, RI=102.46%) or in their combinations respectively followed by an the maximum efficiency in selection for green pod yield was exhibited by a discriminant function involving green pod yield per plant, number of pods per plant, number of cluster per plant, ten pod weight and pod length and which had a genetic advance and relative efficiency of 89.89g and 140.62%, index of three characters *viz.*, green pod yield per plant, number of pods per plant, ten pod weight and pod length which had a genetic advance and relative efficiency of 88.68g and 138.84%, The best selection index identified for four characters *viz.*, green pod yield per plant, number of pods per plant, number of cluster per plant and ten pod weight ($X_1+X_2+X_3+X_4$) with 88.43g genetic advance and 138.46% relative efficiency. The best selection index identified for three character combination included green pod yield per plant, number of pods per plant and ten pod weight ($X_1+X_2+X_4$) having expected genetic gain of 87.22g and a relative efficiency of 136.57 % as compared to the straight selection for green pod yield per plant. This results is supported by Khanpara *et al.* (2015) [2].

Further, there was a consistent increase in the relative efficiency of the succeeding index with simultaneous inclusion of each character. However in practice, the plant breeder might be interested in maximum gain with the minimum number of characters. In such a case, selection index involving green pod yield per plant, number of pods per plant, number of cluster per plant, ten pod weight and pod length ($X_1.X_2.X_3.X_4.X_5$) followed by green pod yield per plant, number of pods per plant, ten pod weight and pod length ($X_1.X_2.X_4$ $X_5$ ) or green pod yield per plant, number of pods per plant, number of cluster per plant and ten pod weight ($X_1X_2X_3X_4$) could be advantageously exploited in the vegetable cowpea breeding programmes. The results of the present study also revealed that, the discriminant function method of making selection in plants appeared to be the most useful than the straight selection for green pod yield alone and hence, due weightage should be given to the important selection indices while making selection for yield advancement in vegetable cowpea.

**Table 1.1:** List of genotypes and their origin

| Sr. No. | Genotype | Origin |
|---|---|---|
| 1 | JCPL – 01 | Veg. Res. Station, J.A.U., Junagadh |
| 2 | JCPL – 02 | Veg. Res. Station, J.A.U., Junagadh |
| 3 | JCPL – 08 | Veg. Res. Station, J.A.U., Junagadh |
| 4 | JCPL – 09 | Veg. Res. Station, J.A.U., Junagadh |
| 5 | JCPL – 13 | Veg. Res. Station, J.A.U., Junagadh |
| 6 | JCPL – 14 | Veg. Res. Station, J.A.U., Junagadh |
| 7 | JCPL – 17 | Veg. Res. Station, J.A.U., Junagadh |
| 8 | JCPL – 23 | Veg. Res. Station, J.A.U., Junagadh |
| 9. | JCPL – 24 | Veg. Res. Station, J.A.U., Junagadh |
| 10 | JCPL – 25 | Veg. Res. Station, J.A.U., Junagadh |
| 11 | JCPL – 26 | Veg. Res. Station, J.A.U., Junagadh |
| 12 | AVC-2 | Main Veg. Res. Station, A.A.U., Anand |
| 13 | JCPL – 29 | Veg. Res. Station, J.A.U., Junagadh |
| 14 | JCPL – 32 | Veg. Res. Station, J.A.U., Junagadh |
| 15 | JCPL – 33 | Veg. Res. Station, J.A.U., Junagadh |
| 16 | JCPL – 38 | Veg. Res. Station, J.A.U., Junagadh |
| 17 | JCPL – 41 | Veg. Res. Station, J.A.U., Junagadh |
| 18 | JCPL – 42 | Veg. Res. Station, J.A.U., Junagadh |
| 19 | JCPL – 43 | Veg. Res. Station, J.A.U., Junagadh |
| 20 | JCPL – 54 | Veg. Res. Station, J.A.U., Junagadh |
| 21 | JCPL – 55 | Veg. Res. Station, J.A.U., Junagadh |
| 22 | JCPL – 59 | Veg. Res. Station, J.A.U., Junagadh |
| 23 | JCPL – 61 | Veg. Res. Station, J.A.U., Junagadh |
| 24 | PUSA PHALGUNI | IARI, New Delhi |
| 25 | JCPL – 64 | Veg. Res. Station, J.A.U., Junagadh |
| 26 | JCPL – 68 | Veg. Res. Station, J.A.U., Junagadh |
| 27 | JCPL – 70 | Veg. Res. Station, J.A.U., Junagadh |
| 28 | JCPL – 46 | Veg. Res. Station, J.A.U., Junagadh |
| Sr. No. | Genotype | Origin |
| 29 | JCPL – 71 | Veg. Res. Station, J.A.U., Junagadh |
| 30 | JCPL – 73 | Veg. Res. Station, J.A.U., Junagadh |
| 31 | ANKUR GOMATI | Ankur seeds Pvt. Ltd. |
| 32 | JCPL – 79 | Veg. Res. Station, J.A.U., Junagadh |
| 33 | JCPL – 83 | Veg. Res. Station, J.A.U., Junagadh |
| 34 | JCPL – 87 | Veg. Res. Station, J.A.U., Junagadh |
| 35 | JCPL – 97 | Veg. Res. Station, J.A.U., Junagadh |
| 36 | JCPL – 98 | Veg. Res. Station, J.A.U., Junagadh |
| 37 | UV-5 | Ankur seeds Pvt. Ltd. |
| 38 | JCPL – 99 | Veg. Res. Station, J.A.U., Junagadh |
| 39 | JCPL – 100 | Veg. Res. Station, J.A.U., Junagadh |
| 40 | JCPL – 101 | Veg. Res. Station, J.A.U., Junagadh |
| 41 | JCPL – 103 | Veg. Res. Station, J.A.U., Junagadh |
| 42 | JCPL – 104 | Veg. Res. Station, J.A.U., Junagadh |
| 43 | ANKUR HARI | Ankur seeds Pvt. Ltd. |
| 44 | JCPL – 105 | Veg. Res. Station, J.A.U., Junagadh |
| 45 | JCPL – 107 | Veg. Res. Station, J.A.U., Junagadh |
| 46 | JCPL – 108 | Veg. Res. Station, J.A.U., Junagadh |

| | | |
|---|---|---|
| 47 | JCPL – 109 | Veg. Res. Station, J.A.U., Junagadh |
| 48 | JCPL – 110 | Veg. Res. Station, J.A.U., Junagadh |
| 49 | JCPL – 111 | Veg. Res. Station, J.A.U., Junagadh |
| 50 | JCPL – 112 | Veg. Res. Station, J.A.U., Junagadh |
| 51 | JCPL – 113 | Veg. Res. Station, J.A.U., Junagadh |
| 52 | JCPL – 114 | Veg. Res. Station, J.A.U., Junagadh |
| 53 | JCPL – 115 | Veg. Res. Station, J.A.U., Junagadh |
| 54 | JCPL – 116 | Veg. Res. Station, J.A.U., Junagadh |

**Table 1.2:** Selection index, discriminant function, expected genetic advance in yield and relative efficiency from the use of different selection indices in vegetable cowpea.

| Sr. No. | Selection indices | Discriminant function | Expeted genetic advance | Relative efficieny (%) |
|---|---|---|---|---|
| 1 | $X_1$ Green pod yield per plant | $0.9425X_1$ | 63.87 | 100.00 |
| 2 | $X_2$ Number of pods per plant | $0.9621X_2$ | 18.96 | 29.68 |
| 3 | $X_3$ No of clusters per plant | $0.9928X_3$ | 3.700 | 5.79 |
| 4 | $X_4$ Ten pod weight | $0.9824X_4$ | 22.50 | 35.23 |
| 5 | $X_5$ pod length | $0.3885X_5$ | 5.65 | 8.8 |
| 6 | $X_1+X_2$ | $0.9121X_1 + 1.1643X_2$ | 78.62 | 123.10 |
| 7 | $X_1+X_3$ | $0.9362X_1 + 1.3641X_3$ | 65.22 | 102.11 |
| 8 | $X_1+X_4$ | $0.9398X_1 + 1.0233X_4$ | 73.36 | 114.86 |
| 9 | $X_1+X_5$ | $0.9418X_1 + 1.1037X_5$ | 65.44 | 102.46 |
| 10 | $X_2+X_3$ | $0.9605X_2 + 1.0392X_3$ | 20.13 | 31.51 |
| 11 | $X_2+X_4$ | $0.9603X_2 + 0.9840X_4$ | 31.47 | 49.27 |
| 12 | $X_2+X_5$ | $0.9600X_2 + 0.8545X_5$ | 19.77 | 30.95 |
| 13 | $X_3+X_4$ | $0.9970X_3 + 0.9824X_4$ | 22.93 | 35.90 |
| 14 | $X_3+X_5$ | $0.9485X_3 + 0.8717X_5$ | 6.04 | 9.46 |
| 15 | $X_4+X_5$ | $0.9880X_4 + 0.8650X_5$ | 24.32 | 38.08 |
| 16 | $X_1+X_2+X_3$ | $0.9065X_1 + 1.1625X_2 + 1.3464X_3$ | 79.92 | 125.13 |
| 17 | $X_1+X_2+X_4$ | $0.9104X_1 + 1.1599X_2 + 1.0225X_4$ | 87.22 | 136.57 |
| 18 | $X_1+X_2+X_5$ | $0.9114X_1 + 1.1627X_2 + 1.1275X_5$ | 79.90 | 125.09 |
| 19 | $X_1+X_3+X_4$ | $0.9331X_1 + 1.3769X_3 + 1.0264X_4$ | 74.58 | 116.76 |
| 20 | $X_1+X_3+X_5$ | $0.9334X_1 + 1.4297X_3 + 1.1645X_5$ | 66.70 | 104.43 |
| 21 | $X_1+X_4+X_5$ | $0.9397X_1 + 1.0229X_4 + 1.0700X_5$ | 75.11 | 117.59 |
| 22 | $X_2+X_3+X_4$ | $0.9584X_2 + 1.0455X_3 + 0.9840X_4$ | 32.28 | 50.54 |
| 23 | $X_2+X_3+X_5$ | $0.9605X_2 + 0.9885X_3 + 0.8521X_5$ | 20.68 | 32.37 |
| 24 | $X_2+X_4+X_5$ | $0.9570X_2 + 0.9915X_4 + 0.8388X_5$ | 32.79 | 51.35 |
| 25 | $X_3+X_4+X_5$ | $0.9468X_3 + 0.9887X_4 + 0.8576X_5$ | 24.53 | 38.42 |
| 26 | $X_1+X_2+X_3+X_4$ | $0.9043X_1 + 1.1581X_2 + 1.3593X_3 + 1.0254X_4$ | 88.43 | 138.46 |
| 27 | $X_1+X_2+X_3+X_5$ | $0.9029X_1 + 1.1639X_2 + 1.4225X_3 + 1.1876X_5$ | 81.13 | 127.02 |
| 28 | $X_1+X_2+X_4+X_5$ | $0.9112X_1 + 1.1562X_2 + 1.0154X_4 + 1.0958X_5$ | 88.68 | 138.84 |
| 29 | $X_1+X_3+X_4+X_5$ | $0.9318X_1 + 1.4252X_3 + 1.0182X_4 + 1.1328X_5$ | 76.22 | 119.34 |
| 30 | $X_2+X_3+X_4+X_5$ | $0.9575X_2 + 0.9892X_3 + 0.9916X_4 + 0.8364X_5$ | 33.44 | 52.36 |
| 31 | $X_1+X_2+X_3+X_4+X_5$ | $0.9027X_1 + 1.1573X_2 + 1.4175X_3 + 1.0162X_4 + 1.155X_5$ | 89.89 | 140.62 |

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