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RELATIVE EFFICIENCY OF DIFFERENT SELECTION INDICES FOR SEED YIELD IN PIGEONPEA (*CAJANUS CAJAN* L.)

T. S. SANDHU, K. R. REDDY AND R. K. GUMBER

PAU Regional Research Station
Faridkot 151203

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ABSTRACT

Different selection indices were constructed in 96 germplasm accessions of pigeonpea (*Cajanus cajan* L.) on the basis of multiple regression analysis and discriminant functions to determine the relative importance of various component characters. Genetic advance was used to compare the efficiency of different selection indices. The multiple regression equation involving all the characters, viz. days to flowering, duration of flowering, days to maturity, plant height, primary branches, secondary branches, pods per plant, seeds per pod, 100-seed weight, protein content and harvest index indicated that 74% of variation in seed yield were explained by these characters. All the partial regression coefficients except for flowering duration, protein content, seeds per pod and primary branches were significant and the degree of determination was not affected when multiple regression equation was fitted with characters having significant partial regression coefficients. Different discriminant functions fitted for the characters showing significant partial regression on seed yield showed that secondary branches, followed by seed yield, pods per plant, harvest index, days to maturity, plant height, and 100-seed weight were the important characters. The best character combination was of secondary branches and seed yield, which was 137% more efficient than straight selection for seed yield. The efficiency increased with every additional character. In the present investigation the index involving four characters, viz. secondary branches, seed yield, pods per plant and harvest index, was effective and efficient.

Key words: Pigeonpea, selection index, discriminant function.

Selection based on a single character may not always be effective. On the other hand, it is a very cumbersome process for a breeder to involve a large number of component characters simultaneously in a selection procedure. Therefore, the knowledge of major yield components is necessary for evolving a effective selection criteria. In the present investigation different selection indices have been constructed on the basis of multiple regression and discriminant functions. The relative efficiency of different indices was also assessed.

MATERIALS AND METHODS

Ninety six germplasm strains of pigeonpea were grown in randomized block design with four replications. Each strain was sown in a single-row plot, 5 m long, with 50 x 25 cm spacing. Observation were recorded on five random plants from each replication for days to flowering, duration of flowering, and maturity, plant height, number of primary and secondary branches, pods per plant, seeds per pod, 100-seed weight, grain yield per plant, harvest index (%) and protein content (%). The Kjeldahl method of Mckenzie and Wallace [1] was followed to estimate nitrogen content which was multiplied by 6.25 to obtain protein percentage. Multiple regression equations were constructed with the help of regression coefficient of yield on independent characters. The component characters on which seed yield showed significant partial regression were used to construct different selection indices based on discriminant functions [2].

RESULTS AND DISCUSSIONS

The partial regression coefficients and the corresponding standard errors in the multiple regression equations fitted with all the characters are given below:

Character	Partial regression coefficients
Days to flowering	$0.378^{*} \pm 0.174$
Duration of flowering	0.039 ± 0.170
Days to maturity	$0.373^{*} \pm 0.186$
Plant height	$0.109^{*} \pm 0.043$
Primary branches	0.091 ± 0.072
Secondary branches	$0.856^{**} \pm 0.227$
Pods per plant	$0.071^{**} \pm 0.009$
Seeds per pod	2.288 ± 1.675
100-seed weight	$1.913^{*} \pm 0.833$
Harvest index	$1.720^{**} \pm 0.242$
Protein content	1.693 ± 1.153
	a = – 179.26

All the partial regression coefficients except duration of flowering, protein content, seeds per pod and primary branches were significant. The degree of determination was 0.74, indicating that about 74% of the total variation was due to these characters. Another multiple regression equation fitted considering only those characters which have significant partial

regression coefficients, viz. days to flowering and maturity, plant height, secondary branches, pods per plant, 100-seed weight and harvest index account for about 73.6% of total variation for seed yield. This clearly indicates that flowering duration, primary branches, seeds per pod and protein content increased the contribution to total variation in seed yield by 0.5% only. In another set of multiple regression equations involving pods per plant, seeds per pod, 100-seed weight, secondary branches and plant height, and the one involving all the above except 100-seed weight contribute almost the same amount of variation in seed yield. This shows that seed weight is not an important component in the variability of the material under study. It is evident from the partial regression coefficient in all the multiple regression equations that due importance should be given to secondary branches, harvest index, pods per plant and plant height while selecting for seed yield.

Discriminant functions were constructed in different combinations for the characters showing significant partial regression on seed yield. The efficiency of different selection indices was determined by

Table 1. Discriminant functions, genetic advance and relative efficiency of different functions in pigeonpea

S. No.	Discriminant function	Genetic advance	Relative efficiency
1.	$b_1 x_1$	2.48	187.87
2.	$b_2 x_2$	1.32	100.00
3.	$b_3 x_3$	1.09	82.57
4.	$b_4 x_4$	0.95	71.96
5.	$b_5 x_5$	0.47	35.60
6.	$b_6 x_6$	0.44	33.33
7.	$b_7 x_7$	0.25	18.93
8.	$b_1 x_1 + b_2 x_2$	3.13	237.12
9.	$b_1 x_1 + b_3 x_3$	2.88	218.18
10.	$b_1 x_1 + b_4 x_4$	2.84	215.15
11.	$b_1 x_1 + b_5 x_5$	2.51	190.15
12.	$b_1 x_1 + b_6 x_6$	2.50	189.39
13.	$b_1 x_1 + b_7 x_7$	2.48	187.87
14.	$b_1 x_1 + b_2 x_2 + b_3 x_3$	3.46	262.12
15.	$b_1 x_1 + b_2 x_2 + b_4 x_4$	3.41	258.33
16.	$b_1 x_1 + b_2 x_2 + b_5 x_5$	3.23	244.69
17.	$b_1 x_1 + b_2 x_2 + b_6 x_6$	3.15	238.63
18.	$b_1 x_1 + b_2 x_2 + b_7 x_7$	3.13	237.12
19.	$b_1 x_1 + b_2 x_2 + b_3 x_3 + b_4 x_4$	3.70	380.30
20.	$b_1 x_1 + b_2 x_2 + b_3 x_3 + b_5 x_5$	3.58	271.21
21.	$b_1 x_1 + b_2 x_2 + b_3 x_3 + b_6 x_6$	3.50	265.15
22.	$b_1 x_1 + b_2 x_2 + b_3 x_3 + b_7 x_7$	3.46	262.12
23.	$b_1 x_1 + b_2 x_2 + b_3 x_3 + b_4 x_4 + b_5 x_5$	3.84	290.00
24.	$b_1 x_1 + b_2 x_2 + b_3 x_3 + b_4 x_4 + b_6 x_6$	3.76	284.84
25.	$b_1 x_1 + b_2 x_2 + b_3 x_3 + b_4 x_4 + b_7 x_7$	3.72	281.81
26.	$b_1 x_1 + b_2 x_2 + b_3 x_3 + b_4 x_4 + b_5 x_5 + b_6 x_6$	3.88	293.93
27.	$b_1 x_1 + b_2 x_2 + b_3 x_3 + b_4 x_4 + b_5 x_5 + b_7 x_7$	3.84	290.00
28.	$b_1 x_1 + b_2 x_2 + b_3 x_3 + b_4 x_4 + b_5 x_5 + b_6 x_6 + b_7 x_7$	3.89	294.69

x_1—Secondary branches; x_2—seed yield per plant; x_3—pods per plant; x_4—harvest index; x_5—days to maturity; x_6—plant height, and x_7—100-seed weight.

calculating genetic advance and comparing it with straight selection for seed yield taken as 100 (Table 1). The straight selection for seed yield was more efficient as compared to indirect selection for yield based on different characters taken individually, except secondary branches. Indirect selection for seed yield based on the number of secondary branches was about 88% more efficient as compared to direct selection for seed yield. Considering two traits at a time, the combination of secondary branches and seed yield had the highest efficiency, which was 2.37 times more efficient than the selection for seed yield alone. Secondary branches and pods per plant, and secondary branches and harvest index were the two other paired combinations with high relative efficiencies. When various other characters were added to the most efficient two-factor combinations, the index involving pods per plant showed highest efficiency (Table 1). It increased the efficiency by 25% over and above the two-factor index. In four character combinations, the index involving secondary branches, seed yield, pods per plant, and harvest index showed maximum relative efficiency (280.3) over direct selection for grain yield. It was 17% more efficient than the best three-character combination of secondary branches, seed yield and pods per plant. With the inclusion of days to maturity, the efficiency increased by 10.3 and 0.76% respectively, over the best previous combinations. Though the efficiency kept on increasing with the addition of the next character, the increase was at a declining rate (Table 1). Moreover, inclusion of as many as seven characters would be cumbersome and is not desirable in view of the magnitude of improvement in seed yield with each additional character. Hence a criterion had to be evolved where maximum genetic advance is possible by inclusion of minimum characters. In the present investigation the index involving four characters, i.e. secondary branches, seed yield, pods per plant and harvest index, was quite efficient. A selection criterion based on higher number of branches, pod clusters, and pods per plant was also suggested by several workers [3–6]. For field selection, the two easily observable characters, namely, number of secondary branches and pods per plant form the best index.

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