Indian J. Genet., **56** (1): 12–15 (1996)

SELECTION INDICES IN CHICKPEA (*CICER ARIETINUM* L.)

K. M. SAMAL AND P. N. JAGADEV*

Regional Research Station, Keonjhar, Orissa 758002

(Received: August 24, 1990; accepted: June 6, 1995)

ABSTRACT

Selection indices for yield were constructed and their efficiency assessed in terms of predicted genetic advance using 24 cultivars of chickpea. Four groups of indices based on 1 to 7 characters including yield were evaluated. The choice of character combinations was based on four criteria which were functions of heritability ($\hat{h}^2$) and genotypic correlation with yield (r_g). Efficiency of the indices over direct selection in terms of predicted genetic advance ranged from 5.4 to 101.7%, the highest efficiency being for all the inclusive 7-character index. In all the four groups, the efficiency of indices increased with increasing number of characters. The mean predicted advance and efficiency of individual groups of indices indicated that for constructing a selection index to select high yielding genotypes, yield should be indicated first followed by characters having higher $\hat{h}^2 . r_g$ values.

Key words: *Cicer arietinum*, chickpea, selection indices, genetic advance, selection efficiency.

Selection indices provide the means for making use of correlated characters for higher efficiency in selection for characters of low heritability like yield [1]. But all characters are not of equal value for this purpose and in the absence of any objective criterion for choice of characters, several indices (with varying combinations of characters) need to be evaluated to find out the most efficient index. This study was undertaken to construct selection indices and assess their efficiency over direct selection for yield in chickpea as well as to examine the usefulness of a possible criterion for choice of characters for constructing indices.

MATERIALS AND METHODS

Twenty four cultivars of chickpea were evaluated in randomised complete block design with 3 replications, each plot having 4 rows of 5.5 m length maintaining spacing of 30 cm between rows and 8–10 cm between plants by thinning. Observations were recorded on days to 50% flowering and maturity, plant height, branches and pods/plant, 100-seed

*Address for correspondence: Qrs. No. VF-13, OUAT Colony, Bhubaneshwar 751003.

weight, and seed yield/plant from ten random plants per plot. Analyses of variance and covariance were carried out using plot means. Heritability and correlations between yield and its components were estimated following Burton and de Vane [2] and Robinson *et al.* [3], respectively.

Selection indices for yield were constructed and their efficiency over direct selection for yield alone assessed in terms of predicted genetic advance following Smith [1]. Four groups of indices based on 1 to 7 characters including yield were constructed. The characters other than yield were ranked on the basis of absolute values of the product of their heritability ($\hat{h}^2$) and genotypic correlations with yield (r_g) as presented in Table 1. In group I, in single character index was based on the character having highest value and other characters were added in the order of their rank on the said criterion, and finally, yield was included to get the all inclusive 7-character index. For group II, the sequence of characters other than yield was the reverse of group I. Group III was similar to group I, and group IV similar to group II, except that in groups III and IV, yield was included in each index. The characters were so chosen because the usefulness of a character for this purpose was determined by its $\hat{h}^2$ and r_g [4]. The reverse sequence was used as an empirical test to confirm this expectation, which could provide a criterion for the choice of characters for inclusion in selection index. The four groups of indices were as follows:

Group I: $X_5 + X_1 + X_4 + X_6 + X_3 + X_2 + X_7$

Group II: $X_2 + X_3 + X_6 + X_4 + X_1 + X_5 + X_7$

Group III: $X_7 + X_5 + X_1 + X_4 + X_6 + X_3 + X_2$

Group IV: $X_7 + X_2 + X_3 + X_6 + X_4 + X_1 + X_5$

where x_1—days to 50% flowering, x_2—days to maturity, x_3—plant height, x_4—primary branches/plant, x_5–pods/plant, x_6—100-seed weight, and x_7—yield (Table 1).

RESULTS AND DISCUSSION

The predicted genetic advance in yield for the indices at 5% selection intensity ranges from 0.38 to 7.24 g/plant (Table 2) compared with a predicted advance of 7.12 g from direct selection for yield per se. And relative efficiency of the indices over direct selection in terms of predicted advance ranged from 5.4 to 101.7% (Table 3). In all the four groups, the efficiency of indices increased with increasing number of characters and the maximum efficiency was achieved only when all the seven characters including yield were included. The gain in

efficiency from selection indices was not high because several of the characters did not have significant association with yield in the material evaluated [5].

Six indices of group I and group II based on 1 to 6 characters without yield had lower efficiency than direct selection. In contrast, all the indices of group III based on 2 to 7 characters including yield had higher efficiency than direct selection, the gain in efficiency ranging from 0.9 to 1.7%. The indices of group IV also had higher efficiency than direct selection, but the gain in efficiency was nominal till inclusion of four characters including yield and excluding days to flowering, branch number and pod number. The mean predicted advance and selection efficiency over the 7 indices of individual groups ranged from 2.51 to 7.20 g/plant and 35.3 to 101.1%, respectively. The mean predicted advance was the highest for group III, closely followed by group VI, while group II had the lowest average value. The mean advances for the groups of indices indicated that for constructing a selection index to select high yielding genotypes, yield should be included first, followed by characters having higher $\hat{h}^2$ and r_g product values. These results were in conformity with the effect that $\hat{h}^2$ and r_g are the two parameters that determine the correlated response from indirect selection [4].

Table 1. Heritability ($\hat{h}^2$), phenotypic (r_p) and genotypic (r_g) correlations of component characters with yield (x_7) in chickpea

Character	$\hat{h}^2$ (%)	r_p	r_g	$\hat{h}^2 \cdot r_g$
Days to 50% flowering (x_1)	90.1	- 0.05	- 0.08	0.07
Days to maturity (x_2)	57.5	- 0.05	- 0.06	0.03
Plant height (x_3)	63.2	0.07	- 0.05	0.03
Primary branches/plant (x_4)	14.2	0.38	0.34	0.05
Pods/plant (x_5)	39.4	0.71*	0.68*	0.27
100-seed weight (x_6)	92.5	0.06	0.04	0.03

*Significant at 1% level.

Table 2. Predicted genetic advance in seed yield for different number of characters included in the selection indices in chickpea

No. of characters in selection index	Genetic advance (g/plant)				
	group-1	group-2	group-3	group-4	mean
1	4.19	0.38	7.12	7.12	4.70
2	4.20	0.47	7.18	7.12	4.74
3	4.28	0.59	7.18	7.13	4.80
4	4.42	1.99	7.21	7.13	5.19
5	4.82	2.09	7.22	7.21	5.33
6	4.82	4.82	7.23	7.21	6.02
7	7.24	7.24	7.24	7.24	7.24
Mean	4.85	2.51	7.20	7.17	5.43

The validity of the predicted superiority of indices over direct selection or of any one index over others depends on the precision of the estimates of variance and covariance (which formed the basis of index construction here), though there was no objective criterion to judge the reliability of these estimates [6]. However, selection indices have specific applicability to the particular set of material for realizing the expected superiority; so indices worked out in this study could not be taken to be generally applicable to chickpea. Thus, the search for an effective

criterion for the choice of characters for constructing indices and the identification of characters that could serve as useful criteria of selection for yield in chickpea were the more general aspects of this study. The pattern of changes in efficiency of indices in relation to the number of characters and the average efficiency of individual groups indicated that characters could be chosen on the basis of absolute values of the product of their $\hat{h}^2$ and r_g. The most efficient index could perhaps be found by constructing and evaluating indices with the one having the highest value for the said criterion.

Table 3. Relative efficiency of selection indices over direct selection for seed yield in chickpea

No. of characters in selection index	Relative efficiency (%)				
	group-1	group-2	group-3	group-4	mean
1	58.9	5.4	100.0	100.0	66.1
2	58.9	6.6	100.9	100.0	66.6
3	60.1	8.3	100.9	100.1	67.4
4	62.1	27.9	101.3	100.1	72.9
5	67.6	29.3	101.5	101.2	74.9
6	67.7	67.7	101.5	101.2	84.5
7	101.7	101.7	101.7	101.7	101.7
Mean	68.2	35.3	101.1	100.6	76.3

ACKNOWLEDGEMENTS

The authors are grateful to ICRISAT, Hyderabad, for supply of seed material for this work.

REFERENCES

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

2. G. W. Burton and E. H. de Vane. 1953. Estimating heritability in tall fescue (*Festuca arundinacea*) from replicated clonal material. Agron. J., **45** : 478–481.

3. H. F. Robinson, R. E. Comstock and P. H. Harvey. 1951. Genotypic and phenotypic correlations in corn and their implications in selection. Agron. J., **43** : 282–287.

4. D. S. Falconer. 1960. Introduction to Quantitative Genetics. Oliver and Boyd, Edinburg.

5. K. C. Muduli. 1986. Genetic Variability, Character Association and Selection Indices for Yield in Linseed. M. Sc. Ag. Thesis. Orissa University of Agriculture and Technology, Bhubaneswar, Orissa.

6. C. A. Brim, H. W. Johnson and C. C. Cockerham. 1959. Multiple selection criteria in soybean. Agron. J., **51**: 42–46.