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SELECTION INDICES IN GREENGRAM

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Selection indices for yield were constructed on the basis of five different criteria (Viz. h^2, G.A., rg, h^2-rg and P values) based on 1-9 characters using 30 varieties of greengram (*Vigna radiata* Wilczek.). Expected genetic gain in yield due to the indices were computed and their efficiency over direct selection for yield *per se* was assessed. In all the five groups the efficiency of the indices increased gradually with addition of characters to the indices. Combined direct and indirect selection was found to be more effective than indirect selection alone. The direct effect component (p.) of the characters on yield was found to be the best criterian for selection of characters for inclusion in the indices. The 6-character index based on pods/plant, 1000-seed wt., seeds/pod, reproductive period, clusters/plant and yield/plant was found to be most efficient index in realising genetic advance in yield. Inclusion of characters like length of pod and plant height did not add much to the efficiency of indices.

selection indices provide the means for making use of correlated characters for higher efficiency in selection for yield (smith, 1938). Selection indices for yield and also for multiple economic traits have been worked out by several workers in wide range of crop plants, but in all these studies, efficiency of the indices have been assessed in terms of predicted genetic advance. These studies showed that all the characters are not of equal selection value for improvement in yield. In the absence of any specific objective criterian for choice of characters, a very large number of indices (with varying combinations of characters) are needed to be evaluated to find out the most efficient index. This study was undertaken to construct selection indices on the basis of some genetic criteria and to assess their efficiency over direct selection for yield *per se* in greengram and also to examine the usefulness of some posciable criteria for choice of characters for constructing indices.

MATERIALS AND METHODS

The material for the present study consisted of 30 greengram varieties of diverse geographic (5 from Orissa, 3 standards and 22 form other states) and genetic origin. The trial was conducted during Kharif 1978-79 in randomised complete block design with 4 replications. The plot size was 8 rows of 2.5m of with a 30 cm x 10mc spacing. Observations were recorded on days to maturity, reproductive period (1st flowering to maturity) 1000-seed wt-(g)on plot basis and on plant height (cm), clusters/plant, pods/plant, seeds/pod length of pod (cm) and yield/plant (g) on 10 random plants per plot. Heritability, genetic advance (at 5%) of the characters and their genotypic correlation with yield were estimated following Burton and de Vane (1953) and Robinson *et al.*, (1951). Ths direct effect components of these characters on yield were esti-

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mated by path-analysis following Dewey and Lu (1959). Selection indices for yield (as the economic trait) were constructed and their efficiency over direct selection for yield was assessed in terms of expected genetic advance in yield following Smith (1938).

Five groups of indices were evaluated, the characters being chosen on the basis of 5 different criteria, via. (i) heritability (h^2), (ii) genetic advance (G. A.), (iii) genotypic correlation with yield (rg), (iv) h^2. rg, (v) direct effect component of the characters on yield (p). The rational behind selection of these genetic parameters as criteria of character selection for the groups is that rg and P indicate the bearing of the characters on yield, whereas, h^2 and G.A. reflect the dependability of the characters in selection.

For set 'A' (indirect selection, where yield is not included for construction of indices), in each of the five groups, the single character index was based on the one having the highest absolute value for the criterian of choice for the group, and characters were added, one at a time in discending order of absolute value of the criterian (Table-1) till 1 to 8 character indirect selection indices were obtained. For set 'B' (combined direct and indirect selection) the groups and indices were made as done for set 'A', but yield was included in construction of each index in order to give 2 to 9 character indices. Thus based on the estimates of h^2, G. A., rg, h^2. rg, and P (Table-1) the sequence of addition of characters for the 5 groups of indices for both the sets were:

Set 'A' Group I : $X_8 + X_3 + X_5 + X_4 + X_1 + X_2 + X_6 + X_7$
Group II : $X_4 + X_5 + X_3 + X_8 + X_2 + X_7 + X_6 + X_1$
Group III : $X_5 + X_2 + X_4 + X_3 + X_1 + X_8 + X_7 + X_6$
Group IV : $X_5 + X_2 + X_3 + X_4 + X_1 + X_8 + X_7 + X_6$
Group V : $X_5 + X_8 + X_6 + X_2 + X_4 + X_7 + X_3 + X_1$

Set 'B' Group I : $X_9 + X_8 + X_3 + X_5 + X_4 + X_1 + X_2 + X_6 + X_7$
Group II : $X_9 + X_4 + X_5 + X_3 + X_8 + X_2 + X_7 + X_6 + X_1$
Group III : $X_9 + X_5 + X_2 + X_4 + X_3 + X_1 + X_8 + X_7 + X_6$
Group IV : $X_9 + X_5 + X_2 + X_3 + X_4 + X_1 + X_8 + X_7 + X_6$
Group V : $X_9 + X_5 + X_8 + X_6 + X_2 + X_4 + X_7 + X_3 + X_1$

The relative efficiency of the indices over direct selection for yield *per se* was assessed in terms of predicted genetic advance in yield.

Table-1 : Heritability (h^2), genetic advance (G. A.) of yield components, their genotypic correlation with yield (rg), and direct effect component on yield (p) in greengram.

	Characters	h^2	G. A. (%)	rg	h^2. rg	P
X_1	Days to maturity	0.801	5.78	0.539	0.432	0.008
X_2	Reproductive period	0.800	13.58	0.742	0.594	0.090
X_3	Plant height	0.866	21.15	0.632	0.547	0.009
X_4	Clusters/plant	0.814	34.02	0.644	0.524	0.063
X_5	Pods/plant	0.858	33.92	0.824	0.707	0.816
X_6	Seeds/pod	0.723	8.24	-0.011	-0.008	0.234
X_7	Length of pod	0.678	8.96	0.210	0.142	0.015
X_8	1000-seed wt:	0.961	22.59	0.242	0.233	0.519
X_9	Yield/plant	0.743	21.06			

RESULTS AND DISCUSSION

Predicted genetic advance in yield for the different indices at 5% seletion intensity for indirect selection (Set 'A') ranged from0.270 to 0.877g/plant (Table-2), whereas, those for combined direct and indirect selection (Set 'B') ranged from 0.751 to 0.894 g/plant (Table-3) against 0.740 g/plant for direct selection for yield *per se*. The predicted gain in efficiency from use of the indices over direct selection for yield *per se* ranged from-63.5 to 18.5% for set 'A' and 1.5% to 20.8% for set 'B'.

The average predicted advance over all the 8 indices of individual groups of both set 'A' and 'B', showed that group V (based on P-values) indices had the highest efficiency of 11.7% and 16.4% over direct selection followed by Group IV (h^2. rg), Group III (ry), Group II (GA) and Group I (h^2) indices. This shows that direct effect component (P-value) of the character on yield would be the most effective criterian for choice of characters for inclusion in selection indices followed by h^2. rg, rg and G A., while h^2 is the least effective criterian. Sahu and Patnaik (1980) evaluated 5 groups of indices based on 5 different criteria (via. h^2, rp, rg, h^2, rp,h^2 . rg) with 1 to 10 characters in niger and observed that h^2. rg would be the most effective criterian for choice of characters for inclusion in selection indices, while h^2 or rp would be least effective.

For set 'A' (indirect selection) the average predicted advance for 1 to 8 character indices ranged from 73.5 % to 118.5% over direct selection. Pods/plant formed the single character index in 3 groups, whereas, 1000 seed wt. and clusters/plant in one group each. In all these cases single character indices had lower efficiency than direct selection. For 2-character indices pods/plant came in 4 groups, whereas, 1000-seed wt. and reproductive period in 2 groups each. These 2-character indices had lower efficiency than direct selection in all groups except group-V, where the gain in efficiency by the index (pods/plant and 1000-seed wt.) was 5.4%. For 3 character indices the efficiency of group-V (pods/plant,1000-seed wt. and seeds/pod) was 13.0%, whereas, in other groups there was very little or no gain. The gain in efficiency went on gradually increasing with increase in number of characters in the indices in all the groups. A comparision of the individual indices of the 5 groups revealed that the indices of group V (based on P-values) had invariably higher efficiency than other groups. The 5-characters index in group V, based on pods/plant, 1000 seed wt., seeds/pod, reproductive period and clusters/plant had an efficiency of 17.4%, out of total posciable 20.8% in case 9-character index. This showes that these characters are of high selection value for yield. Inclusion of characters like length of pod and plant ht. in the indices does not add much to the efficiency, whereas, days to maturity adds 1.1% to the efficiency. This indicates that selections for length of pod and plant height are not efficient parameters for selection in yield, whereas, days in maturity have some selection value.

For set 'B' (combined direct and indirect selection), where yield is included in forming each of the indices, the average predicted genetic advance for 2 to 9 characters indices ranged from 0 779 to 0.894 g/plant with effi-

Table-2 : Predicted genetic advance in yield and relative efficiency of the indirect selection indices (Set-A) involving 1-8 characters over direct selection in yield for greengram

No. of Character Index No.	Genetic advance (g/Plant) Gr I h^2	II GA	III rg	IV h^2.rg	V P	Average	Relative efficiency (%)* Gr I h^2	II GA	III rg	IV h^2. rg	V P	Average
1.	0.270	0.467	0.661	0.661	0.661	0.544	36.5	63.1	89.3	89.3	89.3	73.5
2.	0.650	0.721	0.698	0.698	0.780	0.709	87.8	97.4	94.3	94.3	105.4	95.8
3.	0.749	0.734	0.710	0.729	0.836	0.782	101.2	99.2	95.9	98.5	113.0	101.6
4.	0.789	0.789	0.747	0.747	0.849	0.784	106.6	106.6	100.9	100.9	114.7	105.9
5.	0.798	0.825	0.756	0.756	0.869	0.801	107.8	111.5	102.2	102.2	117.4	108.2
6.	0.830	0.828	0.830	0.830	0.870	0.838	112.2	111.4	112.2	112.2	117.6	113.2
7.	0.869	0.864	0.841	0.841	0.869	0.857	117.4	116.8	113.6	113.6	117.4	118.5
8.	0.877	0.877	0.877	0.877	0.877	0.877	118.5	118.5	118.5	118.5	115.5	118.5
Average	0.728	0.763	0.765	0.767	0.826		98.50	103.13	103.36	103.98	111.66	

* G. A. for yield *per se* 0.740 g/plant.

Table-3 : Predicted genetic advance in yield and relative efficiency of the combined direct and indirect selection for indices (Set-B) involving 2 - 9 characters over direct selection for yield in greengram

No. of characters index No.	Genetic advance (g/plant) Gr I h^2	II GA	III rg	IV h^2.rg	V P	Average	Relative efficiency (%)* Gr I h^2	II GA	III rg	IV h^2.rg	V P	Average
1.	0.751	0.759	0.795	0.795	0 795	0.779	101.5	102.6	107.4	107.4	107.4	105.3
2.	0.756	0.801	0.806	0.806	0.824	0.799	102.2	108.2	108.9	108.9	111.4	107.9
3.	0.825	0.816	0.824	0.812	0.858	0.827	111.5	110.6	109.7	117.4	115.9	111.8
4.	0.845	0.845	0.833	0.833	0.869	0.845	114.2	114.2	112.6	112.7	117.4	114.2
5.	0.854	0.854	0.836	0.836	0 884	0.853	115.4	115.4	113.0	113.0	119.5	117.5
6.	0.867	0.860	0.867	0.867	0.885	0.868	117.2	116.2	117.2	117.2	119.6	115.3
7.	0.879	0.884	0.874	0.874	0.884	0.879	118.8	119.5	118.1	118.1	119.5	118.8
8.	0.894	0.894	0.894	0.894	0.894	0.894	120.8	120.8	120.8	120.8	120.8	120.8
Average	0.833	0.839	0.840	0.841	0.862		112.7	113.4	113.5	113.7	116.4	

* G. A. for yield *per se* 0.740 g/plant.

ciency of 5.3 to 20.8% over direct selection. In each group the efficiency goes on increasing gradually with addition of characters to the indices. Like set 'A' in set 'B' indices of group V had higher efficiency than those of other groups. In this group the 4-character (yield/plant, pods/plant, 1000-seed wt., seeds/pod) index had an efficiency of 15.9%. After the inclusion of 2 more characters (reproductive period and clusters/plant), the 6-characters index had an efficiency of 19.5% against 20.8% for 9-character index. Similar trend of efficiency as in group A was observed for length of pod, plant height and days of maturity. A comparison of the two sets of indices showed that set 'B' had higher genetic gain for all the indices. Thus inclusion of yield/plant in the indices adds much to the efficiency of the indices.

The validity of the predicted superiority of indices over direct selection, or of one index over another, is dependant upon the precision of the variance and covariance estimates (which from the basis of index construction), though there is no objective criterian to judge the reliability of these estimates (Brim *et al*, 1959). In this study the variances and covariances are expected to be reasonably good estimates as the coefficient of variation (C.V.) for the characters were low to moderate, which indicates good precission of the experiment. However, selection indices have specific applicability to the particular set of material for evaluating the expected superiority and thus cannot be generalised. But this experiment on search of an effective criterian for choice of characters for constructing indices and the identification of characters that would be useful in selection for yield are the more general aspect of study on selection indices and can be generalised for the crop. The pattern of changes in efficiency of the indices in relation to number of characters and the average efficiency of individual groups indicated that characters should be chosed on the basis of direct effect component value of characters with yield and combined direct and indirect selection was found superior to indirect selection alone. The results of this experiment suggest that an 6-character index based on yield/plant, pods/plant, 1000 seed wt., seeds/pods, reproductive period and clusters/plant would be sufficient to avail of the increase in efficiency due to selection.

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