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Comparative efficacy of pedigree selection and selective intermating in greengram (*Vigna radiata* (L.) Wilczek) *

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Summary. Selective intermating and pedigree selection methods were applied simultaneously to highly heterogeneous and heterozygous base populations of greengram in order to compare their relative efficacy in terms of evolving the number of productive lines as well as their production potential. Selection after two cycles of selective intermating was found to be a better method than traditional pedigree selection. The demerits of pedigree selection and merits of selective intermating are discussed. It is suggested that selective intermating replace the widely adopted but less effective pedigree selection for generating promising new material in such autogamous crops as greengram.

Key words: Greengram – *Vigna radiata* – Selective intermating – Pedigree selection

Introduction

Grain legumes constitute an important source of dietary proteins for the people of Asia, Africa, Latin America, and many other developing countries. They are also endowed with the capacity to fix atmospheric nitrogen, and thus improve soil fertility. Chickpea, pigeonpea, fieldpea and various species of the genus *Vigna* are the major food legumes which are widely grown and consumed in various forms. Greengram is well known for it's easily digestibile, good quality protein with its high biological value and lack of antinutritional factors.

The varietal improvement programmes in greengram are oriented towards making simple crosses and single plant selection for few segregating generations followed by yield testing in later generations: i.e., the pedigree method of selection is used as the breeding method. Though this method is highly effective for simple inherited characters and has been quite successful in evolving improved varieties, the method has certain limitations. Jensen (1970) suggested the use of diallel selective mating as an alternative to pedigree selection in order to overcome the limitations of the latter. Recurrent selection and some of its modifications are also being currently used for improvement of autogamous crops (Khadr and Frey 1965; Joshi and Dhawan 1966; Hanson et al. 1967; Compton 1968; Gill et al. 1973; Kochhar 1974; Verma and Kumar 1974; Redden and Jenson 1974; Kapoor 1977).

This paper presents the results of a comparative evaluation of pedigree selection and selective intermating by employing them on a broad based population of greengram.

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Materials and methods

The experimental material for the present study was a highly heterogeneous and heterozygous base population developed thorough stepwise multiple crosses involving fifteen varieties/genetic stocks representing a wide spectrum of genetic variability. The experiment was initiated by planting the base population in the field at the Haryana Agricultural University, Hisar (29°10′N and 75°46′E) during April 1981. About 10,000 plants of the base population were subjected simultaneously to pedigree selection and selective intermating (Fig. 1). Using pedigree selection, 476 single plants were selected on the basis of their general vigour, number of pods, resistance to diseases, early maturity, plant height, yield components and resistance to shattering. Self seed from each of these plants was harvested separately. These selections were advanced by planting single plant families followed by single plant selections. Two cycles of such pedigree selection were completed. In the case of selective intermating, 300 plants were selected and intermated randomly among themselves. Hybrid seeds numbering about 1,000 were harvested in bulk. These were planted in the subsequent season and once again random mating was done among the best 200 plants. The hybrid seeds, representing two

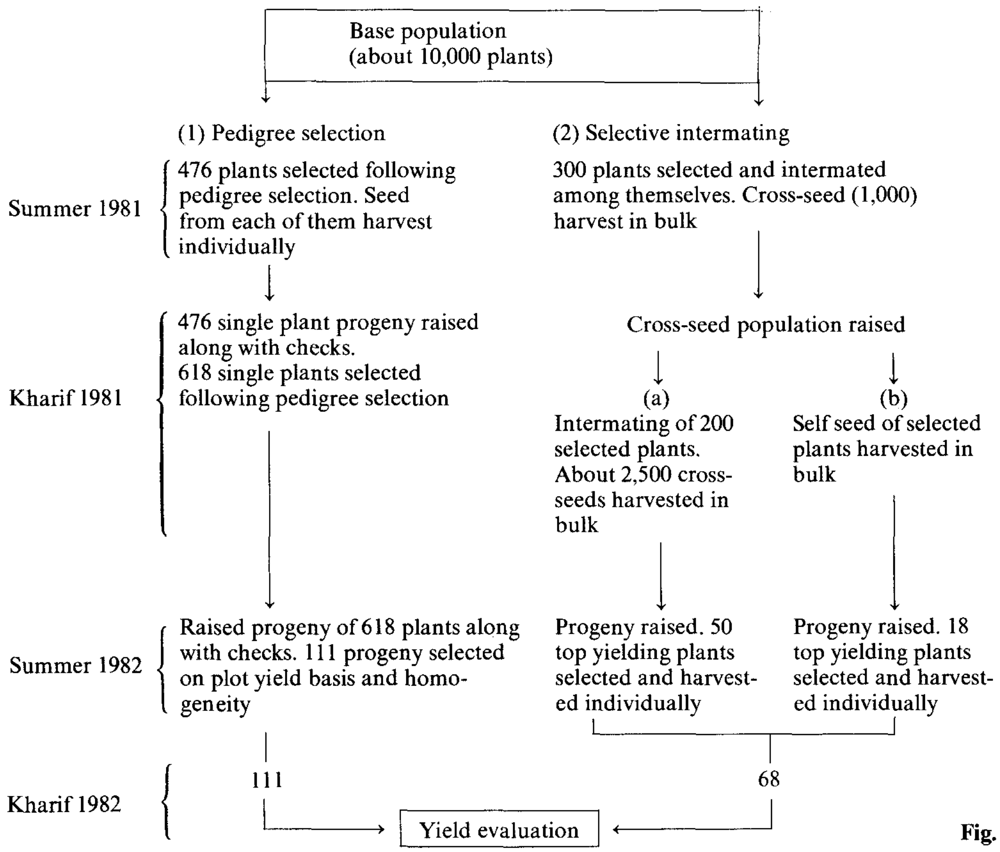

Fig. 1. Selection scheme followed

cycles of intermating, were collected in bulk. In addition, some extraordinarily good-looking plants were selected and their self-seed, representing one cycle of intermating, was harvested in bulk. The seed material from one and two cycles of intermating was space-planted. Single plants from both of these plots were selected by adopting the same criterion as employed under pedigree selection. The progeny of the single plants so selected after one or two cycles of selective intermating were evaluated along with the progeny that evolved through pedigree selection. In all, 179 single plant families, 111 from pedigree selection, 50 from two cycles of intermating and 18 from one cycle of intermating, were evaluated in the field during 1982 following a compact family block design with four replications. Data were recorded on five plants from each family for adult plant height, number of pods and clusters per plant, pods per cluster, pod length, seeds per pod and seed yield per plant. Days to 50% flowering was recorded on a plot basis. Analysis of variance was done following Panse and Sukhatme (1978). The efficacy of the selection methods was compared in terms of evolving the number of productive lines (i.e. the lines with significantly higher yield over the check variety) and their production potential.

Results and discussion

All 111 entries developed through two cycles of pedigree selection (PS) were found to have highly significant differences among them for the eight quantitative characters studied (Table 1), except pods/cluster and seed/pod. These entries were also significantly different from the check varieties K851 and T44 for these characters. The 68 entries developed through selective intermating (SI) showed highly significant differences for all the eight characters studied (Table 1). They were also different from the checks except for pods per cluster, pod length and seeds per pod. Progenies developed through selection after one cycle of intermating (one-cycle progenies) showed differences among themselves for all characters except seeds per pod and seed yield per plant. Those developed after two cycles of selective intermating (two-cycle progenies) were found to differ significantly among themselves for all eight characters. Thus, two cycles of intermating had an edge over one cycle in creating variability for seeds per pod and seed yield per plant. Comparing the efficacy of these selection methods in terms of per cent progenies outyielding the check, mean yield of all entries developed through a particular method and mean yield of the top 10% entries, selective intermating was observed to be a better method of breeding than the pedigree selection (Table 2). About 31% of the entries developed through

Table 1. Mean squares for eight characters in progenies developed through pedigree selection and selective intermating

Method/Source of variation	d.f.	Mean squares							
		1	2	3	4	5	6	7	8
A. Pedigree selection									
1. Replications	3	56.46**	1,092.10**	139.89**	13.90**	0.91*	0.24**	14.45**	5.33
2. Entries	112	58.42**	279.30**	70.73**	4.66**	0.41	0.21**	0.88	4.36**
a) Checks	1	3.12	729.62**	0.45	0.01	0.01	0.01	1.12	0.00
b) Progenies	110	56.86**	254.30**	69.05**	4.53**	0.41	0.21**	0.88	3.52*
c) Check vs progenies	1	228.40**	258.68	325.30**	22.98**	0.11	1.43**	0.64	101.72**
3. Error	336	3.52	68.33	37.54	2.93	0.33	0.05	0.75	2.58
B. Selective intermating									
1. Replications	3	92.22**	317.98**	128.05	52.06**	11.26**	0.26	9.30**	14.22**
2. Entries	69	35.56**	314.16**	115.18**	7.86**	0.67**	0.27**	1.16**	7.48**
a) Checks	1	0.50	12.00	15.12	0.50	1.53	0.06	1.05	1.36
b) Progenies	67	36.15**	316.64**	102.91**	7.01**	0.66**	0.28**	1.17**	6.93**
b_1 One-cycle progenies	17	34.97**	456.13**	109.32**	8.05*	1.06**	0.39**	0.30	4.18
b_2 Two-cycle progenies	49	25.00**	201.63**	102.04**	5.64**	0.52**	0.25**	3.50**	7.92**
b_3 One-vs-Two cycle progenies	1	602.39**	3,580.97**	36.45	0.03	0.77	0.02	4.57*	4.88
c) Checks vs progenies	1	30.86*	449.88**	1,037.80**	71.74**	0.61	0.01	0.72	50.86**
3. Error	207	5.28	75.68	50.02	4.90	0.41	0.16	0.70	3.51

*, ** Significant at P 0.05 and 0.01, respectively

1. Days to 50% flowering; 2. Plant height (cm); 3. Pods per plant; 4. Clusters per plant; 5. Pods per cluster; 6. Pod length (cm); 7. Seeds per pod; 8. Seed yield per plant (g)

Table 2. Comparison of two selection methods in greengram for seed yield (g/plant)

Selection method	% of entries outyielding better check	Mean of all entries	Mean of top 10% entries	Mean of top yielding entry
1. Pedigree method (2 cycles)	9.01	5.64	7.68	9.15
2. Selective intermating	30.88	6.31	8.84	9.90
a) One-cycle	(22.22)	(6.22)	(7.83)	(8.25)
b) Two-cycle	(34.00)	(6.52)	(9.10)	(9.00)

SI outyielded the better checks significantly while in the case of PS, such entries accounted for only 9%. Overall mean yield of all the entries was also higher (6.31 g) in the case of SI over PS (5.64 g). Similarly, mean yield of the top 10% entries was more (8.84 g) in the case of SI than PS (7.68 g). Highest yielding progeny (9.9 g/plant) also came from SI. Two cycles of SI were found to be better than the one cycle of SI. Thus, two cycles of selective intermating proved to be a better method of generation advancement than the traditional and widely adopted PS. Though SI involves some amount of extra labour in terms of crossing work, even then it must be preferred by considering its merits in the form of developing valuable material in such autogamous crops as greengram.

The application of PS as a method of generation advancement in grain legumes, needs rethinking due to it several drawbacks. Firstly, PS is not effective for characters having low heritability. Secondly, it is a costly method in terms of money, time, space and energy. It places a ceiling on the amount of material to be handled. There are no further chances of recombination after the initial crossing, leading to quick fixation of linkage blocks in material handled through PS. Also, this system, particularly in single crosses, has other limitations, such as local adaptation, and changed selection pressure because of changed environment each year. Many of these drawbacks can safely be removed by adopting intermating among selected plants of a segregating material. Several cycles of such intermating help in concentrating favourable genes in a common gene pool by breaking undesirable linkages. Hanson (1959) has also suggested intercrossing for at least one, and preferably several generations after the F_1 to break down linkage. The recurrent selection method, which also needs selective intermating, has been found to be quite effective in breaking linkages in several crops: soybean (Hanson et al. 1967), wheat and barley (Redden and Jenson 1974) and cotton (Miller and Rawlings 1967; El-Adl and Miller 1971; Singh and Singh 1983). For intermating, sufficiently large numbers of plants should be used in the segregating generation, otherwise a high sampling error may nullify the effect of selection.

On the basis of the present study and in the light of available literature on this aspect, it seems that selective intermating should invariably be followed by one or two cycles while exploiting the potential crosses, particularly in the crops where artificial crossing is comparatively easier.

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