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VARIABILITY AND CORRELATION STUDIES IN DESI, KABULI AND INTERMEDIATE CHICKPEAS*

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ABSTRACT

Variability and correlation studies were carried out on two crosses of chickpea (*Cicer arietinum* L.) involving a desi, kabuli and an intermediate type parents. T 39-1 a small seeded and high protein intermediate line was crossed with a medium bold seeded desi variety RS 11 and a large seeded kabuli line P 9623. The parental, F_1 and F_2 generations were evaluated at ICRISAT center. Significant differences between the two crosses were observed for plant height, number of pods per plant, number of seeds per plant, number of seeds per pod, 100-seed weight, seed protein and crude fibre content. Seed type also varied with the crosses. Kabuli and intermediate types were recovered in P 9623 x T 39-1 cross while desi and intermediate types were recovered in RS 11 x T 39-1 cross. In both the crosses, seed yield was positively correlated with number of pods, seeds, primary branches and secondary branches per plant. Protein and crude fibre content were unrelated with yield. Protein content showed negative correlation with 100-seed weight. Cross P 9623 x T 39-1 was considered superior to the other cross RS 11 x T 39-1 owing to bolder kabuli type of seeds with high protein and low crude fibre content in the segregants.

INTRODUCTION

Crop improvement depends upon the magnitude of genetic variability present in base population. Chickpea (*Cicer arietinum* L.) is a self-pollinated crop. It needs intensive studies to investigate and exploit the existing variability. Chickpea is an important source of good quality protein providing nourishment to the vegetarian masses. It is estimated that only about 10-15% of the total world production is of the kabuli type. Most of the world production is of desi type. Desi types have higher fibre content than kabuli types. Most of the desi chickpea is processed into *dhal* for human consumption. Less fibre content is essential for maximum recovery of *dhal*. But the genetic improvement with regards to yield and quality parameters like protein and fibre content has not been impressive. In order to improve chickpea for both yield and quality parameters an understanding of their association among themselves is necessary. Variability and correlation studies help in selection of suitable genotypes and reliable yield components for efficient yield improvement.

MATERIAL AND METHODS

An investigation on chickpea was taken up at the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT). The experiment was conducted on two crosses of chickpea namely P 9623 x T 39-1 and RS 11 x T 39-1 involving P 9623, RS 11 and T 39-1, one parent T 39-1 being common. P 9623 is a white flowered, large seeded kabuli type chickpea having owl's head shaped salmon white seeds with moderate protein and low fibre content. RS 11 has white flower colour, medium sized, yellow brown angular desi seeds and low protein and high fibre content. T 39-1 is a high protein and low fibre line with blue flowers and gray coloured small pea shaped seeds. The crosses P 9623 x T 39-1 and RS 11 x T 39-1 were made in the *Rabi* season 1995 to get the F_1 generations. The F_1 seeds were grown during the *Rabi* season 1996 to obtain the F_2 seeds. These F_2 seeds were taken as the material for the present investigation. The F_2 seeds of the two crosses were sown on 14 October 1997 on deep vertisols under conserved soil moisture conditions. They were sown on ridges 4 m long in 10 rows in an unreplicated block. Spacing adopted was 60 x 20 cm. Normal management practices to raise a healthy crop were taken up.

Data on yield and yield contributing characters were recorded on 117 random competitive plants in the cross P 9623 x T 39-1 and 90 plants in the cross RS 11 x T 39-1. Single

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plant data were recorded for the characters namely plant height, number of primary branches per plant, number of secondary branches per plant, number of pods per plant, number of seeds per plant, number of seeds per pod, 100-seed weight, seed protein content, crude fibre content and seed yield per plant.

Seed protein content of individual plants was determined by multiplying the total nitrogen content (N) in the seeds obtained by Technicon Autoanalyser (TAA) with factor 6.25. Crude fibre content was estimated following the standard AOAC procedures. Seed protein and crude fibre content estimations were done in Crop Quality Service Laboratory at ICRISAT. t and Z tests and correlation analysis were carried out for the data.

RESULTS AND DISCUSSION

The results showing differences between the two crosses are presented in Table 1. The crosses showed highly significant differences for plant height, number of pods per plant, number of seeds per plant, number of seeds per pod, 100-seed weight, seed protein content and crude fibre content.

Cross P 9623 x T 39-1 showed taller plant height with bolder seeds having high protein content compared to the other cross RS 11 x T 39-1. The range was also wider in P 9623 x T 39-1 cross compared to the other cross suggesting further improvement in this cross. Segregants with bolder seed size and high protein content may be recoverable simultaneously by careful selection in large populations. Variation was reported for plant height and 100-seed weight by Patil *et al.* (1996) and for seed protein content by Kharrat *et al.* (1990).

The cross RS 11 x T 39-1 had more number of pods, seeds and seeds per pod and crude fibre content compared to the other cross P 9623 x T 39-1. This difference may have occurred because of pod size variation between the crosses. Singh and Rao (1991) and Patil *et al.* (1996) observed variation for number of pods, seeds and seeds per pod while Kumar and Singh (1989) and Kharrat *et al.* (1990) observed variation for seed coat thickness or fibre content. However, the ranges for number of pods, seeds and seeds per pod were wider in the cross P 9623 x T 39-1 allowing selection for these characters in greater intensity in this cross.

The crosses did not differ from each other significantly for number of primary and secondary branches per plant. Jahagirdar *et al.* (1996) also reported low variation for these characters.

The two crosses showed no significant difference for seed yield per plant. This varies with the reports of Singh and Rao (1991) and Patil *et al.* (1996). But the range was higher in the cross P 9623 x T 39-1 than the other cross. The maximum value of yield was also higher in this cross indicating the scope of direct selection for seed yield.

The two crosses showed difference for seed type (Table 2). The cross P 9623 x T 39-1 involving kabuli and intermediate type parents in the F_2 generation resulted in kabuli types nearly three times that of intermediates. Thus, kabuli type was more frequent in this cross which is mostly preferred for human consumption. The other cross RS 11 x T

Table 1 : Means and ranges for 10 characters for F_2 generation of two chickpea crosses, *Rabi* 1997/98.

Character	P 9623 x T 39-1		RS 11 x T 39-1		t-value	Probability value
	Mean ± S.E.	Range	Mean ± S.E.	Range		
Plant height (cm)	53.75 ± 0.562	42.00 - 70.00	51.76 ± 0.574	40.00 - 64.00	3.508	0.0006**
No. of primary branches per plant	4.62 ± 0.141	2.00 - 10.00	4.46 ± 0.157	2.00 - 9.00	1.107	0.2697
No. of secondary branches per plant	10.81 ± 0.394	4.00 - 22.00	10.21 ± 0.382	4.00 - 20.00	0.202	0.8402
No. of pods per plant	58.69 ± 3.763	10.00 - 301.00	77.99 ± 4.504	10.00 - 244.00	4.705	0.0000**
No. of seeds per plant	52.39 ± 3.701	10.00 - 305.00	84.27 ± 5.025	13.00 - 249.00	7.370	0.0000**
No. of seeds per pod	0.91 ± 0.025	0.40 - 2.00	1.11 ± 0.027	0.60 - 2.00	7.725	0.0000**
100-seed weight (g)	25.56 ± 0.618	11.70 - 46.90	14.95 ± 0.352	7.70 - 22.30	20.429	0.0000**
Seed protein content (%)	25.94 ± 0.182	21.40-30.50	24.32 ± 0.224	20.50 - 30.10	8.046	0.0000**
Crude fibre content (%)	4.19 ± 0.083	2.52 - 6.50	8.48 ± 0.125	5.20 - 11.60	41.498	0.0000**
Seed yield per plant (g)	12.80 ± 0.891	2.60 - 73.50	12.26± 0.745	1.60 - 41.60	0.646	0.5187

Table 2 : Seed type variation in the F_2 generations of two chickpea crosses, *Rabi* 1997/98.

Cross	Desi	Kabuli	Inter-mediate	Total
P 9623 x T 39-1	–	83	34	117
RS 11 x T 39-1	52	–	38	90

39-1 with desi and intermediate type parents resulted in desi types more than that of intermediates.

Thus, the present study indicated some amount of variability between the crosses, which facilitates recovery of desirable characters in greater intensity by selection in these crosses. The ranges for these characters in both the crosses were also high indicating variation between the individual plants. This variation among the plants could be utilised in selection for desirable characters.

Selection for desirable segregants could be done in the cross P 9623 x T 39-1 because of its taller plants, bolder seeds with high seed protein content and the preferred kabuli type of seed. The wider range for number of pods, seeds and seeds per pod could also be utilised for selecting segregants having these characters in greater intensity. For milling and stock feed purposes, thin seed coat with less fibre content is preferred. So cross P 9623 x T 39-1 having less fibre content was considered better than the cross RS 11 x T 39-1. However, higher crude fibre content of the cross RS 11 x T 39-1 could be used for developing lines resistant to root diseases and bruchids (Kumar and Singh, 1989).

Phenotypic correlation coefficients were computed for the F_2 generation for both the crosses P 9623 x T 39-1 and RS 11 x T 39-1 (Table 3). In both the crosses, seed yield showed highly significant positive correlations with number of primary branches, secondary branches, pods and seeds per plant. This is in accordance with the reports of Tripathi *et al.* (1995), Chand and Singh

Table 3 : Phenotypic correlation matrix for 10 characters for two chickpea crosses, *Rabi* 1997/98.

	Cross	Plant height (cm)	No. of primary branches per plant	No. of secondary branches per plant	No. of pods per plant	No. of seeds per plant	No. of seeds per pod	100-seed weight (g)	Seed protein content (%)	Crude fibre content (%)	Seed yield per plant (g)
Plant height (cm)	I	1.000	0.260**	0.205*	-0.046	-0.086	-0.198*	0.207*	-0.006	-0.288**	-0.058
	II	1.000	0.379**	0.349**	0.261*	0.250*	-0.018	-0.022	0.076	-0.280**	0.221*
No. of primary branches per plant	I		1.000	0.836**	0.434**	0.356**	-0.248**	0.047	0.084	-0.208*	0.377**
	II		1.000	0.723**	0.335**	0.323**	0.045	-0.123	0.111	-0.130	0.284**
No. of secondary branches per plant	I			1.000	0.398**	0.308**	-0.256**	0.004	0.065	-0.175	0.315**
	II			1.000	0.519**	0.476**	-0.027	-0.152	0.174	-0.234*	0.388**
No. of pods per plant	I				1.000	0.941**	-0.098	-0.178	0.058	-0.071	0.897**
	II				1.000	0.883**	-0.188	-0.343**	0.248*	-0.104	0.741**
No. of seeds per plant	I					1.000	0.189*	-0.222*	0.024	-0.007	0.939**
	II					1.000	0.234*	-0.254*	0.135	0.063	0.893**
No. of seeds per pod	I						1.000	-0.179	-0.185*	0.144	0.140
	II						1.000	0.108	-0.242*	0.030	0.266*
100-seed weight (g)	I							1.000	-0.301**	-0.357**	0.065
	II							1.000	-0.630**	0.231*	0.149
Seed protein content (%)	I								1.000	0.133	-0.109
	II								1.000	-0.260*	0.131
Crude fibre content (%)	I									1.000	-0.093
	II									1.000	0.061
Seed yield per plant (g)	I										1.000
	II										1.000

Cross I - P 9623 x T 39-1
Cross II - RS 11 x T 39-1

(1997) and Manjare *et al.* (1997). In the cross RS 11 x T 39-1, it also showed significant positive correlations with plant height and number of seeds per pod.

Seed protein content in both the crosses exhibited highly significant negative association with 100-seed weight and significant negative association with number of seeds per pod. Pundir *et al.* (1991) also showed negative association with 100-seed weight but Singh *et al.* (1990) reported non-significant association. In the cross RS 11 x T 39-1, seed protein showed significant negative association with crude fibre content and positive association with number of pods per plant.

In the two crosses, crude fibre content had highly significant negative relationship with plant height and significant negative relationship with number of primary branches per plant (P 9623 x T 39-1) and number of secondary branches per plant (RS 11 x T 39-1). It showed significant negative relationship with 100-seed weight in the cross P 9623 x T 39-1 while significant positive relationship in the cross RS 11 x T 39-1. Singh *et al.* (1980) also reported negative relationship between seed coat percentage and seed mass. But Kharrat *et al.* (1990) reported non-significant relationship between fibre content and 100-seed weight.

100-seed weight had significant negative correlations with number of seeds per plant in the two crosses and with number of pods per plant in the cross RS 11 x T 39-1. Sadhu and Mandal (1989) reported negative correlation between 100-seed weight and seeds per plant. Lal *et al.* (1993) showed negative correlation between number of pods per plant and 100-seed weight.

Number of primary branches, secondary branches, pods and seeds per plant were correlated highly significantly and positively among themselves. Sandhu *et al.* (1991) recorded positive correlations of number of pods per plant with number of primary branches per plant and number of secondary branches per plant. Sathe *et al.* (1993) showed positive correlation of number of pods per plant with number of seeds per plant.

Number of seeds per plant was also correlated significantly and positively with number of seeds per pod in both the crosses. Sathe *et al.* (1993) reported positive association of number of seeds per plant with number of seeds per pod. The cross RS 11 x T 39-1 only exhibited significant positive correlations of number of pods and seeds per plant with plant height.

In both the crosses, number of primary and secondary branches per plant were correlated with plant height. In the cross P 9623 x T 39-1, number of primary branches and secondary branches per plant were correlated highly significantly and negatively with number of seeds per pod, while such a correlation was absent in the cross RS 11 x T 39-1. Plant height showed significant negative correlation with number of seeds per pod in only P 9623 x T 39-1 cross.

In both the crosses, seed yield was positively correlated with number of primary branches, secondary branches, pods and seeds per plant which were all correlated among themselves and hence could be considered as major factors for seed yield improvement. Correlation coefficients between primary and secondary branches per plant, pods and seeds per plant, pods and seed yield per plant, seeds and seed yield per plant, and 100-seed weight and protein content were comparatively higher in the cross P 9623 x T 39-1 than the other cross indicating greater possibility of selection for yield and protein content through these characters. In the cross RS 11 x T 39-1, plant height and number of seeds per pod were also positively correlated with seed yield and other yield characters. So they could also be considered for selection in this cross. 100-seed weight was negatively correlated with number of seeds per plant in both the crosses and with number of pods per plant only in the cross RS 11 x T 39-1, but non-significantly correlated with seed yield per plant. Selection for higher seed yield indirectly through number of pods and seeds may reduce seed weight. Hence, a simultaneous and careful selection for pods and seeds with bolder seed weight may be helpful for yield improvement.

Seed protein content was negatively correlated with 100-seed weight in the two crosses. Therefore, a simultaneous improvement of both the characters may be difficult and necessiates careful selection. It was non-significantly correlated with yield and other yield characters in the two crosses. Crude fibre content was negatively correlated with 100-seed weight in the cross P 9623 x T 39-

1 while positively correlated in the cross RS 11 x T 39-1. In the cross RS 11 x T 39-1 crude fibre and seed protein content were negatively correlated.

Thus, P 9623 x T 39-1 cross involving kabuli parent could be used for selection for bolder seeds with high protein content which would result in low fibre content. This could be effectively used for nutritive and *dhal* recovery purposes. The cross RS 11 x T 39-1 could be used for selection for high seed yield with bolder seeds which increases fibre content and lowers protein content. In this cross segregants having higher fibre content will be helpful for developing resistance to root diseases and bruchids (Kumar and Singh, 1989). This would also improve calcium content as 70% of total seed calcium is contributed by seed coat (Singh, 1985).

The differences of means and correlation analysis showed that the cross P 9623 x T 39-1 was superior to the other cross RS 11 x T 39-1 due to bold kabuli type of seeds with high protein and low fibre content suitable for nutritive and *dhal* extraction purposes.

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