

INHERITANCE OF CRUDE FIBRE CONTENT IN CHICKPEA*

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Chickpea Breeding

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ABSTRACT

A study was carried out to investigate the genetics of crude fibre content in two crosses of chickpea, P 9623 x T 39-1 and RS 11 x T 39-1. The parents selected differed significantly for this character. The study revealed the dominance of high crude fibre over low fibre content. The frequency distribution for each F_2 was near normal suggesting polygenic control for this character. Transgressive segregation was observed towards high fibre content in both the crosses indicating the presence of genes for high fibre content in low parents as well. Desi type segregants with low fibre content were obtained. This has implications for increased *dhal* recovery.

INTRODUCTION

Chickpea (*Cicer arietinum* L.) also known as bengal gram, gram, chana and garbanzo bean is a premier pulse crop of India. Chickpeas are of two types—kabuli and desi. Seeds of the former are generally large and light coloured while desi seeds range from yellow to black, are generally smaller, and have a rough surface. Desi and kabuli chickpeas differ not only in morphology, but also in their fibre content which is mainly deposited in the seed coat (Singh *et al.*, 1980). Desi types have higher fibre content than kabuli types. It is estimated that only about 10-15% of the total world production is of the kabuli type. Most of the desi chickpea is processed into *dhal* for human consumption. Thus, a higher percentage of seed fibre reduces *dhal* recovery. Different categories of fibre viz. Crude fibre (CF), Acid detergent fibre (ADF), Neutral detergent fibre (NDF) and Dietary fibre (DF) involve estimation of different components. Crude fibre is an estimation of cellulose. Cellulose has a direct effect on the utilisation of dietary nutrients. Utilization of ingested protein decreases with increasing levels of cellulose regardless of the quality of protein ingested. Also cellulose has been reported to be the least digestible component of dietary

fibre. It is the predominant component of the dietary fibre, differs with desi and kabuli cultivars and is located mainly in the husk (Singh, 1984).

The concentration of crude fibre is directly related to the amount of seed coat in chickpea. In terms of calorific value and utilisation of dietary constituents kabuli whole seed should be preferred to desi as the latter contains larger amounts of dietary fibre particularly cellulose and hemicellulose. White seeded cultivars have better food technological qualities because of their lower seed coat content and thickness suggesting that cultivars with thinner seed coats have better grain quality. Husk accounted for about 75 and 95% of the total crude fibre of seeds of desi and kabuli cultivars respectively (Singh, 1985). For maximum recovery of *dhal*, desi types that have higher seed weight or lower seed coat percentage will be desirable. Not only does this strategy increase the effective yield of *dhal*, but also it increases the fat and starch contents, which provide the bulk of energy in diet (Jambunathan and Singh, 1980). For maximum recovery of *dhal*, low fibre content is desirable. Therefore, present study of the inheritance of fibre content was undertaken.

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MATERIAL AND METHODS

An experiment was conducted during winter season 1997-98 at the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT). The experiment was conducted with three genotypes P 9623, RS 11 and T 39-1, involved in two crosses, P 9623 x T 39-1 and RS 11 x T 39-1. P 9623 is a kabuli type with low fibre content, RS 11 is desi type with high fibre content and T 39-1 is an intermediate (pea shaped, round seeds) type with moderate fibre content.

The crosses P 9623 x T 39-1 and RS 11 x T 39-1 were made in 1995-96 winter season to get the F_1 generations. The F_1 seeds were grown during 1996-97 winter to obtain the F_2 seeds. These F_2 seeds were taken as the material for the present investigation. The F_1 generations for the study were obtained in the glass house and sown during the 1997-98 winter season. The parental, F_1 and F_2 seeds of the two crosses were sown on 14 October 1997 on deep vertisols under conserved soil moisture conditions. These were sown on 4 m long ridges spaced 60 cm in an

unreplicated block, distance between plants within row being about 20 cm. F_2 seeds were sown in 10 rows while F_1 and parental generations in single row each. Normal management practices were followed.

Crude fibre content estimation was done on seeds of individual plants in the Crop Quality Service Laboratory at ICRISAT following the standard AOAC procedures. Sample was ground in Udy cyclone mill and passed through 0.4 mm mesh. Sample was subjected to sequential extractions with solutions of 1.25% sulphuric acid and 1.25% sodium hydroxide. Thus, the crude fibre content was estimated. Estimation was done in F_2 generation on 117 random competitive plants in the cross P 9623 x T 39-1, 90 random competitive plants in the cross RS 11 x T 39-1, 20 plants in each parent and 10 plants in each F_1 for the two crosses.

RESULTS AND DISCUSSION

Chickpea line P 9623, a kabuli type showed a range of 3.02 - 4.49% with a mean value of 3.63% for crude fibre content. (Table-1). T 39-1, which is an intermediate

Table 1 . Crude fibre content for the parental, F_1 and F_2 generations of two crosses of chickpea, ICRISAT, Patancheru, 1997-98.

Cross	Parent / Generation	Crude fibre content (%)	Range
P 9623 x T 39-1	P 9623	3.63 ± 0.256	3.02 - 4.49
	T 39-1	4.93 ± 0.070	4.60 - 5.20
	F_1	5.23 ± 0.260	4.90 - 5.80
	F_2	4.19 ± 0.083	2.52 - 6.50
RS 11 x T 39-1	RS 11	9.78 ± 0.160	9.10 - 10.30
	T 39-1	4.93 ± 0.070	4.60 - 5.20
	F_1	9.26 ± 0.160	8.70 - 9.80
	F_2	8.48 ± 0.125	5.20 - 11.60

type had a mean crude fibre content of 4.93% with a range of 4.60 - 5.20%. RS 11 had a mean crude fibre content of 9.78% and a range of 9.10 - 10.30%. The F_1 of the cross P 9623 x T 39-1 showed a mean value of 5.23% ± 0.260 which was almost equal to the high parent indicating dominance for high fibre content. The F_1 of the cross RS 11 x T 39-1 showed a mean value of 9.26% ± 0.160, which was higher than the mid parental value of 7.36% and more towards high parent, RS 11 again suggesting dominance for high crude fibre content. Earlier dominance of thick seed coat over thin seed coat was

reported by Gil and Cubero (1993).

The F_2 generation of the cross P 9623 x T 39-1 varied from 2.52 - 6.50% with a mean value of $4.19\% \pm 0.083$, which was approaching mid parental value (4.28%) and lower than F_1 mean value. While F_2 generation of the cross RS 11 x T 39-1 showed a mean crude fibre content of 8.48% and a range of 5.20 - 11.60%. In this

cross mean was slightly lower than F_1 value but was higher than the mid parental (7.36%) value and approaching the high parent.

The F_2 values in both the crosses showed near normal frequency distribution which indicated polygenic control of the character (Fig. 1 and 2).

Near normal distribution in F_2

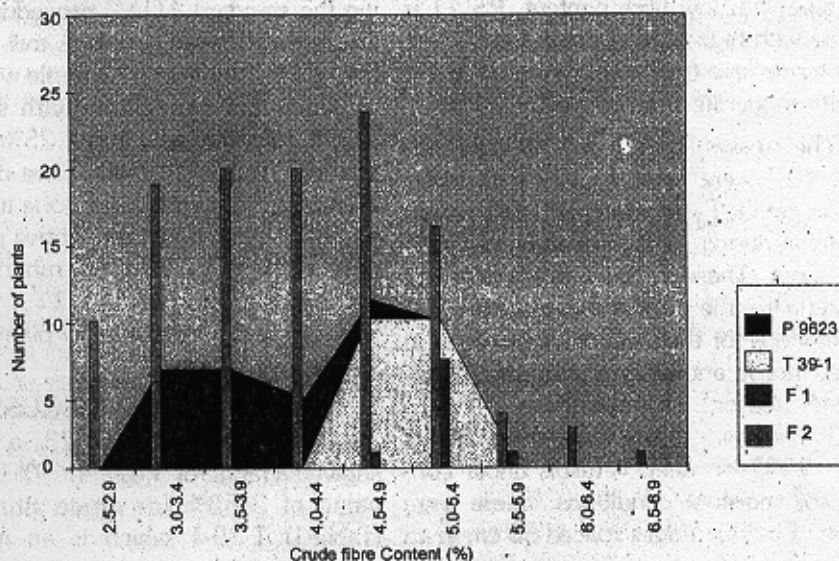


Fig.1 Frequency distribution for crude fibre content in Parental, F_1 and F_2 generations for the cross P 9623 x T 39-1, ICRISAT, Patancheru, 1997-98

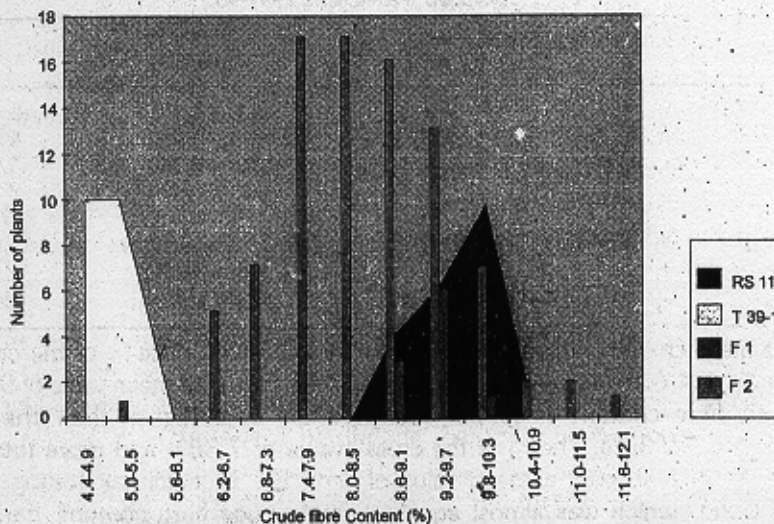


Fig.2 Frequency distribution for crude fibre content in Parental, F_1 and F_2 generations for the cross RS 11 x T 39-1, ICRISAT, Patancheru, 1997-98

generation for seed coat thickness was also obtained by Kumar and Singh (1989) who suggested the involvement of several genes governing this trait. These results are contrary to those of Gil and Cubero (1993) who observed that the seed coat thickness exhibited monogenic inheritance with thick seed coat being dominant to thin seed coat. However, fibre content showed unimodal distribution in F_2 and F_3 generations.

In the F_2 generation of the cross P 9623 x T 39-1, the range extended beyond both the parents indicating non-isodirectional distribution and presence of genes for high and low crude fibre content in both the parents. This could also be due to recombination between the genomes of two parents resulting in complementation when they segregated in F_2 generation. Therefore, there is possibility of developing genotypes with low or high fibre content. In the cross RS 11 x T 39-1, F_2 range extended beyond the high parent. Transgressive segregation was obtained towards high crude fibre content suggesting non-isodirectional distribution of genes for high fibre content and presence of complimentary genes for high fibre content in low parent as well. Thus, high fibre content in F_3 s and near normal distribution pattern in F_2 s suggest dominance for high fibre content and role of at least a few genes governing this character. Both the crosses showed significant difference and wider range for this character. This

suggested the presence of variability that could be exploited. Singh *et al.* (1980) also reported variation for this character. The cross RS 11 x T 39-1 involving desi parent RS 11, showed higher fibre content than the other cross. Singh (1984) also reported higher fibre content for desi types. The present study showed the recovery of desi type segregants with relatively thinner seed coats. This trait could be stabilized in later generations which may produce a higher proportion of *dhal* than that recovered at present. This possibility was also suggested by Kumar and Singh (1989). The results also indicated the development of genotypes with very high crude fibre content or thicker seed coat which might offer resistance to root diseases and bruchids (Kumar and Singh, 1989). Thicker seed coat may be nutritionally desirable as the seed coat contributes about 70% of the total seed calcium (Singh, 1985).

The present study showed the involvement of at least a few genes governing the crude fibre content. It is possible to select for low and high fibre content in the segregating populations. Thin seed coat may help to develop desi chickpea with low fibre content useful for increased *dhal* recovery.

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