Table 1. Heritability, genetic advance, and character association in chickpea, 1986/87, 1987/88, and 1988/89.

Characters/ year	Time to 50% flowering	Time to maturity	Plant height	Branches plant^{-1}	Pods plant^{-1}	Seeds pod^{-1}	100-seed mass	Seed yield
Heritability (h^2) (%)								
1986/87	72.2	77.9	76.3	61.3	65.7	47.3	75.8	4.63
1987/88	64.3	55.1	62.5	32.2	58.3	32.5	65.2	3.25
1988/89	76.4	62.3	72.4	47.7	74.2	43.8	78.0	5.97
SE	±6.1	±11.7	±7.1	±14.6	±8.0	±7.7	±6.8	±1.36
Mean	71.0	65.1	70.4	47.1	66.1	41.2	73.0	4.62
Genetic advance (GA) (% of mean)								
1986/87	8.7	7.3	11.2	12.9	22.0	19.6	14.7	0.97
1987/88	6.3	5.4	6.9	17.3	19.4	8.2	19.2	0.69
1988/89	11.0	16.1	18.7	20.0	26.8	17.9	12.3	1.75
SE	±2.4	± 5.7	±6.0	± 3.6	±3.8	±6.2	±3.5	±0.55
Mean	8.7	9.6	12.3	16.7	22.7	15.2	15.4	1.14
Genotypic correlation (r_g) with seed yield								
1986/87	0.38	0.55*	0.49*	0.57*	0.81**	0.49*	0.60**	
1987/88	0.14	0.27	0.38	0.31	0.64**	0.53*	0.55*	
1988/89	0.52*	0.38	0.31	0.65**	0.75**	0.41	0.71**	
SE	±0.19	± 0.14	±0.09	± 0.18	±0.09	±0.06	±0.08	
Mean	0.35	0.40	0.39	0.51	0.73	0.48	0.62	

*,** = r_g estimates significant at 5% and 1% levels.

ity, it was observed that selection for more pods plant^{-1} and higher seed mass would be effective in the selection of genotypes for higher yields.

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Genetic Relationship Among the Newly Identified Non-nodulating Chickpea Lines

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Genetics of nodulation in a chickpea mutant, PM 233, was first reported by Davis et al. (1986). Singh et al. (in press) studied the genetics of another non-nodulating chickpea line ICC 435M, and found that PM 233 and ICC 435M were nonallelic in respect of gene controlling the non-nodulation in the two parents. Subsequently, two more non-nodulating (Nod$^-$) lines were identified from cultivars, Annigeri (ICC 4918) and Rabat (ICC 4993), and named as ICC 4918M and ICC 4993M. We are attempting to determine the genetic control of non-nodulation in the newly found Nod$^-$ lines and their relationship with the Nod$^-$ lines reported earlier. Progress made in these studies is reported in this note.

Four non-nodulating lines, PM 233, ICC 435M, ICC 4918M, and ICC 4993M, were crossed in all possible combinations in 1989/90 at ICRISAT Center. The parents and their F_1s were grown on a Vertisol having native chickpea rhizobial population $\geq 10^3$ g^{-1} soil in the 1990/91 postrainy season. The plot size varied from two to four rows of 4 m length with a spacing of 75 cm between, and 20 cm within the rows. At 50 days after sowing, 10 plants from each plot were carefully dug up and observed for nodulation.

The four parents and the cross ICC 435M × ICC 4918M did not nodulate while the remaining five crosses nodulated normally. It thus suggested that the genes controlling non-nodulation in ICC 435M and ICC 4918M are the same but are different from those in PM 233 and ICC 4993M. Similarly, the genes responsible for non-nodulation in PM 233 and ICC 4993M are also nonallelic.

Further studies to determine the number of genes involved in causing non-nodulation in parents ICC 4918M and ICC 4993M, and as to how they differ from each other and from PM 233 and ICC 435M, are in progress.

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Improvement in Chickpea Production Through Induced Mutations

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Chickpea or gram (*Cicer arietinum* L.) is one of the important pulse crops in Pakistan grown mostly in rainfed areas during the postrainy season. Areawise, chickpea is the third largest crop grown after rice and wheat (Pakistan: Federal Bureau of Statistics 1990). It occupies an area of 71% and produces 73% of the production of all legume crops grown in the country. In the North West Frontier Province (NWFP), where two-thirds of the area is rainfed, 98% of the total chickpea area is grown in the southern zone where it is considered to be a cash crop (Government of Pakistan 1990). However, the national average yield in the country is between 0.45 to 0.56 t ha^{-1}, which has been stagnant for the past 20 years. Most of the currently cultivated varieties are poor in yield potential and susceptible to diseases, especially chickpea blight, which is the main yield-reducing factor. Due to the narrow genetic base in the cultivated varieties of chickpea in Pakistan, mutation breeding was found promising to improve yield potential by selecting the desirable mutants as reported by Shaikh et al. (1982) and Hassan et al. (1987). At the Nuclear Institute for Food and Agriculture (NIFA), our main objectives were to develop blight-resistant and high-yielding varieties of chickpea with desirable plant type through induced mutations.

We tested the yield performances of the promising chickpea mutants, CM 1, CM 88, CM 663, CM 687, CM 1913, CM 1918, and varieties RC 32, E 1289, C 141, and CM 72 (control) for 3 years (1986-1988) in advanced yield trials at NIFA, Peshawar (Table 1). We conducted the trials in a randomized complete block design, replicated four times with a plot size of 10.8 m^2. The mutant CM 1918 significantly outyielded the other mutants and varieties during 1985/86 and 1986/87 producing 2.69 and 1.12 t ha^{-1}. The control variety CM 72 produced 1.78 t ha^{-1} in 1985/86 and 0.67 t ha^{-1} in 1986/87. In 1986/87, the crop was greatly damaged by rains and hailstorm which resulted in low yield. During 1987/88, the mutant CM 1918 also yielded significantly higher than the four mutants and three varieties, and CM 72 and CM 1913, were not significantly different though they gave lower yields

Table 1. Three years' mean yield of chickpea mutants/varieties at NIFA, 1986-88.

Mutants/ varieties	Yield (t ha^{-1})			
	1985/86	1986/87	1987/88	Mean
CM 72	1.78	0.67	2.22	1.56
CM 1918	2.69	1.12	2.48	2.09
RC 32	1.03	0.38	1.57	1.00
E 1289	0.76	0.29	1.48	0.84
C 141	2.63	0.91	1.26	1.60
CM 1	1.13	0.47	0.98	0.86
CM 88	1.11	0.49	0.66	0.75
CM 663	0.63	0.48	0.91	0.67
CM 687	0.96	0.36	0.43	0.58
CM 1913	2.30	0.60	2.21	1.70
SE	±0.23	±0.077	±0.22	