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Effect of Intercropping on Genetic Variability in Gram (*Cicer arietinum* L.)

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An investigation was carried out to compare the amount of genetic improvement of yield and its three major attributes viz, pods and seeds plant and 100-seed weight three in F_2 and F_3 crosses in gram. The analysis made environment wise in both the generations revealed that intercropping is a better environment for the genetic improvement of pod and seed number per plant and 100-seed weight characters. The estimates of parameters of genetic variability expected, genetic advance and genetic advance as percentage of mean were higher in F_3 than in F_2 and under intercrop than in sole crop. Heritability estimates were higher in sole crop than in intercrop and in F_2 than in F_3 for pod number and 100-seed weight characters.

Gram or chickpea is a major pulse crop which is grown as a sole crop as well as in mixture with cereals, millets, oilseeds etc. in varying proportions. Such a mix cropping ensures either higher cereals or millet return in case of good monsoon or winter rains or higher pulse return in case of poor monsoon or winter rains. It is for these reasons farmers grow pulses in mixture rather than as a sole crop. But little or no attention has been given to its genetic amelioration. So far very little is known regaring the environment which would lead to rapid and effective genetic improvement of this crop. Therefore, the present investigation was carried out to know the expression of F_2 and F_3 under sole and intercropping conditions with respect to the estimates of heritability and expected genetic advance, for yield and its major attributes.

MATERIAL AND METHODS

The investigation was carried out at the Experimental Station, College of Agriculture, Jabalpur. In the first year (1974-75) the experimental material consisted of three F_2 crosses involving parents differing widely in seed size (100-seed weight) and origin. Each of the crosses was grown under sole (E_1) and intercropping (E_2) (gram:wheat 1 : 1 row). The experiment was laid out in a randomized block design with four replications. The plot consisted of 4 rows each 5m long with a row spacing of 10 cm. Observations were recorded on pods per plant, seeds per plant, 100-seed weight and yield per plant.

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On the basis of data collected on single plants in F_2 the following bulks were made in the two environments:

Single Seed Descent (S. S. D): Two seeds from every competitive F_2 plant were taken to constitute this bulk.

Random Bulk (R. B.) : Randomly choosen 5 per cent plants consituted this bulk.

Seed Yield Bluk (Y. B.): Top yielding 5 per cent plants constituted this bulk. *Seed Size Bluk*: Top 5 per cent plants in seed size were taken.

The F_3 comprising of 12 bulk populations of three crosses under each of the two environments was raised as sole crop in the second year (1975-76) in a randomized block design with four replications. The plot consisted of 3 rows each 5 m long accomodating 30 plants per row, with row to row spacing of 4-5 cm and plant to plant spacing of 15 cm (Plot size 5×1.35 m²).

In F_3, observations were recorded on randomly chosen 10 plants per plot for the characters, pods per plant, seeds per plant, 100 seed weight and yield per plant.

Analysis of variance and analysis for the parameters of variability were done environment wise separately in both the generations by conventional statistical and biometrical techniques

RESULTS AND DISCUSSION

The estimates of parameters of variability viz, mean, range genotypic, environmental and phenotypic variances, haritability, expected genetic advance and genetic advance as percentage of mean, genetic coefficient of variability and coefficient of variability for pod number, seed number, 100-seed weight and yield per plant characters are presented in Table I.

The perusal of the Table under reference reveals the results as given below:

Except 100 seed weight, there was an increase in the magnitude of mean values for the characters from F_2 to F_3 generation, but the two environments did not differ considerably for the estimates of mean value, in either of the generations.

A wide range of variability was observed for the characters under study in both the environments and generations.

For pods per plant, the estimates of genetic and phenotypic variances, heritability, G.A and G.A. as per cent of mean were invariably higher under intercropping (E_2) than under sole cropping (E_1) in both the generations. And in F_3 higher estimates of the parameters were obtained than in F_2: but heritability estimates under both the environments in F_3 were lower (11 52 and 53.60) than that of F_2 estimates (40 09 and 66 01). For the remaining three characters the two environments did not show this pattern in F_2, however, in F_3 higher estimates were recorded under F_2 than under E_1 but lower estimates of heritability were E_2 of F_3 as obtained for pods per plant. Possibly pods per plant is more susceptible to environmental changes, so the higher estimates in E_2 were obtained in F_2 itself. In comparison this to other characters has exhibited some sort of plasticity to the environmental change as they have better expression under E_2 of in F_3 instead of F_2. This is supported by a study of effect of environment on heritability and predicted selection response, in which it has been argued that (1) if genetic variation, which is latent in one environment, is exposed and utilized by selection in a second, eventually the genotype achieves expression in the first and (2) if the genotype to undergo selection is less well expressed in the environment in which it is to be utilised, its genetic advance will be more rapid when selected in one environment in which it is better expressed (Rendel and Binet, 1974). Here the latent genetic variation of E_1 has been exposed under E_2 and due to selection pressure higher estimates in F_3 than in F_2 are obtained. And for pods per plant the expression under E_2 has resulted possibly due to its more amenability to E_2.

Higher estimates of G.A. and G.A. as percentage of mean under E_2 than under E_1 are mainly due to increase in magnitude of phenotypic standard deviations and not due to heritabilities since the latter ones estimate lower under E_2 than under E_1.

In F_3, under both the environmental variance has increased upto the extent that zero estimates of genetic variance and thus, of other parameters also are recorded (the genetic variances go to minus so it is considered as zero and if we go for their estimation, higher values, than under E_1 will be obtained under E_2.)

The highest estimates of heritability were recorded for 100-seed weight in both F_2 and F_3 generations under both envirnments (in F_2-97.74% in E_1, 95.47% in E_2 and in F_3 88.45% in E_2). It was followed by the estimates for seed and pod number per plant lowest (zero) being for yield per plant in F_3 under both the environments. The highest estimate of G. A. was obtained for seed number in F_3 under E_2 (32.52) being followed by per pods per plant in F_3 under E_2 (19.91) and for seeds per plant in E_1 (18.41). G. A. as percentage of mean was the highest for 100 seed weight in F_2 under E_2 (25.69, being followed by the estimates for seeds per plant in E_2 (24.66) and 100-seed weight in F_2 under E_2 (22.67), in F_3 again for 100 seed weight under E_2 (21.18) and E_1 (17.95)

From the present investigation it is obvious that intercropping is better environment for the genetic improvement of the characters seed number, seed size pod number per plant and also yield per plant. The possible reason for which may be that under intercropping with wheat plant to plant competition in gram is reduced and the genotype gets its better expression.

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REFERENCE

RENDEL, J.M. and F.E. BINET, 1974. The effect of environment on heritability and predicted selection response : a reply. *Heredity* **35** : 106-108.

TABLE Estimates of variability Parameters in gram populations.

Characters / Parameters		Pods/plant F_2	Pods/plant F_3	Seeds/plant F_2	Seeds/plant F_3	100 seed weight F_2	100 seed weight F_3	Yield/plant F_2	Yield/plant F_3
Mean	E_1	31.53	119.50	37.91	137.1	19.29	21.38	7.15	28.88
	E_2	32.77	116.34	34.90	131.86	19.89	22.04	6.88	27.80
Range	E_1	11-105	36-302	11-110	41-433	11.19-35.20	8.76-34.20	1.74-23.94	7.67-70.36
	E_2	9-107	35-332	9-111	36.445	9.71-34.90	8.49-37.20	1.31-20.26	7.48-68.57
$\sigma^2 g$	E_1	1.78	8.58	3.86	298.80	5.92	3.92	0.31	—
	E_2	3.22	159.42	2.77	358.80	5.13	5.86	0.29	—
$\sigma^2 e$	E_1	4.66	65.31	4.66	103.80	0.14	0.51	0.18	3.88
	E_2	1.60	112.64	3.05	161.44	0.25	0.81	0.30	4.67
$\sigma^2 p$	E_1	4.44	73.89	6.69	132.96	6.05	4.43	0.49	2.67
	E_2	4.82	272.08	5.89	520.24	5.38	6.67	0.59	4.28
h^2	E_1	40.09	11.52	57.74	77.52	97.74	88.45	63.20	—
	E_2	66.01	58.60	47.64	68.97	95.47	87.84	49.15	—
G.A. (Exp.)	E_1	0.17	2.04	3.07	18.41	4.95	3.83	0.05	—
	E_2	3.028	19.91	2.36	32.52	4.50	4.67	0.89	—
G.A. as % Mean	E_1	0.48	1.70	8.09	13.43	25.69	17.95	0.72	—
	E_2	9.24	17.11	6.78	24.66	22.67	21.18	13.02	—
GCV	E_1	3.75	2.44	5.17	12.59	1.33	9.31	12.80	—
	E_2	5.47	10.85	4.74	14.36	8.14	10.98	11.36	—
CV	E_1	12.06	13.53	12.40	14.86	3.83	13.38	17.19	—
	E_2	7.72	18.25	10.00	18.40	5.02	8.17	10.76	—
SE ±	E_1	2.14	—	2.16	—	—	—	0.42	0.98
	E_2	1.26	—	1.75	—	—	—	0.55	1.08
SEd ±	E_1	—	5.73	—	7.23	0.52	1.01	—	—
	E_2	—	7.52	—	9.01	0.70	0.0639	—	—
CD5 % ±	E_1	—	11.70	—	14.76	1.17	2.06	—	—
	E_2	—	15.35	—	18.40	1.59	0.1304	—	—