

## Inbreeding depression in cowpea (*Vigna unguiculata* (L.) Walp.)

Akhilesh Kumar Pal, B. Singh\* and A.N. Maurya

Department of Horticulture, Institute of Agricultural Sciences, BHU, Varanasi – 221 005 (U.P.)

\*Indian Institute of Vegetable Research, Varanasi - 221 005 (U.P.), India

### Abstract

A study on inbreeding depression was carried out in line x tester crossing design of cowpea during *Kharif* 1999-2000 and data on 30 hybrids generated from 13 parents were analyzed for inbreeding depression in  $F_2$  generation. Significant and varying degree of inbreeding depression was observed for all the parameters under study like days to 50% flowering, days to 1<sup>st</sup> green pod picking, plant height, number of primary branches/ plant, pod length, number of pods/ peduncle, number of pods/ plant, green pod yield/ plant and 100-seed weight, indicating the presence of high degree of diversity among the parents and presence of non additive gene action. Cross combination KLS-10 x Cowpea-263 yielded more in  $F_2$  generation for green pod yield/plant, which indicated the role of fixable gene effects.

**Key words:** Cowpea, inbreeding depression, gene action

### Introduction

Cowpea (*Vigna unguiculata* (L.) Walp.) is an important vegetable, which is also used as fodder and pulse crop. Its tender green pod is highly nutritious, rich in protein, carbohydrates and vitamins, which is used as a delicious vegetable. Cowpea provides 4-5 % proteins in green pods and 25-30% in mature seeds (Bressani and Elias, 1980). It is also utilized as a quick growing cover crop (Speck *et al.*, 1965). The extent of inbreeding depression gives an idea about the productivity of a crop, thus it is imperative to know the nature and magnitude of inbreeding depressions in cowpea. Therefore, the present investigation was undertaken to study the inbreeding depression between two subspecies of cowpea *i.e.* *Vigna unguiculata* and *Vigna sesquipedalis*.

### Materials and methods

The material for the present study comprised of  $F_1$  and  $F_2$  generation derived from lines (10) x testers (3) analysis. The diverse parents namely, Sel. 2-1 ( $L_1$ ), NDCP-13 ( $L_2$ ), KLS-10 ( $L_3$ ), Sel. 2-2 ( $L_4$ ), Cowpea Local ( $L_5$ ), RCV-7 ( $L_6$ ), Black Seeded ( $L_7$ ), Kala Zamala ( $L_8$ ), Red Seeded ( $L_9$ ) and Ramnagar Kala ( $L_{10}$ ) as lines and Cowpea-263 ( $T_1$ ), Pusa Komal ( $T_2$ ), and Arka Garima ( $T_3$ ) as testers, were grown in a randomized block design with three replications at Vegetable Research Farm, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi during 1999-2000. All the parents belonged to two cultivar groups (inter specific category), *viz.*, *unguiculata* and *sesquipedalis* (Ng and Marechal, 1985).  $F_1$  and  $F_2$  were dibbled in 3.5 metre long rows at row to row distance of 60 cm and plant to plant 20 cm apart. Standard package of practices were followed to raise a good crop. The observations were recorded on 10 competitive plants in each of  $F_1$  and 40 plants in  $F_2$  for each treatment in each replication. Thirteen characters, *viz.*, days to 50% flowering, days to 1<sup>st</sup> green pod picking, plant height (cm), peduncle length

(cm), number of primary branches/plant, pods/ peduncle, number of pods/ plant, number of seeds/ pod, green pod yield/ plant (g) and 100-seed weight (g) were studied and inbreeding depression was calculated using following formula:

$$\text{Inbreeding Depression} = \frac{F_1 - F_2}{F_1} \times 100$$

### Results and discussion

The analysis of variance revealed that variance due to parents,  $F_1$ s and  $F_2$ s were highly significant indicating the presence of genetic variation among the genotype for all the characters under study. The differences among the parents vs.  $F_1$  and parents vs.  $F_2$ s were highly significant for all the characters. The character wise results related to inbreeding depression have been presented in Table 1. For days to 50% flowering significant positive and negative inbreeding depression was exhibited by one and twenty-six crosses, respectively, which ranged from -18.53 (Black Seeded x Pusa Komal) to 1.91% (Sel. 2-2 x Arka Garima). The significant positive and negative inbreeding depression for days to 1<sup>st</sup> green pod picking was also observed in one and twenty-six crosses, respectively, ranging between -16.28 (Black seeded x Pusa Komal) to 2.55 percent (Sel.2-2 x Arka Garima). The significantly positive as well as negative inbreeding depression was exhibited by twenty-six and three crosses, respectively, with minimum of -34.95 (RCV-7 x Cowpea- 263) to the maximum of 65.82 percent (KLS-10 x Cowpea-263) for plant height. The positive significant inbreeding depression was exhibited by twelve crosses, which ranged from 2.31 (Kala Zamala x Pusa Komal) to 25.53 % (Sel. 2-1 x Arka Garima) for peduncle length. Significant positive inbreeding depression for number of primary branches/ plant ranged from 2.94 (Black Seeded x Pusa Komal) to 25.70% (RCV-7 x Arka Garima). Out of thirty, seventeen cross combinations showed significant inbreeding depression, which ranged from 1.63 (RCV-7 x Pusa Komal) to 15.85% (Cowpea Local x Arka Garima) for pod length. Whereas, for pod diameter the significant

inbreeding depression ranged from 1.32 (Sel. 2-1 x Arka Garima) to 20.65% (Ramnagar Kala x Arka Garima). For number of peduncles/ plant significant positive and negative inbreeding depression was observed in twenty and three crosses, respectively, ranging from -16.23 (Black seeded x Pusa Komal) to 84.27% (NDCP- 13 x Arka Garima). Significant inbreeding depression ranging from 0.63 (Sel. 2-2 x Arka Garima) to 34.93 % (Cowpea Local x Pusa Komal) was recorded in twenty two crosses for number of pods/ peduncle. Twenty three cross combination showed significant inbreeding depression, which ranged from -3.41 (KLS-10 x Cowpea-263) to 32.75% (NDCP-13 x Arka Garima) for number of pods/ plant. The significant inbreeding depression varied from 4.37 (Cowpea Local x Arka Garima) to 25.83% (Sel. 2-2 x Arka Garima) in all the twelve crosses for number of seeds/pod. Out of thirty, twenty-seven crosses reflected significant positive which, varied from -2.94 (KLS-10 x Cowpea-263) to 33.55% (Cowpea Local x Pusa Komal) for green pod yield/plant. Significant positive inbreeding depression which ranged from -2.01 (RCV-7 x Pusa Komal) to 12.10% (Cowpea Local x Arka Garima) was noticed in six crosses for 100-seed weight.

The inbreeding depression was observed in F<sub>2</sub> generation for all the characters and its extent varied from character to character. The inbreeding depression in cowpea was also reported by Singh,

(1975); Kheradnam *et al.* (1975); Ningappa (1983), Viswnatha *et al.* (1998) and Kumar *et al.* (2000) for different characters under study. Earlier workers have used few crosses to study inbreeding depression whereas, present experiment was conducted with more number of crosses and was repeated for wider applicability and reliability. Although cowpea is a self-pollinated crop, the results revealed high degree of inbreeding depression for most of the traits. It may be due to high degree of diversity exists in the study material used which included parents from two cultivated subspecies of cowpea (*Vigna unguiculata* (L.) Walp.). Kheradnam *et al.* (1975) reported that when the values of a measured character were close for the two parental lines involved in a cross, the mean values of the subsequent generation deviated very little from the mid parents value and thus little heterosis or inbreeding depression was exhibited.

One hybrid, *i.e.*, KLS-10 x Cowpea- 263 yielded more in F<sub>2</sub> generation for green pod yield/ plant, which indicated the role of fixable gene effects. In such cross pedigree method of selection may be adopted for development of high yielding variety. Some of the crosses even exhibited negative inbreeding depression for some attributes such as plant height, number of peduncles/ plant, number of pods/ plant, number of seeds/ pod and 100 seed weight. This could be due to the appearance of large number of

**Table 1. Percent inbreeding depression in cowpea**

Crosses	DF	DPP	PH	PDL	PB	PL	PD	NPP	NP	NPP	NSP	GPY	SW
L <sub>1</sub> X T <sub>1</sub>	-0.19	-0.90	-10.46**	4.76	6.88*	8.10**	2.41**	14.61**	11.17**	11.52**	2.96	9.82**	5.84
L <sub>1</sub> X T <sub>2</sub>	-4.03**	-4.06**	30.33**	5.87	8.24*	9.98**	2.53**	10.01*	6.90**	22.16**	6.12	18.99**	6.84
L <sub>1</sub> X T <sub>3</sub>	-3.02**	-6.71**	31.53**	25.53**	15.07**	8.70**	1.32*	9.11	3.35	20.26**	21.97**	15.08**	8.00
L <sub>2</sub> X T <sub>1</sub>	-6.12**	-5.38**	10.46**	5.75	6.02	4.18	6.10**	11.00*	20.18**	7.96*	11.90*	2.27*	2.42
L <sub>2</sub> X T <sub>2</sub>	-8.32**	-3.92**	5.89**	3.92	6.13	8.28**	1.35**	19.25**	9.68**	18.95**	6.29	21.05**	3.80
L <sub>2</sub> X T <sub>3</sub>	-9.88**	-11.34**	38.58**	4.58	9.20*	7.49*	7.32**	24.27**	19.13**	32.75**	5.22	10.99**	9.33*
L <sub>3</sub> X T <sub>1</sub>	-5.15**	-8.77**	65.82**	10.16**	10.59*	5.16	7.60**	16.61**	17.41**	-3.41	25.75**	-2.94**	2.81
L <sub>3</sub> X T <sub>2</sub>	-2.60**	-3.31**	24.48**	20.74**	6.86	5.19	1.39*	12.90*	18.22**	22.68**	18.77**	3.15**	-1.19
L <sub>3</sub> X T <sub>3</sub>	-4.53**	-5.38**	48.85**	24.35**	7.54*	6.20	2.63**	0.35	14.60**	12.34**	24.79**	1.79	2.69
L <sub>4</sub> X T <sub>1</sub>	-1.11	-0.98	45.55**	4.80	5.24	6.01	7.23**	11.33*	9.09**	4.97	-1.71	15.99**	10.96*
L <sub>4</sub> X T <sub>2</sub>	-5.30**	-4.41**	33.77**	3.71	4.91	7.99*	5.80**	14.88**	10.33**	11.00**	14.36**	17.17**	3.28
L <sub>4</sub> X T <sub>3</sub>	1.91*	2.55**	58.15**	3.88	4.79	6.95*	1.43*	10.83*	0.63	3.97	25.83**	8.99**	3.46
L <sub>5</sub> X T <sub>1</sub>	-0.67	-4.63**	28.17**	3.17	17.10**	10.23**	6.17**	17.16**	28.69**	20.83*	22.08**	29.78**	2.33
L <sub>5</sub> X T <sub>2</sub>	-2.36*	-6.04**	35.56**	8.30*	19.15**	9.41**	1.49*	-11.78*	34.93**	11.29**	-1.24	33.55**	1.96
L <sub>5</sub> X T <sub>3</sub>	-2.83**	-5.45**	54.90**	10.80**	6.50	15.85**	11.96**	10.74*	13.81**	-0.34	-4.37	4.49**	12.10**
L <sub>6</sub> X T <sub>1</sub>	-9.04**	-6.71**	-34.95**	6.38	11.70**	3.74	3.70**	23.45**	13.92**	30.96**	4.07	16.75**	1.81
L <sub>6</sub> X T <sub>2</sub>	-7.45**	-5.92**	-12.92**	3.27	5.18	1.63	1.59*	18.79**	26.22**	19.17**	2.83	13.39**	-2.01
L <sub>6</sub> X T <sub>3</sub>	-1.93**	-3.69**	-3.85	9.13**	25.70**	2.72	1.47*	1.31	1.16	10.18**	24.77**	5.98**	-1.59
L <sub>7</sub> X T <sub>1</sub>	-10.34**	-8.80**	43.30**	2.41	8.16*	10.17**	3.45**	23.39**	0.98	13.53**	7.04	7.69**	1.55
L <sub>7</sub> X T <sub>2</sub>	-18.53**	-16.28**	45.83**	2.50	2.94	4.01	3.95**	-16.38**	2.78	9.32**	5.52	2.15	-1.82
L <sub>7</sub> X T <sub>3</sub>	-3.35**	-1.38	38.01**	9.19**	10.29**	4.43	3.85**	18.28**	1.41	16.13**	26.01**	6.97**	3.07
L <sub>8</sub> X T <sub>1</sub>	-10.28**	-9.06**	7.87**	3.15	10.31**	5.78	4.53**	-13.68**	14.36**	14.13**	3.01	6.60**	7.35
L <sub>8</sub> X T <sub>2</sub>	-11.02**	-5.44**	12.45**	2.31	8.83*	4.30	4.17**	12.68*	5.09**	27.35**	6.15	9.45**	7.91
L <sub>8</sub> X T <sub>3</sub>	-5.63**	-6.70**	14.28**	9.45**	17.06**	5.41	4.88**	1.34	3.61	3.99	5.51	3.76**	5.07
L <sub>9</sub> X T <sub>1</sub>	-8.33**	-5.77**	26.30**	7.77*	13.93**	6.10*	4.88**	16.14**	6.12**	20.12**	5.38	11.35**	8.12
L <sub>9</sub> X T <sub>2</sub>	-8.43**	-4.07**	17.31**	4.32	18.79**	8.03*	4.82**	10.85*	18.53**	30.16**	9.41	23.14**	8.95*
L <sub>9</sub> X T <sub>3</sub>	-8.69**	-9.09**	58.86**	8.76**	15.16**	10.23**	3.66**	7.96	6.92**	1.40	8.82	17.79**	5.66
L <sub>10</sub> X T <sub>1</sub>	-15.44**	-11.51**	21.90**	6.55	22.16**	7.53*	5.68**	9.38	7.27**	25.35**	8.45	25.33**	8.71*
L <sub>10</sub> X T <sub>2</sub>	-11.52**	-12.95**	18.48**	7.58*	2.49	11.79**	6.02**	8.03	13.37**	11.00**	9.76*	29.11**	6.35
L <sub>10</sub> X T <sub>3</sub>	-13.88**	-10.12**	40.38**	4.40	8.79*	13.25**	26.65**	12.14*	1.99	2.38	18.65**	21.15**	11.86**

DF=Days to 50% flowering, DPP= Days to 1<sup>st</sup> green pod picking, PH= Plant height (cm), PDL= Peduncle length (cm), PB= Primary branches/ plant, PL= Pod length (cm), PD= Pod diameter (cm), NPP= Number of peduncles/ plant, NP= Number of pods/ peduncle NPD= Number of pods/ plant, NSP= Number of seeds/ pod, GPY= Green pod yield/ plant (g), SW= 100 seed weight (g)

transgressive segregants in the experimental population utilized for taking observations. On the other hand, cross NDCP-13 x Arka Garima showed highly significant positive heterosis for green pod yield/plant and it also showed slight inbreeding depression in F<sub>2</sub> generation indicate the presence of non-additive gene action. These findings are in conformity with the results of Bhor *et al.* (1997) and Kumar *et al.* (2000). The inbreeding depression resulted due to fixation of unfavourable recessive genes in F<sub>2</sub> generation. In the present results high inbreeding depression indicates the presence of non-additive gene action (dominance and epistasis) for the traits under study, *e.g.* green pod yield/ plant, number of peduncles/ plant, number of pods/ plant therefore commercial hybrid production in this species seems definitely advantageous if feasible technique is developed.

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