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Inbreeding Depression for Dry Pod Yield and its Components in Chilli (*Capsicum annuum* L.)

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A study was conducted on "Inbreeding depression for dry pod yield and its components in chilli (*Capsicum annuum* L.)" at the Department of Vegetable Crops, Horticultural College and Research Institute, TNAU, Periyakulam, India during 2013-14. The investigation was carried out with six selected genotypes of chilli namely Arka Lohit, K 1, LCA 334, LCA 625, PKM 1 and Pusa Jwala. All the crosses also revealed inbreeding depression for most of the characters. These traits can be improved effectively through pedigree method of selection. In general, the crosses K 1 x PKM 1 and K 1 x Pusa Jwala were identified as promising hybrids since they depicted significant negative inbreeding depression for green and dry fruit yield and its important yield contributing characters. Low inbreeding depression for yield and yield related traits were exhibited by Pusa Jwala x PKM 1, LCA 625 x K 1 and K 1 x Arka Lohit. The segregating materials generated during this study may be utilized for the identification and selection of desirable recombinants in advanced generations in order to develop high yielding varieties with specific attributes.

Key words: Chilli, Inbreeding depression, Segregating generation, Yield

Chilli (*Capsicum annuum* L.) is an important vegetable cum spice crop grown in almost all parts of tropical and sub-tropical regions of the world (Hazra *et al*.,2011). Chilli is the first largest commodity in the international trade. India contributes one-fourth of the world production of chilli with an average annual production of 1,304,000 tonnes from an area of 7, 94,000 hectares with productivity of 1600 kg per hectare (Indian Horticulture Database, 2014). Andhra Pradesh, Karnataka, Maharashtra, Odisha and Tamil Nadu account for three fourths of the total cropped area (Rajesh Kumar *et al*., 2011). It has attained a status of high value crop in India and occupies a unique place among vegetables in Indian cuisine because of its delicate taste and pleasant flavor coupled with rich content of ascorbic acid and other vitamins and minerals. Chillies are low in sodium and cholesterol free, rich in vitamin A, vitamin C, vitamin E, a good source of potassium and folic acid (Manjula *et al*., 2011 and Sharanakumar *et al*., 2011)

In comparison to other solanaceous crops, chilli has more inherent capacity to carry hidden genetic load of recessive genes due to its partial natural out-crossing nature and with little efforts breeders can make use of it in enhancing yield (Prajapati and Agalodia, 2011). Consequently, heterosis and inbreeding depression are complementary to each other. In chilli, genetic diversity of parents is related with the performance of hybrids and its influence on the genotypes of segregating generations (Naik, 2009). Inbreeding is the basic mechanism for providing the base material for selection. The extent of inbreeding depression gives an idea about the productivity of hybrid in a crop and thus it is imperative to know the nature and magnitude of inbreeding depression in chilli.

The single cross hybrid can throw the superior transgressive progenies in segregating generations for different characters. Some of the superior segregants can yield nearer to single cross hybrids. So systematic documentation of the variability for yield in the segregating generations and later, selection of the superior plants on the basis of vigour, yield and yield related characters can lead to the development of superior inbred lines on continuous selfing for six to seven generations. If superior inbred lines having yielding potential nearer to the hybrids are identified then they can be released as a variety for commercial cultivation, which can reduce the seed cost to a great extent usually put on hybrid seeds. To enhance the export potential, producers prefer a variety which possesses higher yield, combined with quality. So by using different varieties, it is possible to get desirable segregants which may be suitable for present needs.

Kumar *et al*. (2005) studied the heterosis and inbreeding depression for yield and its components in bhendi. Low inbreeding depression was observed for number of nodes per plant, single fruit weight, fruit length, fruit yield due to additive and additive x additive genes in F_2. Negative inbreeding depression exhibited by brinjal crosses RCMB-7 x RCMA-4 for yield, RCMB-10 x RCMB-4 for plant height, RCMB-7 x RCMB-3 for fruit length and number of fruits and RCMB-4 x RCMB-1 for fruit diameter evaluated by Rai *et al.* (2007). Inbreeding depression in F_2 was variable for different crosses and traits (Kamani and Monpara,

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2009). Prajapati and Agalodia (2011) reported the inbreeding depression in three chilli crosses by using P_1, P_2, F_1, F_2, BC_1 and BC_2 population. The cross JCh- 676 x JCh-659 showed high heterosis in summer with high fertility condition and moderate to low inbreeding depression for days to flowering, plant height, secondary branches per plant, average fruit weight and green fruit yield.

Though a number of hybrids have been developed in chilli, they have not been fully exploited and adopted for commercial cultivation, in which F_1 seed cost is high. In addition to develop hybrids for commercial cultivation, study of heterosis provides information on probable gene effects and helps in sorting out F_1 s likely to yield better segregants. Whereas, the extent of inbreeding depression gives an idea about the productivity of hybrids, and also magnitude of transgressive segregants, which may be stabilized as improved inbreeds. Hence, the nature and magnitude of inbreeding depression was studied for green fruit as well as dry pod yield and 8 other characters with thirty crosses involving six parental genotypes of chilli available at Horticultural College and Research Institute, Periyakulam of Tamil Nadu

Materials and Methods

The experimental materials consists of six homozygous inbred of chilli *viz*., Arka Lohit (P_1), K 1 (P_2), LCA 334 (P_3), LCA 625 (P_4), PKM 1(P_5), and Pusa Jwala (P_6) were selected for this study and crossed in a with all possible combinations including reciprocals during kharif, 2013 (Table 1). The F_1 consisting of 15 direct crosses and 15 reciprocals were raised along with their parents in a randomized block design with three replications during November 2013 to April 2014 at the experimental farm of Department of Vegetable Crops, Horticultural College and Research Institute, Tamil Nadu Agricultural University, Periyakulam, India. In F_1, thirty plants were maintained in each replication in each hybrid combination. Observations were recorded in ten randomly selected plants. The selfed seeds from F_1 were collected and utilized for raising F_2 generation. All the F_2 were raised for further evaluation. The selections were made in the F_2 progeny on the basis of single plant fruit yield. The superior single plants were selected. The seeds from the selfed fruits were collected and stored for further evaluation. This study was carried out during May, 2014 to November, 2014. The main field was prepared to a fine tilth and FYM @ 25 t ha^{-1} was applied at the last ploughing. The ridges were formed 60 cm apart and 45 day old seedlings were planted with a plant spacing of 45 cm at the rate of one seedling per hill. Standard horticultural practices recommended for chilli (CPG, 2013) were adopted uniformly for all the plots.

Observation were recorded for plant height, branches per plant, days to 50% flowering, fruits per plant, fruit length (cm), fruit girth (cm), fresh fruit weight (g), dry pod weight (g), fresh fruit yield per plant (g) and dry pod yield per plant (g) were studied.

Statistical analysis

The mean data of all the hybrids, F_2 progenies and their parents for each character were tabulated and subjected to analysis of variance (Panse and Sukhatme, 1957).

Inbreeding depression

Inbreeding depression was measured using F_1 and F_2 mean values according to the following formula

$$\text{Inbreeding depression (per cent)} = \frac{\overline{F_1} - \overline{F_2}}{\overline{F_1}} \times 100$$

$$\text{Test of ID} = \frac{\text{Estimated value of ID}}{SE_m}$$

Where,

$$SE_m = \sqrt{V\overline{F}_1 + V\overline{F}_2}$$

$$V\ \overline{F_1} = \text{Variance of } F_1 \text{ mean}$$

$$V\ \overline{F_2} = \text{Variance of } F_2 \text{ mean}$$

Results and Discussion

Inbreeding a converse phenomenum of heterosis, is usually defined as the lowered fitness or vigour of inbred individuals compared with their non-inbred counterparts. It is the most powerful of all mating systems in all self pollinated crops to lower the percentage of heterozygosity in the population leading to fixation of alleles and thus the phenotype to the extent that is under genetic control (Allard, 1960). In quantitative genetic theory, inbreeding depression and heterosis are due to non-additive gene action, and are considered to be two aspects of the same phenomenon (Mather and Jinks, 1982). Thus, the most striking observed consequence of inbreeding is the reducing of mean phenotypic value and the phenomenum known as inbreeding depression.

The estimates of inbreeding depression in F_2 (expressed as the reduction in F_2 means from F_1 means) were worked out for all ten biometrical characters. The character wise results on inbreeding depression have been presented in the table 1. The negative and significant inbreeding depression for plant height is desirable for chilli hybrid breeding programme, which was observed in the cross Arka Lohit x LCA 625 (-19.89) suggesting selection in later generation. Low inbreeding depression for plant height was observed by Pusa Jwala x K 1 (9.13), Pusa Jwala x PKM 1 (7.76) and K 1 x Arka Lohit (2.31), it indicates the presence of additive gene action. Similar results were also obtained by Khanorkar and Karthiria (2010) and Sao and Metha (2011).

Table 1. Inbreeding depression (per cent) for yield and yield related characters in F2 generations of chilli

Hybrids	Plant height	Branches / plant	Days to 50 % flowering	Fruits/ plant	Fruit length	Fruit girth	Fresh fruit weight	Dry pod weight	Fresh fruit yield /plant	Dry pod yield/ plant
Arka Lohit x K 1	10.19	8.76*	-3.30	28.72	0.81	-1.84**	1.11**	1.25**	29.04	33.25
Arka Lohit x LCA 334	11.52	-8.12*	-3.74	20.60	-2.05	-3.32**	4.07**	-5.95**	23.87	15.53
Arka Lohit x LCA 625	-19.89*	5.78	-8.06	28.49	2.74	7.75**	11.12**	2.41**	34.16	24.85
Arka Lohit x PKM 1	22.15*	-12.80**	-3.97	28.65	4.07	-5.42**	-6.94**	1.43**	23.26	26.49
Arka Lohit x Pusa Jwala	9.16	-8.92*	-4.11	14.34	1.86	-1.94**	5.98**	7.35**	19.36	21.75
K 1x Arka Lohit	2.31	17.21**	0.15	17.83	-0.97	0.60	4.04**	3.26**	20.64	20.20
K 1 x LCA 334	10.46	-20.50**	-1.49	27.43	5.34*	2.71**	7.43**	-1.35**	32.29	29.79
K 1 x LCA 625	-2.96	-5.72	-1.47	22.21	-0.63	-5.01**	-7.66**	-4.76**	16.27	17.94
K 1 x PKM 1	11.70	-5.53	0.38	-10.96	3.52	-2.71**	-9.13**	-3.66**	-29.44	-22.22
K1 x Pusa Jwala	8.35	-6.52	1.20	-21.16	0.74	-0.96*	-3.11**	-3.61**	-15.42	-22.08
LCA 334 x Arka Lohit	-2.96	7.14*	-1.58	35.99	1.57	-2.44**	-12.90**	-2.86**	27.97	34.88
LCA 334 x K1	4.20	-3.32	-2.89	22.45	5.35*	-4.98**	12.84**	5.80**	32.91	27.18
LCA 334 x LCA 625	11.49	-3.25	-5.35	20.38	-1.20	2.48**	-1.96**	-1.52**	18.14	20.68
LCA 334 x PKM 1	4.46	-8.67*	-2.88	34.01	5.70**	13.04**	-2.45**	4.29**	30.83	38.06**
LCA 334 x Pusa Jwala	1.39	-5.71	-6.42	25.24	-2.45	3.02**	5.06**	3.77**	28.59	31.02*
LCA 625 x Arka Lohit	-8.24	-9.50*	-5.97	18.18	8.43**	-8.77**	-1.57**	-2.63**	11.91	21.09
LCA 625 x K 1	11.45	30.47**	-4.41	18.82	3.49	1.92**	6.61**	-1.14**	24.11	20.44
LCA 625 x LCA 334	16.79	-1.61	-5.33	18.70	5.22**	-3.00**	17.63**	2.99**	22.25	20.38
LCA 625 x PKM 1	7.40	3.29	-8.38	25.94	-0.65	2.35**	7.47**	3.80**	23.56	34.58
LCA 625 x Pusa Jwala	1.53	-10.24**	-3.44	20.29	7.89**	-3.43**	9.64**	2.78**	31.99	33.30*
PKM 1 x Arka Lohit	-0.69	-3.57	-7.94	25.17	2.75	11.81**	3.29**	3.33**	27.39	39.06*
PKM 1 x K1	-0.68	-19.17**	-3.33	20.17	3.15	-3.04**	-10.13**	-10.81**	11.86	25.77
PKM 1x LCA 335	2.28	-4.62	-5.16	29.26	9.68**	21.87**	5.14**	6.35**	31.10	44.76**
PKM 1 x LCA 625	7.69	-7.60	-5.31	21.30	8.38**	-2.47**	1.30	3.61**	22.18	29.68
PKM 1x Pusa Jwala	-1.34	-12.00**	-6.05	30.61	5.49**	-2.38**	-3.59**	-2.56**	33.85	41.23*
Pusa Jwala x Arka Lohit	7.10	4.01	-7.19	-1.96	8.03**	20.97**	5.39**	-1.61**	3.30	16.77
Pusa Jwala x K 1	9.13	11.59**	-5.03	21.78	11.09**	-2.39**	-4.58**	-5.88**	17.79	24.59
Pusa Jwala x LCA 334	16.95	3.55	-7.91	30.36	10.12**	13.34**	13.47**	3.85**	43.97	41.57**
Pusa Jwala x LCA 625	7.21	-22.25**	-7.07	36.14	1.53	6.08**	6.67**	2.74**	39.44	38.40**
Pusa Jwala x PKM 1	7.76	2.95	-4.29	14.29	1.76	-1.20**	0.43	-2.27**	14.41	18.16

Branches per plant are an important yield component in chilli. In the present study, the range of inbreeding depression was from - 22.25 to 30.47 per cent showing significant difference between F_1s and F_2s. Negative and significant inbreeding depression for number of branches per plant indicated the role of fixable gene effects. In such crosses, pedigree method of selection may be adopted for development of higher number of branches. Significant low inbreeding depression was exhibited by the hybrids Pusa Jwala x PKM 1 (2.95) and K 1 x Arka Lohit (17.21) for branches per plant due to additive gene effect. Prajapati and Agalodia (2011) in chilli reported non additive gene action for primary and secondary branches per plant.

The positive inbreeding depression was found for days to 50 per cent flowering in K 1 x Arka Lohit (0.15), K 1 x PKM 1(0.38) and K 1 x Pusa Jwala (1.20). It predicts better chance to obtain desirable segregants for earliness in the subsequent filial generations of these crosses. On the contrary, the negative inbreeding depression, which is undesirable for chilli breeding programme, was also found in the present study. Negative inbreeding depression indicated that F_1s were earlier in maturity than F_2s. Prajapati and Agalodia (2011) also cited positive inbreeding depression for days to 50 per cent flowering in chilli.

The negative inbreeding depression that is useful for chilli crop improvement programme was observed for fruits per plant in the crosses K 1 x PKM 1 (-10.96), K 1 x Pusa Jwala (-21.16) and Pusa Jwala x Arka Lohit (-1.96). The negative inbreeding depression which could be due to the appearance of large number of transgressive segregants in above said crosses, such crosses is expected to give superior segregants which may be handled through pedigree method. The crosses *viz*., LCA 625 x K 1 (18.82), Pusa Jwala x PKM 1 (14.29) and K 1 x Arka Lohit (17.83) exhibited low inbreeding depression for fruits per plant, revealing involvement of additive genes and these crosses may be considered as the promising crosses. The desirable inbreeding depression that is negative and low in direction was also cited for fruits per plant by Kalpande *et al.* (2009); Singh *et al.* (2009).

For fruit length, among the 30 hybrids, 12 hybrids exhibited significant inbreeding depression showing non additive gene action in this character. However, six hybrids showed negative inbreeding depression due to fixation of genes in F_2 showing additive gene action. The crosses, K 1 x PKM 1 (3.52) and PKM 1 x K 1 (3.15) showing significant low inbreeding depression, may be utilized for improvement of fruit length through selection. Based on the results, it may seem fruit length was to be governed by non additive gene effects.

The significant inbreeding depression was observed in 12 hybrids for fruit girth. Inbreeding depression suggested the importance of non-additive genes in controlling this phenomenum. Among the 22 hybrids, 17 hybrids showed negative inbreeding depression.The best performing hybrids for fruit girth based on negative inbreeding values were LCA 625 x Arka Lohit (-8.77), Arka Lohit x PKM 1 (-5.42) and K 1 x LCA 625 (-5.01) indicating the predominance of additive gene action. Low inbreeding depression was recorded in the K 1 x Arka Lohit (0.60). These results are in accordance with the findings of Rai *et al.* (2007); Prajapati and Agalodia (2011).

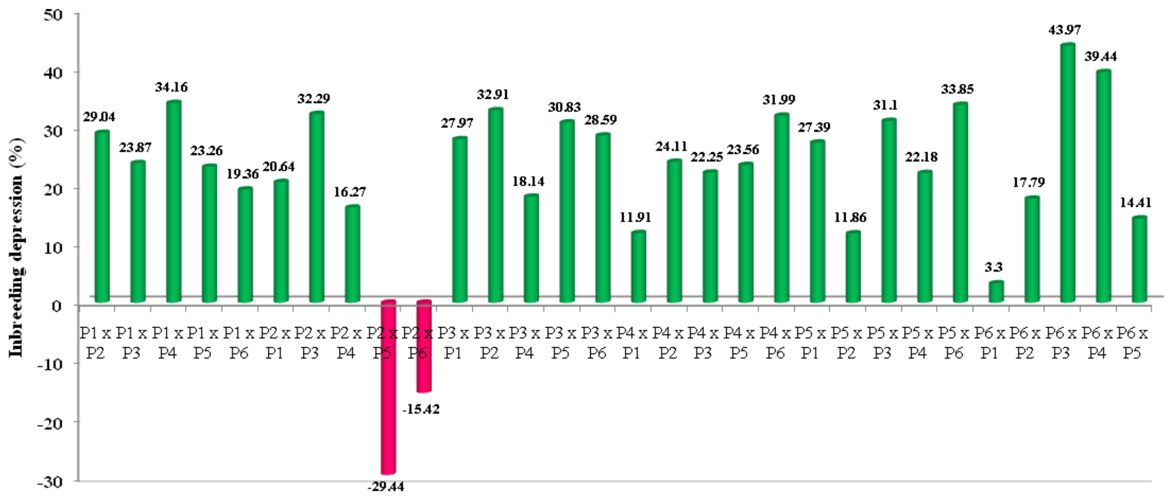

Fig. 1. Inbreeding depression (per cent) for fresh fruit yield per plant

Among the 30 hybrids, 11 hybrids showed significant negative inbreeding depression for individual fresh fruit weight. The hybrids LCA 334 x Arka Lohit (-12.90), PKM 1 x K 1 (-4.58) and K 1 x PKM 1(-9.13) were the high performing hybrids based on negative inbreeding values for fresh fruit weight. The low inbreeding depression was shown by the hybrids K 1 x Arka Lohit (4.04) and Pusa Jwala x PKM 1(0.43). The results showed that in F_2 even after inbreeding depression, some promising segregants exhibited good performance and positive selection in such crosses can lead to further improvement. Based on the present experiment this trait may be governed by both additive and non-additive gene action. The results of the present experiment are in conformity with the findings of Pandey and Dixit (2001); Kumar *et al*. (2005); Prajapati and Agalodia (2011).

Considering individual dry pod weight, both positive and negative inbreeding depression values were recorded. Out of 30 hybrids, 16 hybrids showed significant inbreeding depression. It was due to significant reduction in pods weight in F_2 generation. The results indicated the predominance of non-additive gene action. Fourteen hybrids showed negative inbreeding depression and the hybrids PKM 1 x K 1 (-10.81), Arka Lohit x LCA 334 (-5.95) and Pusa Jwala x K 1 (-5.88) were the best performing hybrids based on negative inbreeding values and this cross showed additive gene action for this trait. These investigations on dry pod weight were similar to the reports of Prajapati and Agalodia (2011).

Both positive and negative inbreeding depressions were found in fresh fruit yield and dry pod yield per plant. Two hybrids *viz*., K 1 x PKM 1 (-29.44%) and K 1 x Pusa Jwala (-15.42%) yielded more in F_2 generation for fresh fruit yield (Fig.1), which indicated the role of fixable gene effects. The best performing hybrids based on low inbreeding were K 1 x Arka Lohit (20.64%), LCA 625 x K 1 (24.11%) and Pusa Jwala x PKM 1 (14.41%). In such crosses, pedigree method of selection may be adopted for the development of high yielding varieties. The result in F_2 generation provides good ground for further study in segregating generations. It is suggested that yield of the F_1 did not predict the yield of the bulks in the advanced generations and the combined performance of the hybrids in the F_1 and F_2 generation could be a good indicator to identify the most promising populations to be utilized either as F_2 hybrids or as a source population for further selection in advanced generations. These results are in accordance with the outcome of Singh *et al*., (2009); Sao and Metha (2011); Prajapati and Agalodia (2011).

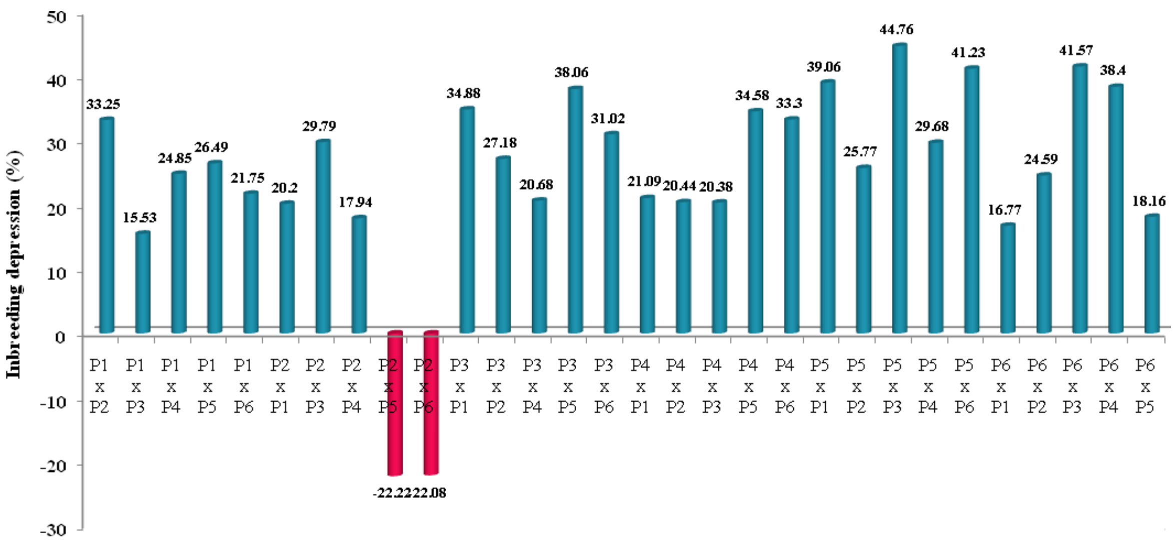

Fig. 2. Inbreeding depression (per cent) for dry pod yield per plant

The negative inbreeding depression could be useful for chilli crop improvement. Pandey (1998) also showed that some of the hybrids exhibited negative inbreeding depression in F_2 generation. This could be due to appearance of large number of transgressive segregants in the experimental population utilized for taking observations. The desirable inbreeding depression that is negative in direction was observed in K 1 x PKM 1 (-22.22%) and K 1 x Pusa Jwala (-22.08%) for yield and yield contributing characters Fig 2. It is desirable to have high, significant and positive heterosis with low inbreeding depression for fresh fruit and dry pod yield and its components. This is equally applicable to developmental traits. Significant low inbreeding depression for yield and yield related traits were exhibited by Pusa Jwala x PKM 1 (18.16%), LCA 625 x K 1(20.44%) and K 1 x Arka Lohit (20.20%). The segregating materials generated during this study may be utilized for the identification and selection of desirable recombinants in advanced generations in order to develop high yielding varieties with specific attributes.

Inbreeding depression was observed in F_2 generations for all the characters indicating that its extent varied among the characters (Table 2). The crosses PKM 1 x LCA 334 and Pusa Jwala x LCA 334 with high inbreeding depression in F_2 generation indicated the presence of non additive gene action (dominance and epistasis) for most of the yield related traits in the present study. Therefore these crosses can be utilized in heterosis breeding programme. Dominance is directional towards greater vigour and luxuriance, but in the absence of such a directional dominance effects, the loss of vigour and inbreeding is a natural consequence. Some degree of dominance is a common attributes of allele by which change in heterozygosity from inbreeding would affect the level of performance. Thus larger frequency of dominant alleles causes greater inbreeding depression. The incorporated character favors an increase of plant number per area, reducing the change of natural self-pollinations during seed maintenance and multiplication phases. This may be the reason for inbreedin.g depression in this population. The traits *viz*., fruits per plant and fruit yield per plant may be considered to be most important in chilli crop. The negative inbreeding depression could be useful for chilli crop improvement.

Table 2. Best performing F_2 progenies based on positive, negative inbreeding depression

Traits	Best performing hybrids		
	Positive inbreeding depression	Negative inbreeding depression	Low inbreeding depression
Plant height	Arka Lohit x PKM 1 Pusa Jwala x LCA 334 LCA 625 x LCA 334	Arka Lohit x LCA 625	Pusa Jwala x K1 Pusa Jwala x PKM 1 K 1 x Arka Lohit
Branches per plant	LCA 625 x K1 K 1 x Arka Lohit Pusa Jwala x K 1	Pusa Jwala x LCA 625 K 1x LCA 334 PKM 1 x K 1	Pusa Jwala x PKM 1 K 1 x Arka Lohit
Days to 50 per cent flowering	K 1 x Arka Lohit K 1 x PKM 1 K 1 x Pusa Jwala	LCA 625 x PKM1 Arka Lohit x LCA 625 Pusa Jwala x LCA 625	-
Fruits per plant	Pusa Jwala x LCA 625 LCA 334 x Arka Lohit LCA 334 x PKM 1	K 1 x PKM 1 K 1 x Pusa Jwala Pusa Jwala x Arka Lohit	LCA 625 x K 1 Pusa Jwala x PKM 1 K 1 x Arka Lohit
Fruit length	Pusa Jwala x K 1 Pusa Jwala x LCA 334 PKM 1 x LCA 334	Arka Lohit x LCA 334 K1 x Arka Lohit K1 x LCA 625	K 1 x PKM 1 PKM 1x K 1
Fruit girth	PKM 1 x LCA 334 Pusa Jwala x Arka Lohit Pusa Jwala x LCA 334	LCA 625 x Arka Lohit Arka Lohit x PKM1 K1 x LCA 625	K 1 x Arka Lohit
Individual fresh fruit weight	LCA 625 x LCA 334 Pusa Jwala x LCA 334 LCA 334 x K 1	LCA 334 x Arka Lohit PKM 1x K 1 K 1 x PKM 1	K 1 x Arka Lohit Pusa Jwala x PKM 1
Individual dry pod weight	Arka Lohit x Pusa Jwala PKM1 x LCA 334 LCA 334 x K 1	PKM 1x K 1 Arka Lohit x LCA 334 Pusa Jwala x K1	-
Fresh fruit yield per plant	Pusa Jwala x LCA 334 Pusa Jwala x LCA 625 Arka Lohit x LCA 625	K 1 x PKM 1 K 1 x Pusa Jwala	K 1 x Arka Lohit LCA 625 x K 1 Pusa Jwala x PKM 1
Dry pod yield per plant	PKM 1 x LCA 334 Pusa Jwala x LCA 334 PKM1 x Pusa Jwala	K 1 x PKM 1 K 1 x Pusa Jwala	LCA 625 x K 1 K 1 x Arka Lohit Pusa Jwala x PKM 1

Pandey and Dixit (2001) also showed that some of the hybrids exhibited negative inbreeding depression in F_2 generation. This could be due to appearance of large number of transgressive segregants in the experimental population utilized for taking observations. The desirable inbreeding depression that is negative in direction (Table 2) was observed in K 1 x PKM 1 and K 1 x Pusa Jwala for yield and yield contributing characters. It is desirable to have low inbreeding depression for fresh fruit and dry pod yield and its components. Low inbreeding depression for yield and yield related traits were exhibited by Pusa Jwala x PKM 1, LCA 625 x K 1 and K 1 x Arka Lohit. The segregating materials generated during this study may be utilized for the identification and selection of desirable recombinants in advanced generations in order to develop high yielding varieties with specific attributes.

Conclusion

F_2 populations of the hybrids K 1 x PKM 1, K 1 x Pusa Jwala and LCA 625 x K 1 are regarded as the potential populations for achieving higher fruit yield per plant. The populations K 1 x Arka Lohit and Pusa Jwala x PKM 1 recorded high fruit girth and dry pod weight indicating its suitability for commercial utilization. The high yielding segregants obtained in the F_2 population of the hybrids, K 1 x PKM 1, K 1 x Pusa Jwala, LCA 625 x K1, K 1 x Arka Lohit and Pusa Jwala x PKM 1 should be studied further to isolate the desirable segregants.

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