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# HETEROSIS IN CHILLI (*CAPSICUM ANNUM* L.) USING CYTOPLASMIC MALE STERILE LINES

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**ABSTRACT**

The present experiment in chilli (*Capsicum annum* L.) was carried out to measure heterosis over better parent and standard check. The experimental material includes 5 CMS lines and six male line. The 30 $F_1$ along with parents and one standard check were evaluated at Dapoli, Karjat and Mulde locations. Three hybrids viz., AVPP0711S x BC-28, AVPP0709S x BC-28 and AVPPOS17S x DPLC-1 were found to be outstanding in respect of net plot yield of fresh fruits and important yield contributing traits over environments. Out of 30 hybrids evaluated 5 promising hybrids were identified which were found superior than their respective better parent and standard check Sitara for net plot yield. The superior quality of these hybrids were observed due to higher values of their yield contributing characters like plant height, fruit length, number of fruits per plant, fresh weight per fruit and fresh weight of fruits per plant.

***Keywords*** **:** Hybrid, yield, standard check.

## Introduction

Chilli (*Capsicum annuum* L.) vegetable-cum-spice is one of the most important commercial solanacious crops of India. Chillies have been categorised as self-pollinated crop, however the extent of cross pollination in chillies varies from 2-96% which may cause change in the genetic uniqueness of the land races (Votava *et al.,* 2005). India contributes about 25 per cent to total world production and remained in first position in terms of international trade by exporting 20 per cent from its total production.

Due to an abundance of better varieties, India is the world's greatest producer of chillies. The use of hybrid seed in India is restricted, and the cultivation of hybrid cultivars can only be successful if sufficient amounts of hybrid seed are supplied at a competitive price. The hybrid seed production in chili required manual emasculation and pollination. Due to delicate nature of chilli flower flower droping and poor fruit set after emasculation is problem. The only way to lower the cost of seed production is to develop a male sterility system, as is done with other vegetables.

One of the most crucial methods in vegetable breeding now involves taking advantage of hybrid vigour to boost production. Although the heterosis has been used economically in a number of vegetable crops, there are very few commercial hybrids of chilli. Crossed chilli fruit produce a lot of viable seeds and a lot of outcrossing, which makes it easier to create commercial hybrids. With the help of heterosis breeding, chilli can be greatly improved. Only heterosis breeding, which is achievable in this crop, can help accomplish the necessary goals of productivity increase in the shortest amount of time. (Joshi and Singh, 1980).

## Material and Methods

The five CMS lines viz. AVPP0711S, AVPP0517S, AVPP0709S, AVPP0309S and AVPP0310S collected from Asian Vegetable Research and development centre, Taiwan were crossed with six

genotypes of chilli viz. Pusa jwala, ACSS-9818, DPLC-1, DPLC-2, DPLC-5 and BC-28 from Department of Agril. Botany, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Dist. Ratnagiri (M.S.). Thirty hybrids along with eleven parents and standard check (Sitara) were evaluated in randomized block design with two replications at Research Farm, Dept. of Agril. Botany, COA, Dapoli, Dist. Ratnagiri (M.S.), Regional Agricultural Research Station, Karjat, Dist. Raigad. (M.S.) and College of Horticulture, Mulde. Dist. Sindhudurg. (M.S.). The observations were recorded on five randomly selected plants for thirteen yield and yield contributing characters viz. Days to 50 per cent flowering , Days to first fruit ripening, Plant height (cm) , Number of fruits per plant , Fresh weight per fruit (g) ,Fruit length (cm) , 1000 seed weight (g) , Number of seeds per fruit, Dry weight per fruit (g) , Dry weight of fruits per plant (g) , Fresh weight of fruits per plant (g) , Net plot yield of fresh fruits (g) , Capsaicin content (%).The mean values of five plants were used in statistical analysis. Standard heterosis and heterobeltiosis was calculated for various characters as per the procedure given by Shall (1914).

## Result and Discussion

Pooled analysis of variance for experimental design showed significant differences among 3 locations for all the characters studied (Table 1). All characters recorded nonsignificant differences for replications within location. The differences among the parents were observed to be significant for all the characters except plant height and among the hybrids were observed to be significant for all the characters studied. The differences among the parents vs. hybrids were recorded to be significant for all the characters studied. Partitioning of genotypes into lines, testers and lines x testers revealed that the variance differences among lines were observed to be significant for all the characters except Plant height and testers were observed to be significant for all the characters except days to 1st fruit ripening. The effects due to lines x testers were non-significant for 50% flowering, days to 1st fruit ripening and dry weight per fruit. (Parents Vs Hybrids) x Locations were non-significant for days to first fruit ripening, plant height, no. of seeds per fruit, fresh wt. of fruit per plant, net plot yield of fresh fruit, capsaicin content. Significant variances for parents × locations interaction were no. of fruits per plant, fresh weight per fruit, dry weight of fruit per plant, net plot yield of fresh fruit. The effects due to hybrids × locations were non-significant for plant height, number of fruits per plant, number of seeds per fruit, net plot yield of fresh fruit and capsaicin content. Further partitioning of hybrids × locations indicated that the interaction of lines × locations and testers × locations non-significant for all the characters except number of fruits per plant, dry weight of fruits per plant, net plot yield of fresh fruit while testers × locations were significant for fresh weight of fruit per plant and lines × locations for fresh weight per fruit. Interaction effects of Lines Vs Testers x location were non-significant for all the characters except fresh weight per fruit, dry weight of fruit per plant, net plot yield of fresh fruit, dry weight per fruit.

Based on the mean performance of the parents and hybrids for different characters shown in table no. 2 indicated that none of the female, male and hybrid showed consistent high performance for all the characters. Based on yield as well as its other contributing characters VI060630B, VI060627B and BC-28 and DPLC-1 (male) were the most productive parents. Among the hybrids AVPP0711S X BC-28 followed by AVPP0709S X BC-28, AVPP0517S X DPLC-1, AVPP0711S X Pusa jwala and AVPP0709S X DPLC-1 appeared the most promising.

The range of heterotic cross over better parent and standard check and number of desirable significant heterotic crosses based on standard check for 13 traits are presented in table number 3.

The heterotic effect in negative direction is desirable for days to 50 % flowering and days to 1st fruit ripening. Hybrid AVPP0301S X DPLC 1 (-9.25%) and AVPP0309S X Pusa Jwala (-6.23%) respectively exhibited significant and highest negative heterobeltosis for the character days to 50 % flowering and days to 1st fruit ripening. Hybrid AVPP0309S X Pusa Jwala show significant and highest negative standard heterosis for the character days to 50 % flowering (-13.21%) and days to 1st fruit ripening (-7.31). Negative heterosis for days to 50 % flowering and days to 1st fruit ripening were recorded by Bhalekar *et. al* (2009).

Hybrid AVPP0711S X DPLC 1 shown significant and highest positive heterobeltosis (67%) and standard heterosis (41.24%) for the character plant height. Positive heterosis for plant height was reported by Kambale *et al.* (2009).

Hybrid AVPP0709S X DPLC 2 recorded significant positive heterosis over better parent (115.32%) and hybrid AVPP0517S X DPLC 1 recorded significant positive heterosis (197.71%) over standard check for character number of fruits per plant (Green). Similar results were reported by Burli *et al.* (2001).

AVPP0711S X BC-28 recorded significant positive heterosis over better parent and standard check

for character fresh weight per fruit (173.63% , 30.95%), fruit length (30.48%, -7.19%) and capsaicin content (56%, 83.83%). For the character fresh weight per fruit Ahmed and Hurra (2000), Fruit length Reddy *et al.* (2002) and capsaicin content Kumar *et al.* (2004 b) recorded significant positive heterosis.

For the character 1000 seed weight hybrid AVPP0517S X DPLC 4 recorded 57.25% and 149.75% significant positive heterobeltosis and standard heterosis respectively.

AVPP0309SX Pusa Jwala (89.65%) and AVPP0517S X ACSS9818 (49.33%) recorded significant and highest positive heterobeltosis and standard heterosis respectively for the character number of seeds per fruit. Similar results were reported by Mishra *et al* (1988).

For the character dry weight per fruit AVPP0517S X DPLC 1 and AVPP0711S X DPLC 4 recorded significant and highest positive heterobeltosis (91.21%) and standard heterosis (20.83%) and hybrid AVPP0709S X BC 28 recorded heterobeltosis (230%) and standard heterosis (350.18%) for the character dry weight of fruit per plant. Temburne and Rao (2012 b) reported similar results for these characters.

For the character fresh weight of fruit per plant and Net plot yield of fresh fruit Hybrid AVPP0309S X ACSS9818 recorded significant positive heterosis over better parent (138.83%, 138.54%) respectively and hybrid AVPP0711S X BC 28 recorded significant positive heterosis over standard check (54.95%) and (110.21%) respectively. Joshi (1986) reported significant positive heterosis for these characters.

## Conclusion

From the above result it is clear that hybrid AVPP0711S X BC 28, AVPP0709S X BC 28, AVPP0517S X DPLC 1, AVPP0711S X Pusa Jwala and AVPP0709S X DPLC 1 having high mean and high heterosis over better parent and standard check for net plot yield of fresh fruit and its related traits and hence in future it can be exploited in practical plant breeding.

**Table 1 :** Analysis of variance for thirteen characters.

| Source of Variance | d.f. | Days to 50% flowering | Days to 1st fruit ripening | Plant height (cm) | Fruit length (cm) | No. of fruits per plant (Green) | No. of seeds per fruit | 1000 seed weight (g) |
|---|---|---|---|---|---|---|---|---|
| Replication within location | 3 | 1.162 | 2.820 | 35.245 | 0.554 | 65.272 | 9.49 | 0.129 |
| Locations | 2 | 448.461** | 354.850** | 554.310** | 34.750** | 12106.36** | 1898.36** | 69.540** |
| Parents | 10 | 18.151** | 16.260** | 416.810 | 16.137** | 16238.59** | 1029.94** | 18.970** |
| Females | 4 | 27.862** | 29.210** | 123.520 | 2.158** | 30573.83** | 1336.19** | 32.650** |
| Males | 5 | 11.789** | 8.970 | 466.657** | 14.763** | 5651.34** | 839.67** | 10.350** |
| Females Vs. Males | 1 | 11.122 | 0.890 | 1340.782** | 78.920** | 11833.83** | 756.28** | 7.300** |
| Hybrids | 29 | 35.166** | 32.338** | 1023.010** | 8.397** | 9608.02** | 913.68** | 30.230** |
| Parents Vs. Hybrids | 1 | 128.706** | 199.760** | 2405.797** | 49.942** | 3505.87** | 369.54** | 16.320** |
| Parents ×Locations | 20 | 1.947 | 3.821 | 2.825 | 0.305 | 830.99** | 3.95 | 0.354 |
| Females ×Locations | 8 | 0.615 | 3.616 | 3.097 | 0.148 | 1694.23** | 3.39 | 0.073 |
| Males ×. Locations | 10 | 2.571 | 4.256 | 3.041 | 0.478 | 289.47* | 4.78 | 0.589 |
| Females Vs. Male × Locations | 2 | 4.159 | 2.456 | 0.6595 | 0.067 | 85.63 | 2.04 | 0.298 |
| Hybrid × Locations | 58 | 8.473** | 9.373* | 49.226 | 2.415** | 127.109 | 12.94 | 2.880** |
| Parents Vs. Hybrids × Locations | 2 | 14.225** | 11.234 | 30.064 | 5.549** | 960.06** | 4.76 | 8.230** |
| Pooled error | 120 | 3.321 | 6.024 | 59.067 | 0.393 | 127.62 | 11.83 | 0.986 |

| Source of Variance | d.f. | Fresh wt. per fruit (g) | Fresh wt of fruit per plant (g) | Dry wt of fruit per plant (g) | Net Plot yield of fresh fruits (kg) | Capsaicin content (%) | Dry wt. per fruit (g) |
|---|---|---|---|---|---|---|---|
| Replication within location | 3 | 0.004 | 489.59 | 5.555 | 1278865.90 | 0.00049 | 0.0019 |
| Locations | 2 | 0.852** | 16623.111** | 999.65** | 11687422.61** | 0.02939** | 1.213** |
| Parents | 10 | 1.414** | 78433.54** | 543.09** | 26748296.61** | 0.04595** | 0.324** |
| Females | 4 | 1.116** | 91225.15** | 827.09** | 26634416.26** | 0.06473** | 0.471** |
| Males | 5 | 1.571** | 67788.70** | 418.76** | 27758007.90** | 0.01006** | 0.267** |
| Females Vs. Males | 1 | 1.816** | 80491.27** | 28.778** | 22155261.58** | 0.15021** | 0.024 |
| Hybrids | 29 | 3.366** | 77598.55** | 1561.93** | 38152496.30** | 0.02451** | 0.383** |
| Parents Vs. Hybrids | 1 | 14.734** | 125657.84** | 874.23** | 51935486.81** | 0.04434** | 0.697** |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Parents ×Locations | 20 | 0.659** | 1808.59 | 64.533** | 1459989.69** | 0.00006 | 0.010 |
| Females ×Locations | 8 | 1.491** | 393.731 | 35.883** | 1355724.10** | 0.00013 | 0.005 |
| Males ×. Locations | 10 | 0.012 | 3161.84* | 41.74** | 1211564.51** | 0.00002 | 0.009 |
| Females Vs. Male × Locations | 2 | 0.572** | 701.82 | 293.058** | 3119177.97** | 0.00005 | 0.030* |
| Hybrid × Locations | 58 | 0.150** | 5294.34** | 65.192** | 277345.41 | 0.00029 | 0.018** |
| Parents Vs. Hybrids × Locations | 2 | 0.794** | 2198.42 | 79.96** | 579565.44 | 0.00037 | 0.072** |
| Pooled error | 120 | 0.043 | 1422.67 | 5.93 | 493183.16 | 0.00192 | 0.006 |

*,** significant at 5 and 1 % level.

**Table 2 :** Mean performance of parents and hybrids for various characters in chilli (pooled over environments)

| Cross Combinations | Days to 50% flowering | Days to 1st fruit ripening | Plant height (cm) | Fruit length (cm) | No. of fruits per plant (Green) | No. of seeds per fruit | 1000 seed weight (g) |
|---|---|---|---|---|---|---|---|
| **Females** | | | | | | | |
| AVPP0309B | 80.68 | 110.50 | 42.71 | 6.40 | 82.60 | 25.91 | 2.58 |
| VI060629B | 86.50 | 116.00 | 49.13 | 7.10 | 149.85 | 50.53 | 7.47 |
| VI060632B | 85.08 | 115.16 | 53.80 | 6.43 | 142.31 | 11.15 | 8.49 |
| VI060627B | 83.73 | 115.41 | 52.21 | 5.85 | 66.78 | 25.11 | 6.03 |
| VI060630B | 84.31 | 113.83 | 53.06 | 7.35 | 247.92 | 38.58 | 7.65 |
| **Mean** | 84.06 | 114.18 | 50.18 | 6.63 | 137.89 | 30.26 | 6.44 |
| **Males** | | | | | | | |
| Pusa Jwala | 83.96 | 115.00 | 64.34 | 4.70 | 96.50 | 22.00 | 3.67 |
| ACSS 9818 | 85.08 | 115.16 | 41.35 | 5.15 | 108.93 | 47.21 | 4.72 |
| DPLC-4 | 83.08 | 113.25 | 63.33 | 1.45 | 97.33 | 31.33 | 6.37 |
| BC-28 | 82.65 | 112.16 | 62.21 | 4.10 | 151.55 | 53.83 | 7.15 |
| DPLC-1 | 81.00 | 113.28 | 61.41 | 5.70 | 141.98 | 38.26 | 6.13 |
| DPLC-2 | 84.25 | 114.83 | 62.77 | 5.48 | 69.72 | 29.00 | 6.62 |
| **Mean** | 83.34 | 113.95 | 59.24 | 4.43 | 111.00 | 36.94 | 5.78 |
| **Parental Mean** | 83.70 | 114.06 | 54.71 | 5.53 | 124.45 | 33.60 | 6.11 |
| **Crosses** | | | | | | | |
| AVPP0309S X Pusa Jwala | 77.50 | 107.83 | 48.15 | 6.15 | 129.36 | 49.10 | 4.61 |
| AVPP0309S X ACSS 9818 | 79.00 | 109.58 | 48.55 | 6.30 | 176.88 | 34.83 | 4.88 |
| AVPP0309S X DPLC-4 | 82.16 | 111.91 | 42.38 | 5.60 | 137.45 | 44.13 | 6.42 |
| AVPP0309S X BC-28 | 81.83 | 111.16 | 60.30 | 7.37 | 106.91 | 13.16 | 6.26 |
| AVPP0309S X DPLC-1 | 81.15 | 111.66 | 53.21 | 5.60 | 130.05 | 56.23 | 4.85 |
| AVPP0309S X DPLC-2 | 81.91 | 111.58 | 53.00 | 5.44 | 48.90 | 41.60 | 7.12 |
| AVPP0310S X Pusa Jwala | 81.75 | 111.00 | 52.80 | 6.21 | 60.68 | 35.71 | 4.95 |
| AVPP0310S X ACSS 9818 | 82.08 | 112.33 | 58.58 | 6.03 | 128.46 | 47.50 | 5.51 |
| AVPP0310S X DPLC-4 | 83.75 | 114.41 | 67.85 | 4.50 | 127.75 | 56.78 | 6.26 |
| AVPP0310S X BC-28 | 81.16 | 110.83 | 59.73 | 4.75 | 84.45 | 23.88 | 5.89 |
| AVPP0310S X DPLC-1 | 78.50 | 110.33 | 58.68 | 5.18 | 113.35 | 40.08 | 4.99 |
| AVPP0310S X DPLC-2 | 82.08 | 112.33 | 63.51 | 5.90 | 172.48 | 44.90 | 3.23 |
| AVPP0517S X Pusa Jwala | 80.50 | 110.58 | 71.35 | 6.16 | 55.33 | 31.16 | 7.86 |
| AVPP0517S X ACSS 9818 | 80.58 | 110.58 | 66.00 | 4.98 | 145.11 | 57.41 | 6.02 |
| AVPP0517S X DPLC-4 | 85.41 | 115.41 | 60.94 | 5.90 | 69.28 | 29.16 | 13.35 |
| AVPP0517S X BC-28 | 81.66 | 113.00 | 65.35 | 6.75 | 47.15 | 15.88 | 9.18 |
| AVPP0517S X DPLC-1 | 80.91 | 110.66 | 61.83 | 6.38 | 181.36 | 33.61 | 9.47 |
| AVPP0517S X DPLC-2 | 81.83 | 113.16 | 57.28 | 7.35 | 85.91 | 43.76 | 6.58 |
| AVPP0709S X Pusa Jwala | 84.26 | 114.00 | 67.41 | 5.21 | 127.90 | 23.88 | 9.06 |
| AVPP0709S X ACSS 9818 | 82.90 | 112.91 | 42.81 | 6.28 | 103.63 | 26.45 | 7.69 |
| AVPP0709S X DPLC-4 | 89.50 | 118.00 | 52.03 | 5.70 | 115.35 | 28.45 | 9.36 |
| AVPP0709S X BC-28 | 78.58 | 108.41 | 68.91 | 7.56 | 133.63 | 22.31 | 10.63 |
| AVPP0709S X DPLC-1 | 83.50 | 113.41 | 57.00 | 7.33 | 175.98 | 49.28 | 5.71 |
| AVPP0709S X DPLC-2 | 81.18 | 110.00 | 79.01 | 6.38 | 150.13 | 20.50 | 5.35 |
| AVPP0711S X Pusa Jwala | 79.66 | 109.91 | 73.08 | 7.16 | 149.90 | 40.48 | 7.19 |
| AVPP0711S X ACSS 9818 | 80.41 | 109.50 | 50.11 | 6.61 | 140.29 | 42.40 | 2.17 |
| AVPP0711S X DPLC-4 | 86.50 | 117.25 | 80.56 | 8.17 | 89.31 | 55.48 | 6.96 |

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|---|---|---|---|---|---|---|---|
| AVPP0711S X BC-28 | 82.16 | 112.41 | 86.31 | 9.59 | 85.15 | 33.93 | 5.48 |
| AVPP0711S X DPLC-1 | 83.03 | 112.91 | 102.56 | 8.20 | 49.65 | 28.32 | 6.703 |
| AVPP0711S X DPLC-2 | 83.65 | 113.50 | 56.06 | 8.53 | 119.35 | 31.61 | 6.13 |
| **Crosses Mean** | 81.97 | 112.02 | 62.18 | 6.44 | 114.70 | 36.73 | 6.66 |
| **Checks** | | | | | | | |
| Sitara | 89.25 | 116.33 | 72.61 | 10.33 | 60.92 | 38.45 | 5.34 |
| **Grand Mean** | 82.58 | 112.65 | 60.58 | 6.27 | 115.65 | 36.05 | 6.48 |
| **S.E** | 0.89 | 1.08 | 2.86 | 0.42 | 5.85 | 1.38 | 0.50 |
| **C.D. 5%** | 2.48 | 3.03 | 7.99 | 1.17 | 16.33 | 3.85 | 1.40 |

| Cross Combinations | Fresh wt. per fruit (g) | Fresh wt of fruit per plant (g) | Dry wt of fruit per plant (g) | Net Plot yield of fresh fruits (kg) | Capsaicin content (%) | Dry wt. per fruit (g) |
|---|---|---|---|---|---|---|
| **Females** | | | | | | |
| AVPP0309B | 2.43 | 160.15 | 39.66 | 3.20 | 0.350 | 1.16 |
| VI060629B | 2.09 | 333.45 | 17.78 | 6.66 | 0.341 | 0.75 |
| VI060632B | 1.60 | 260.83 | 7.31 | 5.68 | 0.493 | 0.56 |
| VI060627B | 2.56 | 177.46 | 18.66 | 3.48 | 0.558 | 0.58 |
| VI060630B | 1.68 | 460.89 | 20.93 | 8.15 | 0.328 | 0.45 |
| **Mean** | 2.07 | 278.56 | 20.87 | 5.43 | 0.41 | 0.70 |
| **Males** | | | | | | |
| Pusa Jwala | 1.06 | 105.16 | 9.73 | 2.10 | 0.337 | 0.43 |
| ACSS 9818 | 1.36 | 106.07 | 24.33 | 2.24 | 0.332 | 0.76 |
| DPLC-4 | 1.46 | 158.95 | 15.30 | 3.17 | 0.253 | 0.83 |
| BC-28 | 2.08 | 351.66 | 12.00 | 7.20 | 0.350 | 0.86 |
| DPLC-1 | 2.23 | 319.71 | 30.53 | 6.39 | 0.280 | 0.55 |
| DPLC-2 | 2.26 | 208.97 | 25.38 | 4.52 | 0.356 | 1.00 |
| **Mean** | 1.74 | 208.42 | 19.55 | 4.27 | 0.32 | 0.74 |
| **Parental Mean** | 1.91 | 243.49 | 20.21 | 4.85 | 0.37 | 0.72 |
| **Crosses** | | | | | | |
| AVPP0309S X Pusa Jwala | 2.00 | 273.76 | 25.53 | 5.47 | 0.296 | 0.50 |
| AVPP0309S X ACSS 9818 | 2.08 | 382.48 | 49.00 | 7.63 | 0.371 | 0.90 |
| AVPP0309S X DPLC-4 | 2.05 | 298.81 | 22.76 | 5.97 | 0.301 | 0.96 |
| AVPP0309S X BC-28 | 1.96 | 203.13 | 21.16 | 4.06 | 0.329 | 1.18 |
| AVPP0309S X DPLC-1 | 2.08 | 310.70 | 14.41 | 6.19 | 0.339 | 1.31 |
| AVPP0309S X DPLC-2 | 2.90 | 88.28 | 3.01 | 1.76 | 0.334 | 0.66 |
| AVPP0310S X Pusa Jwala | 2.75 | 149.02 | 15.33 | 2.97 | 0.241 | 0.60 |
| AVPP0310S X ACSS 9818 | 2.08 | 270.22 | 34.97 | 5.40 | 0.322 | 1.03 |
| AVPP0310S X DPLC-4 | 2.51 | 270.10 | 17.97 | 5.40 | 0.313 | 0.65 |
| AVPP0310S X BC-28 | 2.10 | 169.64 | 1.71 | 3.39 | 0.353 | 0.61 |
| AVPP0310S X DPLC-1 | 2.02 | 220.32 | 14.75 | 4.43 | 0.256 | 1.15 |
| AVPP0310S X DPLC-2 | 1.98 | 382.02 | 4.85 | 7.64 | 0.293 | 0.63 |
| AVPP0517S X Pusa Jwala | 2.02 | 224.76 | 14.00 | 2.46 | 0.248 | 0.73 |
| AVPP0517S X ACSS 9818 | 2.05 | 339.08 | 50.00 | 6.85 | 0.458 | 0.90 |
| AVPP0517S X DPLC-4 | 2.84 | 192.58 | 20.66 | 3.85 | 0.309 | 1.13 |
| AVPP0517S X BC-28 | 1.58 | 116.62 | 14.25 | 2.33 | 0.348 | 0.61 |
| AVPP0517S X DPLC-1 | 2.13 | 474.76 | 31.23 | 9.49 | 0.277 | 1.08 |
| AVPP0517S X DPLC-2 | 2.86 | 247.94 | 18.66 | 4.95 | 0.340 | 0.76 |
| AVPP0709S X Pusa Jwala | 2.27 | 322.67 | 32.08 | 6.45 | 0.449 | 0.60 |
| AVPP0709S X ACSS 9818 | 2.11 | 195.57 | 21.25 | 3.91 | 0.278 | 0.71 |
| AVPP0709S X DPLC-4 | 1.81 | 205.51 | 5.96 | 4.11 | 0.331 | 0.68 |
| AVPP0709S X BC-28 | 2.70 | 488.55 | 61.60 | 9.77 | 0.321 | 0.76 |
| AVPP0709S X DPLC-1 | 2.46 | 454.29 | 54.58 | 9.08 | 0.273 | 0.65 |
| AVPP0709S X DPLC-2 | 2.67 | 314.36 | 11.166 | 6.28 | 0.369 | 1.16 |
| AVPP0711S X Pusa Jwala | 2.76 | 468.85 | 18.31 | 9.37 | 0.324 | 0.46 |
| AVPP0711S X ACSS 9818 | 2.09 | 260.40 | 36.81 | 5.20 | 0.313 | 0.68 |
| AVPP0711S X DPLC-4 | 3.54 | 403.12 | 23.66 | 8.72 | 0.327 | 1.45 |

| | | | | | | |
|---|---|---|---|---|---|---|
| AVPP0711S X BC-28 | 5.70 | 505.05 | 12.75 | 12.14 | 0.546 | 0.98 |
| AVPP0711S X DPLC-1 | 2.93 | 189.18 | 24.61 | 3.78 | 0.375 | 0.80 |
| AVPP0711S X DPLC-2 | 2.32 | 317.54 | 55.60 | 6.01 | 0.282 | 0.91 |
| **Crosses Mean** | 2.45 | 291.31 | 24.42 | 5.84 | 0.33 | 0.84 |
| **Checks** | | | | | | |
| Sitara | 4.35 | 325.94 | 13.68 | 5.77 | 0.297 | 1.20 |
| **Grand Mean** | 2.34 | 278.77 | 23.03 | 5.56 | 0.339 | 0.82 |
| **S.E** | 0.15 | 21.01 | 2.20 | 0.30 | 0.014 | 0.04 |
| **C.D. 5 %** | 0.42 | 58.59 | 6.13 | 8.51 | 0.039 | 0.11 |

**Table 3 :** Range heterosis and best heterotic crosses for thirteen characters in chilli.

| Character | Range of Heterosis (%) | | No. of hybrids (Based on SC) | | Best Hybrids based on | |
|---|---|---|---|---|---|---|
| | BP | SC | +ve | -ve | BP | SC |
| Days to 50 per cent flowering | -9.25 to 6.89 | -13.21 to -0.09 | - | 29 | AVPP0310SxDPLC-1 | AVPP0309SxPusa Jwala |
| Days to first fruit ripening | -6.23 to 3.00 | -7.31 to 1.43 | - | 26 | AVPP0309SxPusa Jwala | AVPP0309SxPusa Jwala |
| Plant height (cm) | -33.08 to 67.00 | -41.63 to 41.24 | 2 | 16 | AVPP0711Sx DPLC-1 | AVPP0711Sx DPLC-1 |
| Number of fruits per plant (green) | -79.97 to 115.32 | -22.61 to 197.71 | 24 | 1 | AVPP0709SxDPLC-2 | AVPP0517SxDPLC-1 |
| Fresh weight per fruit (g) | -29.25 to 173.63 | -63.70 to 30.95 | 01 | 29 | AVPP0711Sx BC-28 | AVPP0711Sx BC-28 |
| Fruit length (cm) | -36.5 to 30.48 | -56.37 to -7.19 | - | 30 | AVPP0711Sx BC-28 | AVPP0711Sx BC-28 |
| 1000 grains weight (g) | -71.56 to 57.25 | -59.29 to 149.75 | 14 | 2 | AVPP0517SxDPLC-4 | AVPP0517SxDPLC-4 |
| Number of seed per fruits | -75.54 to 89.65 | -65.76 to 49.33 | 11 | 14 | AVPP0309SxPusa Jwala | AVPP0517SxACSS 9818 |
| Dry weight per fruit (g) | 57.14 to 91.21 | -61.11 to 20.83 | 02 | 24 | AVPP0517SxDPLC-1 | AVPP0711SxDPLC-4 |
| Dry weight of fruits per plant (g) | -92.39 to 230.00 | -87.45 to 350.18 | 19 | 04 | AVPP0709SxBC-28 | AVPP0709SxBC-28 |
| Fresh weight of fruits per plant (kg) | -66.84 to 138.83 | -72.91 to 54.95 | 8 | 16 | AVPP0309SxACSS 9818 | AVPP0711Sx BC-28 |
| Net plot yield of fresh fruit (g) | -67.61 to 138.54 | -69.42 to 110.21 | 9 | 11 | AVPP0309SxACSS 9818 | AVPP0711Sx BC-28 |
| Capsaicin content (%) | -51.07 to 56.00 | -18.85 to 83.83 | 8 | 2 | AVPP0711Sx BC-28 | AVPP0711Sx BC-28 |

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