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# Line × Tester Analysis in Chilli (*Capsicum annuum* L.): Identification of Superior Parents and Hybrids for Yield and Quality Attributing Traits

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**A B S T R A C T**

Hybrid vigour is a direct property of heterozygosity and is due to superior gene content possible in a hybrid contributed by both the parents. Hybrid vigour, the phenomenon of heterosis, is the basis for improvement in crop yields achieved during 20th century in many crops. In this study, ten lines and four testers and their 40 F1 hybrids in a Line x Tester cross system, were used to estimate heterosis percentage on check hybridand observations on quantitative and qualitative traits were recorded. Considering all the cross combinations individually, the hybrid combinations that out fielded their parents for maximum number of components of merit were $L_8$ x $T_1$ (CA 116 x AVRDC 1127), $L_9$ x $T_4$ (ArkaLohit x *Capsicum frutescens*), $L_6$ x $T_1$ (KashiAnmol x AVRDC 1127) and $L_8$ x $T_4$ (CA 116 x *Capsicum frutescens*). Further, it was also found that the hybrid $L_1$ x $T_2$ (EC 739328 x AVPP 0716) and $L_6$ x $T_4$(KashiAnmol x *Capsicum frutescens*) were adjudged as the best crosses based on their high scores for earliness and $L_8$ x $T_1$ (CA 116 x AVRDC 1127) and $L_9$ x $T_4$ (ArkaLohit x *Capsicum frutescens*) were adjudged as the best crosses based on their high scores for quantitative and qualitative characters.

## Introduction

The genus *Capsicum* consists of a diverse range of plants with different morphological characters and varies enormously with respect to yield and nutrition related characters. Chillies are annual crop, although it can also be cultivated as perennial crop in suitable climatic conditions. Among the five cultivated species, *Capsicum annuum* L. is most widely cultivated for its pungent as hot pepper and non pungent as sweet pepper fruits throughout the country (Bosland and Votava, 2000). Chilli is an important commercial crop of India and grown for its green fruits as vegetable and in ripe dried fruits as spice and throughout the world because of its pungency and pleasant flavors.

It comprises wide spectrum of alkaloids including steam-volatile oil, fatty oils, capsaicinoids, carotenoids, vitamins and protein (Bosland and Votava, 2000). The presence of capsaicin is specific to the genus *Caps*icum, which varies widely among the species, cultivars, varieties, season of cultivation, places of origin, etc (Prasath *et al.,* 2007).

India is the largest producer, consumer and exporter of chillies in the world. Its cultivation is mostly concentrated in the southern states *viz*., ones in terms of area and production are Andhra Pradesh (49%), Karnataka (15%), Odisha (8%), Maharashtra (6%), West Bengal (5%), Rajasthan (4%) and Tamil Nadu (3%). The production and productivity of the crop in Tamil Nadu is 0.34 lakh tonnes and 506 kg/ha, respectively. It is cultivated in an area of 0.67 lakh ha (www.FAO.org 2013). Andhra Pradesh, Karnataka Maharastra, Orissa and Tamil Nadu, occupying nearly 75% of the total area under chilli. Chilli is one of the dryland crops of the Eastern Dry zone of Karnataka.

Heterosis breeding has been advantageous for higher chilli yield and production. For effective transfer of suitable genes controlling both quantitative and qualitative characters in the resultant $F_1$ Hybrids it is necessary to exploit the better combining breeding materials (Kearsey and Farquhar, 1998).

Since yield is a quantitative character, governed by a large number of component characters, it is mandatory to know the interrelationship between yield and its related characters to arrive at an optimal selection index for improvement of yield. Several hybrids have been developed in hot chillies; however, the hybrid development programme should be continuous so as to make the seeds available to the growers at affordable cost. This investigation was planned to identify good combiners and heterotic cross combinations for yield as well as quality and its component traits in chilli.

## Materials and Methods

Ten lines and four testers was identified for hybridization programme from various national and international institutions were evaluated in a randomized block design with three replications at college orchard, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India. The experiment was carried out during the year 2016. 30 to 45 days old seedlings were transplanted to the crossing block to synthesis 40 hybrids. All the 40 F1 hybrids produced through Line x Tester mating design, were used in the present study to estimate heterosis percentage on better parent, and observations on quantitative and qualitative traits were recorded.

All other cultural practices were followed as per the recommended package of practices. Plants were selected randomly for recording the observations on quantitative and qualitative characters *viz.,* plant height (cm), number of branches per plant, days taken for first flowering, days taken for 50 per cent flowering, number of fruits / plant, individual fruit weight (g), fruit length (cm), fruit girth, fruit yield / plant, total phenols and polyphenol activity.

## Results and Discussion

Success in plant breeding programme depends upon the release of variability created through recombination and segregation. The greater attention has been directed in plant breeding research to the management of variation and to control its release. Biometrical genetics is the most important and reliable tool that enables us to analyse the variation into its heritable and non-heritable components and reveals its implication in breeding. The biometrical genetics also has the power to trace the cause of basic phenomenon such as heterosis and to predict outcome in plant breeding. It can thus help the breeder to interpret the results and also to plan the strategies for any plant breeding programme. Line x Tester analysis proposed by Kempthorne (1957) received considerable attention to assess the genetic differences in the parents on quantitative traits. It is one of the most convenient methods since the large number of genotypes used as lines could be tested for their combining ability even against a minimum of two or three testers. This line x tester analysis indicates the relative capacity of female and male parents to produce a desirable recombinant.

## Analysis of variance for parents and hybrids

The analysis of variance for the ten lines, four testers and forty hybrids in randomized block design showed highly significant differences among the genotypes for all the characters studied. The standard heterosis for the selected parents (ten lines and four testers) and 40 hybrid combinations derived through Line x Tester mating design for all quantitative and qualitative characters are discussed below. Hybrid vigour is a direct property of heterozygosity and is due to superior gene content possible in a hybrid contributed by both the parents (Mather, 1955). Hybrid vigour, the phenomenon of heterosis, is the basis for improvement in crop yields achieved during 20$^{th}$ century in many crops. The exploitation of heterosis is vital importance to face the challenges of providing novel traits like capsaicin and colour value besides yield and nutritional security for an ever increasing human population. Rapid advances in plant breeding with regard to exploitation of heterosis have served in many ways to develop hybrids with increased yield per hectare along with good quality characters. Based on the heterosis, the best hybrids were identified for various characters is furnished in Table 1.

## Plant height

Plant height is an important component character by which the growth and vigour of the plants are measured. Highest standard heterosis for the plant height, when the hybrids were compared with the check **(**TNAU chilli hybrid CO1**)** the heterotic effect varied from -49.26 per cent in $L_5$ x $T_4$ to 130.97 per cent in $L_8$ x $T_1$. It is worthy to mention here that, L8 by *per se* recorded lower plant height but it has contributed immensely to improve plant height when used as one of the parent.

## Number of branches per plant

Number of branches per plant was shown highest heterosis values over standard check (diii) in hybrids $L_9$ x $T_4$ (84.40 per cent), $L_2$ x $T_1$ (74.81 per cent) and $L_8$ x $T_1$ (69.44 per cent).Number of branches per plant influences the yield to a significant extent through facilitating the production of more number of flowers. For the trait, number of branches per plant most of the crosses involving $T_1$ (AVRDC 1127) and $T_4$ (*Capsicum frutescens*) as parent out fielded in their heterotic vigour. Heterosis for plant height and number of branches per plant had also been reported by Kumar *et al.,* (2014) and Patel *et al.,* (2016). Number of branches per plant influences the yield to a significant extent through facilitating the production of more number of flowers. For the trait, number of branches per plant most of the crosses involving $T_1$ (AVRDC 1127) and $T_4$ (*Capsicum frutescens*) as parent out fielded in their heterotic vigour.

## Days taken for first flowering and Days taken for 50 per cent flowering

Regarding the earliness related characters viz., Days taken for first flowering and Days taken for 50 per cent flowering, when the 40 hybrids developed were compared with the standard check, the highest negative and significant standard heterosis (diii) was observed by the hybrid $L_4$ x $T_3$ (-9.60 per cent). Totally three hybrids exhibited significant and negative standard heterotic values for days taken for first flowering and The hybrids $L_4$ x $T_3$ (-6.51 per cent) and $L_6$ x $T_4$ (-5.81 per cent) registered significant negative diii estimates for days taken for 50 % flowering. Early flowering is a desirable attribute while considering the magnitude of per day productivity. A genotype which produces highest flowers in the early phase of crop duration would be desirable. Negative and significant heterosis was observed for both days taken for first and 50 per cent flowering. The potentiality of these parents was also evidenced from their mean values. This clearly shows that the hybrids were early in flowering compare to check hybrid chilli hybrid CO1. These results are in similarity with that of Sood and Kumar (2010), Savitha (2011) and Kumar *et al.,* (2014).

## Number of fruits per plant, fruit length and fruit girth

Yield parameters are very important during evaluation of chillies, for number of fruits per plant. The hybrid $L_8$ x $T_1$ recorded highest standard heterosis (diii) (27.37 percent) for number of fruits per plant. Fruit length, the hybrid $L_8$ x $T_1$ recorded the highest positive and significant heterosis over standard check (diii) (44.08 per cent) and Fruit girth, the highest positive and significant standard heterosis (diii) was noted in the hybrid $L_8$ x $T_1$ (65.90 per cent) and $L_9$ x $T_4$ (58.66 per cent). Twenty one hybrids recorded positive and significant values over check hybrid. Number of fruits per plant is one of the prime criteria for yield contributing characters. Any hybridization programme in vegetables aims in development of this trait as a manifestation of hybrid vigour. Gill *et al.,* (1977) observed that heterosis for total yield was directly influenced by the hybrid vigour of number of fruits per plant. The fruit parameters, such as fruit length, fruit girth and pedicel length decides the individual green and dry fruit weight and thereby improving the yield potential. However, the hybrid $L_8$ x $T_1$ (CA 116 x AVRDC 1127) was significant and highly heterotic over the check hybrid and the parent $T_4$ (*Capsicum frutescens*) and $T_1$ (AVRDC 1127) proved their potential as male parent in hybrid combinations for expressing high heterotic values.

## Pedicel length

Pedicel length, the highest positive and significant standard heterosis over check (diii) was noted in the hybrid $L_4$ x $T_4$ (75.24 per cent) and $L_4$ x $T_1$ (44.34 per cent). Twenty six hybrids recorded positive and significant values over check hybrid TNAU chilli hybrid CO1. Significant standard heterosisfor pedicel length was observed in the hybrids $L_1$ x $T_1$ (EC 739328 x AVRDC 1127), $L_5$ x $T_1$ (LCA 334 x AVRDC 1127), $L_4$ x $T_1$ (VIO 37449 x AVRDC 1127) and $L_4$ x $T_4$ (VIO 37449 x *Capsicum frutescens*). The present outcomes about fruit length and girth were in conformity with studies of Savitha (2011), Sharma (2012), Kumar *et al.,* (2014) and Patel *et al.,* (2016).

## Individual green fruit weight, individual dry fruit weight and number of seeds per fruit

Individual green fruit weight**,** highest positive and significant heterosis (diii) was observed in the hybrid $L_8$ x $T_1$ (75.28 per cent). Totally nineteen hybrids exhibited positive and significant heterotic values (diii) over standard check hybrid. Individual dry fruit weight, the highest standard heterosis was observed in hybrid $L_8$ x $T_1$ (78.95 per cent) and $L_9$ x $T_4$ (68.42 per cent). Number of seeds per fruit, positive and significant heterosis was recorded in the hybrid $L_7$ x $T_2$ (11.53 per cent). Green fruit yield per plant, totally thirty three hybrids recorded positive and significant dii values. When the hybrids were compared with the standard check TNAU chilli hybrid CO1, the highest positive and significant heterosis (diii) was observed in the hybrid $L_8$ x $T_1$ (184.65 per cent). Totally thirty three hybrids exhibited positive and significant diii values over the standard check hybrid.

Williams (1977) suggested that heterosis for yield was the consequence of multiplicative relationship between the component characters for the yield complex. It may sometimes be due to modifying factors in the reflection of these component traits in to the yield. The heterosis for total yield can occur in hybrids in which the component characters merely show dominant or intermediate level of expression.

For this, the parent must differ as regards to the level of expression of each of the components and neither must have a monopoly of high or low expression of both the unit characters. The hybrids had better individual green fruit weight which is inferred by the better relative heterosis and heterobeltiosis scores by $L_3$ x $T_4$ (VIO 41283 x *Capsicum frutescens*), $L_1$ x $T_4$ (EC 739328 x *Capsicum frutescens*), $L_6$ x $T_3$ (KashiAnmol x AVPP 0717), $L_2$ x $T_4$ (EC 739329 x *Capsicum frutescens*) and $L_9$ x $T_4$ (ArkaLohit x *Capsicum frutescens*).On theother hand, hybrids out fielded over the check hybrid were $L_8$ x $T_1$ (CA 116 x AVRDC 1127), $L_9$ x $T_4$ (ArkaLohit x *Capsicum frutescens*), $L_3$ x $T_4$ (VIO 41283 x *Capsicum frutescens*) and $L_{10}$ x $T_2$ (ArkaSuphal x AVPP 0716). Here, $T_4$, $L_3$, $L_8$ and $L_9$ were the best contributing parent as lines and testers in developing hybrids with the highest heterotic values for individual green fruit weight. For individual dry fruit weight, the highest positive and significant heterosis over mid and better parent was observed in the following hybrids $L_3$ x $T_4$ (VIO 41283 x *Capsicum frutescens*), $L_4$ x $T_4$ (VIO 37449 x *Capsicum frutescens*), $L_5$ x $T_4$ (LCA 334 x *Capsicum frutescens*) and $L_2$ x $T_4$ (EC 739329 x *Capsicum frutescens*). Positive and significant heterosis over the check hybrid were recorded in $L_8$ x $T_1$ (CA 116 x AVRDC 1127), $L_9$ x $T_4$ (ArkaLohit x *Capsicum frutescens*), $L_3$ x $T_4$ (VIO 41283 x *Capsicum frutescens*) and $L_{10}$ x $T_1$ (ArkaSuphal x AVRDC 1127).The parents $T_4$, $L_8$ and $L_9$ alsoproved themselves as better parents in developing hybrids with better dry fruit weight. These results were observed to be in accordance with findings of Prasath (2005), Chadchan (2008), Savitha (2011), Sharma (2012), Kumar *et al.,* (2014) and Patel *et al.*, (2016).

## Polyphenol oxidase and total phenol

Regarding the qualitative parameters, the polyphenol oxidase also shown heterosis vigour in hybrids. When the hybrids were compared with the standard check TNAU chilli hybrid CO1, highest positive and significant heterosis (diii) was observed in the hybrid $L_8$ x $T_4$ (121.84 per cent). Followed by the highest positive and significant heterosis (diii) was observed in the hybrid $L_8$ x $T_4$ (40.23 per cent) for total phenol.

Polyphenol oxidase and total phenol content decides the plant resistance against the biotic stress such as pest and disease infection, which is alternative measure on the resistance to *chilli leaf curl virus* of the hybrids. The highest heterosis over mid and better parent were recorded in the hybrids, $L_5$ x $T_3$ (LCA 334 x AVPP 0717), $L_5$ x $T_2$ (LCA 334 x AVPP 0716), $L_1$ x $T_3$ (EC 739328 x AVPP 0717), $L_1$ x $T_2$ (EC 739328 x AVPP 0716), $L_7$x $T_1$ (CA 247 x AVRDC 1127) and $L_8$ x $T_4$ (CA 116 x *Capsicum frutescens*). These results are supported with the earlier findings of Kim *et al.,* (2001), Ko *et al.,* (2005) and Hasyim *et al.*, (2014)

**Table.1** Hybrid combinations with desired significant standard heterosis for quantitative and qualitative parameters

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **37.32**** | 1.28 ns | 3.73 ns | 12.56** | 36.99** | 34.92** | 40.78** | -3.37 ns | 32.24** | 193.25** | -29.04** | 86.69** | 264.68** | 81.67** |
| **85.86**** | -3.24 ns | -9.34** | -0.12 ns | -27.10** | -9.81** | 1.29 ns | -19.35** | -9.21** | 41.39** | -16.93** | 88.74** | 120.18** | 38.07** |
| **-17.15**** | 52.81** | 4.97* | 0.70 ns | 38.08** | -13.66** | 0.65 ns | -22.22** | 5.92 ns | 102.4** | 1.95 ns | 94.54** | 305.96** | -42.39** |
| **97.54**** | 69.39** | 2.97 ns | 10.70** | -10.98** | -14.76** | 7.12* | 9.99** | 38.16** | 147.03** | 5.40** | 37.88** | 202.75** | -3.33 ns |
| **4.68 ns** | 74.81** | -3.50 ns | -0.34 ns | 22.49** | -10.27** | -0.49 ns | -17.60** | 15.13** | 77.04** | -9.20** | 41.30** | 202.29** | 0.69 ns |
| **81.7**** | 56.61** | 17.80** | 22.56** | 21.50** | 48.49** | 7.77* | -23.10** | 25.66** | 101.61** | -43.19** | 38.91** | 65.14** | 129.44** |
| **34.92**** | 23.4** | 1.45 ns | 0.00 ns | 11.65** | -7.06* | -1.46 ns | 16.48** | 41.45** | 123.91** | -54.41** | 16.04** | 258.26** | 19.06** |
| **48.67**** | 20.63** | 3.80 ns | 9.54** | 5.69* | 50.78** | 1.94 ns | 32.58** | 50.00** | 144.23** | -24.78** | 18.77** | -38.53** | 95.52** |
| **20.60**** | 19.31** | 3.19 ns | 6.98** | -13.73** | -11.46** | 13.27** | -1.62 ns | 47.37** | 117.55** | -10.56** | 17.75** | 16.97** | 35.93** |
| **6.69 ns** | 33.25** | 17.77** | 26.51** | 5.96* | 21.54** | 11.97** | 3.75 ns | 21.71** | 41.44** | -7.93** | -3.75 ns | 134.4** | 87.2** |
| **5.91 ns** | 26.85** | 7.64** | 12.33** | -18.43** | -17.23** | 32.04** | -11.49** | 17.76** | 82.88** | -25.71** | -2.05 ns | 216.51** | 30.61** |
| **22.37**** | -7.67** | 10.01** | 11.74** | 5.42 ns | -14.39** | 16.99** | 51.69** | 65.79** | 63.76** | -11.49** | -1.71 ns | 312.39** | 38.8** |
| **-42.28**** | -9.63** | 23.8** | 36.16** | 18.56** | -2.11 ns | 44.34** | -8.11** | 30.26** | 183.29** | -9.90** | 21.84** | 51.38** | -13.63** |
| **-34.57**** | 2.34 ns | 30.99** | 41.51** | -1.76 ns | -11.73** | 11.17** | 32.21** | 50.00** | 184.48** | -21.13** | 20.48** | 133.49** | 63.12** |
| **-44.66**** | 60.87** | -9.60** | -6.51** | -16.44** | 28.87** | 41.75** | 32.46** | 45.39** | 76.11** | -38.82** | 19.80** | 119.72** | 107.18** |
| **-30.58**** | 0.17 ns | 0.94 ns | 7.33** | 34.91** | 10.54** | 75.24** | 31.84** | 48.68** | 18.73* | -15.04** | 112.63** | 202.75** | -6.45 ns |
| **-2.67 ns** | 21.48** | 5.81* | 16.05** | -15.99** | 35.38** | 29.29** | 3.00 ns | 22.37** | 41.95** | -4.79* | 114.33** | 271.56** | 98.87** |
| **-35.54**** | 60.87** | 10.17** | 17.79** | -25.34** | -10.27** | 14.40** | -3.37 ns | 20.39** | 55** | 0.91 ns | 108.19** | 188.99** | -33.51** |
| **1.09 ns** | 19.01** | 0.02 ns | 9.42** | -14.32** | 6.97 ns | 16.50** | -6.74* | 15.13** | 42.92** | 5.32** | 113.31** | 92.66** | 47.19** |
| **-49.26**** | -34.65** | 3.03 ns | 9.77** | 4.61 ns | 39.6** | 21.68** | -0.25 ns | 21.71** | 35.84** | -21.05** | 23.55** | 99.54** | 122.04** |
| **4.69 ns** | 3.71 ns | -1.72 ns | -0.93 ns | 8.63** | 50.87** | 21.52** | 4.12 ns | -11.84** | 227.51** | 7.18** | 115.7** | 195.41** | 128.95** |
| **-10.74*** | -10.10** | 5.39* | 12.44** | -20.33** | -11.55** | 26.86** | 14.23** | 33.55** | 177.7** | 1.67 ns | 31.40** | 72.02** | 53.54** |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **6.69 ns** | 5.88* | 6.51** | 8.60** | -22.54** | -15.4** | -40.78** | 40.32** | 57.89** | 138.65** | 7.46** | 33.79** | 226.61** | 81.67** |
| **0.53 ns** | -13.64** | -5.91* | -5.81* | 23.08** | 11.82** | -5.34 ns | 1.50 ns | 16.45** | 149.02** | 1.81 ns | 32.76** | 271.56** | 46.92** |
| **-17.15**** | 11.25** | 2.17 ns | 4.88 ns | -1.40 ns | -10.63** | 10.52** | 31.46** | 40.13** | 142.65** | 10.17** | 57.00** | 288.99** | 62.69** |
| **44.43**** | 5.75* | 7.23** | 11.74** | -5.33 ns | -4.95 ns | 24.27** | -3.37 ns | 26.32** | 88.85** | 11.53** | 54.61** | 250.92** | 90.90** |
| **-2.75 ns** | 16.75** | 1.59 ns | 2.56 ns | 31.62** | 43.72** | 1.46 ns | 5.24 ns | 1.97 ns | 72.93** | 6.20** | 55.63** | 99.54** | 91.40** |
| **-14.51**** | 14.41** | 17.22** | 15.69** | 26.47** | 21.26** | -8.74** | 20.97** | 30.26** | 102.80** | 9.72** | 48.12** | 361.01** | 94.28** |
| **130.97**** | 69.44** | 22.72** | 31.97** | 44.08** | 65.90** | -1.46 ns | 75.28** | 78.95** | 273.73** | -12.28** | 48.12** | 85.78** | 184.65** |
| **16.52**** | 11.89** | 20.31** | 36.05** | 27.46** | 48.49** | -26.21** | 34.08** | 47.37** | 88.46** | -6.54** | 47.10** | 3.21 ns | 174.82** |
| **86.90**** | 1.62 ns | 11.72** | 16.63** | 14.91** | -0.18 ns | 10.36** | 32.96** | 37.5** | 43.84** | -14.62** | 26.96** | 192.2** | 162.89** |
| **115.85**** | 41.52** | 3.61 ns | 4.01 ns | 1.31 ns | -7.97* | 16.67** | -17.35** | 6.58 ns | 59.37** | -13.63** | 121.84** | 402.29** | 35.70** |
| **-10.75*** | 52.81** | 23.51** | 30.81** | 9.76** | 54.26** | 16.67** | 36.7** | 52.63** | 186.08** | -20.39** | 25.94** | 195.87** | 148.10** |
| **6.69 ns** | -0.90 ns | -0.08 ns | 0.69 ns | -9.49** | 18.88** | 25.89** | -18.98** | -12.5** | 117.94** | -4.95* | 39.25** | 350.92** | 125.04** |
| **0.53 ns** | 24.30** | 0.04 ns | 2.67 ns | -3.93 ns | 32.45** | 36.41** | 9.99** | 27.63** | 237.87** | -20.53** | 41.64** | 178.90** | 102.52** |
| **118.81**** | 84.4** | 8.68** | 8.14** | 40.79** | 58.66** | -3.4 ns | 52.43** | 68.42** | 251.02** | -38.82** | 38.57** | 175.69** | 148.37** |
| **44.44**** | 14.45** | 4.14 ns | 3.26 ns | 37.35** | 12.10** | -23.95** | 39.58** | 59.87** | 264.96** | -43.16** | 18.09** | 230.28** | -10.42** |
| **-2.75 ns** | -13.68** | 4.55 ns | 4.53 ns | -1.90 ns | 10.63** | 10.03** | 43.45** | 57.89** | 228.71** | -7.94** | 21.50** | 272.02** | 107.18** |
| **-14.51**** | 0.77 ns | 19.68** | 24.65** | 0.81 ns | 21.26** | -20.39** | -8.24** | 17.11** | 186.07** | -0.75 ns | 20.48** | 3.21 ns | 129.44** |
| **37.32**** | 2.98 ns | 22.53** | 32.91** | -23.44** | -15.03** | 12.30** | -20.47** | 29.61** | 147.42** | 4.87* | -11.95** | 78.90** | 12.38** |

| | |
|---|---|
| **1. Plant height** | **8. Individual green fruit weight** |
| **2. Number of branches per plant** | 9. Individual dry fruit weight |
| **3. Days taken for first flowering** | 10. Number of fruits/plant |
| **4. Days taken for 50 % flowering** | 11. Number of seeds/ fruit |
| **5. Fruit length** | 12. Polyphenol oxidase |
| **6. Fruit girth** | 13. Total Phenol |
| **7. Pedicel length** | 14. Green fruit yield per plant |

Considering all the cross combinations individually, the hybrid combinations that out fielded their parents for maximum number of components of merit were $L_8$ x $T_1$ (CA 116 x AVRDC 1127), $L_9$ x $T_4$ (ArkaLohit x *Capsicum frutescens*), $L_6$ x $T_1$ (KashiAnmol x AVRDC 1127), $L_8$ x $T_4$ (CA 116 x *Capsicum frutescens*), $L_6$ x $T_1$ (KashiAnmol x AVRDC 1127), $L_1$ x $T_2$ (EC 739328 x AVPP 0716) and $L_5$ x $T_1$(LCA 334 x AVRDC 1127). Further, it was also found that the hybrid $L_1$ x $T_2$(EC 739328 x AVPP 0716) and $L_6$ x $T_4$(KashiAnmol x *Capsicum frutescens*) were adjudged as the best crosses based on their high scores for earliness and $L_8$ x $T_1$ (CA 116 x AVRDC 1127) and $L_9$ x $T_4$ (ArkaLohit x *Capsicum frutescens*) were adjudged as the best crosses based on their high scores for the traits *viz.*, plant height, number of fruits per plant, fruit length, fruit girth, individual green fruitweight, individual dry fruitweight and green fruit yield per plant which are considered as the main objective of development of hybrids with high yield and quality.

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