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**Kiran Kumar**
Department of Vegetable Science, College of Agriculture, IGKV, Raipur, Chhattisgarh, India

**D Sharma**
Department of Vegetable Science, College of Agriculture, IGKV, Raipur, Chhattisgarh, India

**J Singh**
Department of Vegetable Science, College of Agriculture, IGKV, Raipur, Chhattisgarh, India

**TK Sharma**
Department of Vegetable Science, College of Agriculture, IGKV, Raipur, Chhattisgarh, India

**Vivek Kumar Kurrey**
Department of Vegetable Science, College of Agriculture, IGKV, Raipur, Chhattisgarh, India

**Ritu Rani Minz**
Department of Vegetable Science, College of Agriculture, IGKV, Raipur, Chhattisgarh, India

**Correspondence**
**Kiran Kumar**
Department of Vegetable Science, College of Agriculture, IGKV, Raipur, Chhattisgarh, India

# Combining ability analysis for yield and quality traits in tomato (*Solanum lycopersicum* L.)

**Kiran Kumar, D Sharma, J Singh, TK Sharma, Vivek Kumar Kurrey and Ritu Rani Minz**

**Abstract**
The present investigation was carried out under AICRP on Vegetable Crops, Department of Vegetable Science at Horticultural Research and Instructional Farm, IGKV, Raipur (C.G.) during 2016-17 to 2017-18 to association study for various quantitative characters in tomato genotypes. Crosses were made to determine general combining ability and specific combining ability of parents and crosses respectively using Line x Tester mating fashion, type of gene action involved for fruit yield and its components and to ascertain the magnitude of heterosis. Development of hybrids and varieties for better yield and quality traits requires identification of good specific and general combiners. Combining ability revealed that predominance of non-additive gene action for all the characters under study. This suggests the possibility of exploiting heterosis in the present material. Line H-86 and Kashi Anupam found good general combiner for fruit yield per hectare, average fruit weight, fruit diameter, fruit yield per plant, H-24 for dry matter% of fruit, plant height, number of fruit cluster per plant, number of fruits per cluster, while, 2014/TOLCVRES-3, 2015/TOLCVRES-4, 2015/TOLCVRES-2 was used as tester for fruit yield and its component tomato improvement programme. High *per se* performance with remarkable heterosis and significant SCA effects were expressed by PR x 14/TLCV-3, KA x 15/TLCV-2, H-86 x 14/TLCV-3, KA x 14/TLCV-3 and H-24 x 14/TLCV-1 for higher fruit yield and its contributing traits. Hence, the present study was framework for improvement high yielding genotypes of tomato with desirable traits.

**Keywords:** Tomato, combining ability, quality traits, yield, GCA

## Introduction
Tomato (*Solannum lycopersicum* L.) is one of the most important and popular vegetable crops in the world. Tomato is popular due to its nutritive and medicinal values. Nuez *et al.* 2004 [9] identified it as the horticultural crop with the highest commercial value. In India; tomato is grown across all agro-ecological zones and occupies an area of about 801 thousand hectares with an annual production of 22.33 million tonnes, respectively (Anon., 2017) [7].

Tomato is universally treated as 'Protective Food' since it is very rich in minerals, vitamins, antioxidants, essential amino acids, sugars and dietary fibers which are important ingredients for culinary and table purpose, chutney, pickles, ketchup, soup, juice, puree etc. (Sekhar *et al*., 2010) [12]. Fresh fruit of tomato are in great demand round the year throughout the country. Hence, there is continuous need to strengthen the crop improvement programmes in tomato and ultimately developing new varieties/hybrids satisfying to the present day needs of farmers and consumers as well. It is, therefore, essential to find out the combining ability of desirable genotypes to be involved in breeding programme for effective transfer of desirable genes in the resultant progenies. Hence, combining ability, which is important in the development of breeding procedures, is of notable use in crop hybridization, either to exploit heterosis or to combine the favourable fixable genes.

## Materials and Methods
The experiment was conducted in the field of AICRP on Vegetable Crops at Horticultural Research cum Instructional Farm, Department of Vegetable Science, IGKV, Raipur (C.G.) during the year 2016-17 to 2017-18. The details of materials used and methods employed in the present study to identifying heterotic with high *sca* effect performance resulting from crossing of genetically divergent genotypes as parents in Line x Tester mating fashion (Kempthorne, 1957) [6] based on the study of morphological characterization and diversity analysis of tomato. During *Rabi*, 2017-18 twenty four $F_1$'s including parents were raised in Randomized Block Design with three replications. $F_1$s were evaluated along with their parents for various traits. The recommended packages of practices of tomato cultivation were followed for raising a healthy crop.

The observations for eighteen characters were recorded on five plant basis in each replication. These observations were subjected to statistical analysis.

## Results and Discussion

The analysis of variance for line x tester analysis presented in Table 1. The mean sum of squares due to parent and hybrids were highly significant for all the characters except days to first fruit harvest & total soluble solid. The mean sum of squares due to parents *vs* hybrids were highly significant for majority of the characters except no. of branches per plant, no. of fruit cluster per plant, days to first fruit harvest, fruit length (cm) and ascorbic acid (mg/100g). The mean sum of squares due to lines *vs* testers was highly significant for all the characters except no. of branches per plant, no. of fruits per plant, days to first fruit harvest, pericarp thickness and total soluble solid. The mean sum of squares due to lines & testers respectively were highly significant for majority of the characters except no. of fruits per cluster, days to first fruit harvest, total soluble solid and ascorbic acid. The mean sum of squares due to Lines x Testers were highly significant for all the characters except total soluble solid.

**Table 1:** Analysis of variance for Line x Tester analysis for fruit yield and its component in tomato during *Rabi*, 2017-18 at Raipur

| Characters (df) | Replications | Parents | Hybrids | Parent vs Hybrid | Lines | Testers | Lines vs Testers | Lines x Testers | Errors |
|---|---|---|---|---|---|---|---|---|---|
| | 2 | 9 | 23 | 1 | 5 | 3 | 1 | 15 | 66 |
| Days to 50% flowering | 0.89 | 5.86** | 6.04** | 3.77* | 3.03** | 6.53** | 18.05** | 4.91** | 0.63 |
| No of branches per plant | 0.06 | 3.83** | 7.8** | 1.32 | 3.57** | 5.54** | 0.03 | 8.91** | 0.39 |
| Plant height(cm) | 5.59 | 546.5** | 54.39** | 580.65** | 616.56** | 394.13** | 653.36** | 62.58** | 10.05 |
| No. of fruit cluster per plant | 0.06 | 3.83** | 6** | 0.81 | 2.83** | 5.83** | 2.77** | 7.28** | 0.30 |
| No. of flowers per cluster | 0.02 | 0.75** | 1.14** | 14** | 0.47** | 0.92** | 1.64** | 0.71** | 0.10 |
| No. of fruits per cluster | 0.01 | 0.3** | 1.14** | 15.24** | 0.13 | 0.04 | 1.96** | 0.88** | 0.07 |
| No. of fruits per plant | 1.36 | 28.96** | 37.6** | 58.33** | 46.81** | 8.49* | 1.11 | 38.51** | 2.20 |
| Days to first fruit harvest | 2.22 | 2.73 | 6.28** | 2.42 | 4.56 | 0.59 | 0.01 | 6.02** | 1.68 |
| Fruit yield per plant | 0.01 | 1.99** | 1.31** | 1.93** | 2.76** | 0.53** | 2.49** | 1.26** | 0.01 |
| Fruit length (cm) | 0.19 | 2.84** | 1.23** | 0.64 | 3.23** | 1.49** | 4.89** | 0.8** | 0.26 |
| Fruit diameter (cm) | 0.52* | 2.73** | 1.16** | 1.56** | 2.99** | 0.65** | 7.71** | 1.15** | 0.15 |
| Average fruit wt. (g) | 1.32 | 1427.13** | 1675.8** | 6004.12** | 1470.73** | 947.53** | 2647.92** | 1348.93** | 10.51 |
| No.of Locules per fruit | 0.01 | 2.91** | 1.41** | 1.58** | 2.86** | 2.7** | 3.82** | 1.5** | 0.05 |
| Pericarp thickness (mm) | 0.42* | 1.11** | 2.17** | 14.61** | 0.65** | 2.17** | 0.28 | 2.87** | 0.11 |
| Total soluble solid | 0.02 | 0.62 | 1.05 | 2.74* | 0.9 | 0.27 | 0.28 | 0.74 | 0.68 |
| Ascorbic acid (mg/100g) | 0.5 | 8.73** | 9.64** | 2.65 | 2.44 | 1.69 | 15.52** | 8.05** | 1.35 |
| Dry matter% of fruit | 0.04 | 2.19** | 0.74** | 1.43** | 2.9** | 0.56** | 3.5** | 0.79** | 0.06 |
| Fruit yield per hectare (q) | 386.19 | 45287.7** | 58710.43** | 27330** | 52209.2** | 15898.89** | 98846** | 62812.36** | 775.06 |

* Significant at 5% and ** significant at 1%

## Effect of GCA

Nature and magnitude of combining ability effects provide guideline in identifying the better parents and their utilization. The summery of the GCA effects of the parents (Table 2) revealed that none of the parents excelled for all characters in positive direction. With respect to fruit yield per hectare (q) the lines H-86 (123.81), Kashi Anupam (51.39). Besides the fruit yield per hectare (q), the lines also possessed significant desirable GCA values for its component characters.

**Table 2:** General Combining Ability (GCA) effects of lines and testers for fruit yield and its component in tomato during *rabi*, 2017-18

| Parents | Characters | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
| **Lines** | | | | | | | | | | | | | | | | | | |
| Pusa Ruby | 0.47-** | 0.34** | 2.46-** | 0.31* | 0.18* | 0.28-** | 0.93** | -0.88** | -0.05** | -0.54** | -0.24** | -15.25** | -0.22** | 0.12 | 0.48** | 1.08** | 0.12* | -16.67* |
| Punjab Chhuhara | 02.22-** | 0.98-** | 1.70-* | 0.73-** | 0.28** | 0.12 | 0.96** | -0.41 | -0.23** | -0.55** | -0.45** | -12.73** | -0.01 | -0.56** | -0.48** | -1.56** | 0.37** | -60.10** |
| Arka Vikash | 0.36* | 0.09- | 1.61* | 0.25-* | 0.07- | 0.07 | 1.24** | -0.04 | -0.17** | 0.17 | -0.06 | -7.99** | -0.15** | 0.24** | 0.08 | -0.58* | -0.31** | -45.36** |
| Kashi Anupam | 0.36* | 0.25- | 1.42* | 0.15 | 0.62-** | 0.38-** | 0.14 | 0.37 | 0.26** | 0.00 | 0.36** | 12.16** | 0.75** | -0.16* | 0.19** | 0.45 | -0.28** | 51.39** |
| H-86 | 0.14- | 0.38** | 0.97- | 0.01- | 0.13 | 0.12 | -0.49 | 0.45 | 0.64** | 0.77** | 0.30** | 23.21** | -0.05 | 0.17* | -0.24** | 0.04 | -0.08 | 123.81** |
| H-24 | 0.11 | 060.** | 2.09** | 0.53** | 0.082 | 0.32** | -2.79** | 0.50 | -0.45** | 0.15 | 0.09 | 0.60 | -0.32** | 0.19* | -0.03 | 0.57* | 0.18** | -52.07** |
| SE (Lines) | 0.17 | 0.13 | 0.68 | 0.12 | 0.08 | 0.07 | 0.34 | 0.28 | 0.03 | 0.13 | 0.09 | 0.55 | 0.05 | 0.08 | 0.06 | 0.26 | 0.06 | 6.40 |
| Testers | | | | | | | | | | | | | | | | | | |
| 2015/TOLCVRES-4 | 0.22- | 0.27-** | 1.80-** | 0.15 | 0.25** | 0.11* | -0.88** | 0.18 | -0.02 | 0.05 | 0.04 | 0.48 | -0.12** | 0.06 | -0.10* | 0.33 | 0.07 | -2.83 |
| 2015/TOLCVRES-2 | 0.28* | 0.24* | 1.03 | 0.07- | 0.26** | 0.31** | -1.92** | 0.22 | 0.01 | -0.27** | 0.28** | 8.54** | -0.03 | -0.20** | 0.37** | -0.33 | -0.09** | -3.59 |
| 2014/TOLCVRES-3 | 1.28-** | 0.82** | 0.70 | 0.63** | 0.12* | 0.17** | 1.39** | -1.16** | 0.24** | 0.12 | 0.03 | 3.85** | -0.06 | 0.13* | 0.15** | 1.09** | 0.12** | 52.30** |
| 2014/TOLCVRES-1 | 1.22** | 0.80-** | 0.07 | 0.71-** | 0.62-** | 0.59-** | 1.41** | 0.76** | -0.24** | 0.10 | -0.34** | -12.86** | 0.21** | 0.00 | -0.43** | -1.10** | -0.11** | -45.89** |
| SE (testers) | 0.13 | 0.10 | 0.53 | 0.10 | 0.06 | 0.05 | 0.26 | 0.22 | 0.02 | 0.10 | 0.07 | 0.43 | 0.04 | 0.06 | 0.05 | 0.20 | 0.04 | 4.96 |

*Significant at P = 0.05 level, ** Significant at P = 0.01 level

1. Days to 50% flowering 2.No. of branches per plant 3.Plant height (cm) 4.Number of fruit cluster per plant
5. Number of flowers per cluster 6. Number of fruits per cluster 7.Number of fruits per plant 8.Days to first fruit harvest
9. Fruit yield per plant (kg) 10.Fruit length (cm) 1 1.Fruit diameter (cm) 12.Average fruit weight (g)
13. Number of locules per fruit 14.Pericarp thickness (mm) 15.Total soluble solids (ºBrix) 16.Ascorbic acid content (mg/100g) 17. Dry matter% of fruit 18.Fruit yield per hectare (q)

The GCA effects of the lines for various characters revealed that H-86 possessed significant desirable GCA values for characters *viz.*, fruit yield per hectare, fruit length, average fruit wt., number of branches per plant, fruit diameter, pericarp thickness, fruit yield per plant in positive direction, while Kashi Anupam was regarded for fruit diameter, number of locules per fruit, plant height, fruit yield per plant, average fruit wt., total soluble solid, fruit yield per hectare, H-24 for dry matter% of fruit, plant height, number of fruit cluster per plant, number of fruits per cluster, ascorbic acid, number of branches per plant and pericarp thickness. This result is in accordance with the findings of Mohamed *et al.* (2012) [8], Shankar *et al.* (2013) [13], Savale and Patel (2017) [11] and Triveni *et al.* (2017) [16].

Among the testers, the *GCA* effects with respect to fruit yield per hectare (q) the tester 2014/TOLCVRES-3 (52.30). Besides the fruit yield (q/ha) the testers 2014/TOLCVRES-3 also possessed significant desirable GCA values for its component characters *i.e.* number of branches per plant, number of fruit cluster per plant, days to first fruit harvest, fruit yield per plant, pericarp thickness, ascorbic acid, dry matter% of fruit, days to 50% flowering, number of flowers per cluster, number of fruits per cluster, number of fruits per plant, average fruit wt., and total soluble solid, 2015/TOLCVRES-2 for number of branches per plant, number of flowers per cluster, number of fruits per cluster, fruit diameter, average fruit wt., total soluble solid, 2014/TOLCVRES-1 for number of fruits per plant and number of locules per fruit. Thus these parents could be utilized extensively in hybridization followed by selection to accelerate the pace of genetic improvement of yield and its component traits. These results are similar to the findings of Sharma and Sharma (2010) [14], Avdikos *et al*. (2011) [3] and Singh & Asati (2011) [15], Kumar *et al.* (2013) [7], Alam *et al.* (2017) [1] and Reddy *et al.* (2017) [10].

## Effect of SCA

The specific combining ability effects represents dominance and epistatic gene effects which can be used as an index to determine the usefulness of a particular cross combination for exploitation through heterosis breeding and hybridization programme.

On the basis of specific combining ability effects, it can be concluded that desirable SCA effects was not revealed by any of the cross for all the traits (Table 3). On the basis of higher and significant specific combining ability effects of crosses for fruit yield per hectare (q) identified the crosses PR X 14/TLCV-3, PC X 15/TLCV-2, PC X 14/TLCV-1, AV X 15/TLCV-4, AV X 14/TLCV-3, KA X 15/TLCV-2, KA X 14/TLCV-3, H-86 X 15/TLCV-4, H-86 X 14/TLCV-3 and H-24 X 14/TLCV-1. From SCA effects of the crosses for various characters revealed that PR X 14/TLCV-3 for number of fruit cluster per plant, number of flowers per cluster, number of fruits per plant, days to first fruit harvest, fruit yield per plant, fruit diameter, average fruit wt., number of locules per fruit, pericarp thickness, ascorbic acid and fruit yield per hectare, KA X 15/TLCV-2 for plant height, days to first fruit harvest, fruit yield per plant, fruit length, fruit diameter, average fruit wt, number of locules per fruit, pericarp thickness, ascorbic acid and fruit yield per hectare, KA X 14/TLCV-3 for days to 50% flowering, number of fruit cluster per plant, fruit diameter, fruit length fruit yield per plant, days to first fruit harvest, average fruit wt., number of locules per fruit, pericarp thickness, total soluble solid, dry matter% of fruit and fruit yield per hectare, H-86 X 15/TLCV-4 for days to 50% flowering, fruit yield per plant, average fruit wt., number of locules per fruit, total soluble solid, fruit yield per hectare, H-86 X 14/TLCV-3 for number of fruits per plant, plant height, number of fruit cluster per plant, number of branches per plant, fruit yield per plant, pericarp thickness, dry matter% of fruit, fruit yield per hectare and H-24 X 14/TLCV-1 for number of branches per plant, plant height, number of fruit cluster per plant, days to first fruit harvest, fruit yield per plant, fruit diameter, average fruit wt., number of locules per fruit, total soluble solid, pericarp thickness, ascorbic acid, dry matter% of fruit, fruit yield per hectare (q). This result is in accordance with the findings of Katkar *et al.* (2012) [5], Shankar *et al.* (2013) [13], Basavaraj *et al*. (2015) [4] and Alam *et al.* (2017) [1].

**Table 3:** Specific Combining Ability (SCA) effects of lines and testers for fruit yield and its component in tomato during *Rabi,* 2017-18

| Hybrids | Characters | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
| PR X 15/TLCV-4 | -1.19** | 0.59* | 2.62* | 0.98** | -0.05 | -0.16 | -0.92 | -0.91 | 0.02 | 0.22 | 0.07 | 0.78 | -0.93** | 0.38** | -0.34** | 1.77** | 0.48** | 4.44 |
| PR X 15/TLCV-2 | 0.64* | -2.89** | -4.53** | -2.62** | -0.85** | -0.96** | 5.43** | 1.55** | -0.64** | -0.04 | -0.89** | -22.25** | -0.15 | -0.9** | 0.50** | -1.62** | -0.31** | -149.94** |
| PR X 14/TLCV-3 | -0.47 | 0.84** | 0.45 | 1.45** | 0.48** | 0.18 | 1.38* | -1.00* | 0.53** | 0.21 | 0.47** | 15.14** | 0.34** | 0.35** | -0.17 | 1.68** | -0.37** | 134.36** |
| PR X 14/TLCV-1 | 1.03** | 1.46** | 1.46 | 0.18 | 0.42** | 0.94** | -5.89** | 0.36 | 0.09 | -0.39 | 0.35* | 6.33** | 0.74** | 0.16 | 0 | -1.82** | 0.21* | 11.14 |
| PC X 15/TLCV-4 | 1.56** | -0.42 | -2.47* | -0.32 | 0.25 | 0.04 | -0.82 | -1.14* | -0.16** | 0.17 | 0.1 | -0.76 | -0.48** | 0.92** | 0.01 | 0.18 | 0.03 | -40.2** |
| PC X 15/TLCV-2 | 0.06 | 0.50* | -2.29 | 0.91** | 0.45** | 0.64** | 1.12 | -0.79 | 0.36** | 0.3 | 0.32* | 3.43** | -0.23* | -0.5** | 0.32** | -1.8** | 0.02 | 93.89** |
| PC X 14/TLCV-3 | -0.39 | -1.19** | 7.1** | -1.13** | -0.82** | -0.42** | 1.95** | 1.13* | -0.75** | -0.68** | -0.91** | -29.31** | 0.18* | -0.89** | -0.17 | 0.65 | -0.1 | -174.52** |
| PC X 14/TLCV-1 | -1.22** | 1.11** | -2.33 | 0.55** | 0.12 | -0.26* | -2.26** | 0.79 | 0.54** | 0.21 | 0.48** | 26.63** | 0.53** | 0.47** | -0.16 | 0.97* | 0.05 | 120.84** |
| AV X 15/TLCV-4 | -0.03 | -0.65** | 0.22 | -0.12 | -0.6** | -0.11 | 1.42* | 2.04** | 0.34** | -0.34 | -0.06 | 2.28* | 0.54** | 0.48** | 0.07 | 0.43 | -0.01 | 81** |
| AV X 15/TLCV-2 | -2.53** | -0.16 | -1.63 | -0.06 | -0.2 | -0.51** | -0.82 | -0.78 | -0.02 | -0.4 | -0.08 | -4.1** | -0.43** | -0.34* | 0.13 | 1.21** | 0.62** | 2.58 |
| AV X 14/TLCV-3 | 2.36** | -0.74** | 1.05 | -0.89** | 0.33* | 0.63** | -3.99** | -0.72 | 0.12* | -0.27 | 0.27 | 8.31** | -0.43** | 0.37** | -0.32** | -2.04** | -0.68** | 35.58** |
| AV X 14/TLCV-1 | 0.19 | 1.55** | 0.36 | 1.08** | 0.47** | -0.01 | 3.39** | -0.54 | 0.45** | 1.01** | -0.14 | -6.48** | -0.32** | -0.5** | 0.12 | 0.4 | 0.08 | -119.16** |
| KA X 15/TLCV-4 | 0.64* | 1.25** | -4.25** | 1.47** | 0.35** | 0.54** | -0.15 | 0.89 | -0.26** | -0.09 | -0.18 | -6** | 0.66** | -0.3* | -0.23* | -0.99* | 0.68** | -57.15** |
| KA X 15/TLCV-2 | -0.19 | 0.33 | 4.59** | -0.3 | 0.15 | 0.14 | -2.1** | -1.51** | 0.76** | 0.57* | 0.66** | 26.51** | 0.35** | 1.28** | -0.07 | 2.17** | -0.56** | 153.16** |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| KA X 14/TLCV-3 | -0.64* | 0.72** | -3.8** | 0.63** | 0.08 | -0.12 | -1.41* | -1.10* | 0.62** | 0.50* | 0.53** | 19.52** | 0.57** | 0.47** | 1.08** | -0.11 | 0.6** | 119.08** |
| KA X 14/TLCV-1 | 0.19 | -2.31** | 3.46** | -1.79** | -0.58** | -0.56** | 3.66** | 1.72** | -1.12** | -0.97** | -0.01 | -40.03** | -1.57** | -1.46** | -0.79** | -1.07* | -0.71** | -215.09** |
| H-86 X 15/TLCV-4 | -1.19** | -0.78** | 1.47 | -1.43** | 0.2 | -0.36** | -0.08 | -0.71 | 0.35** | 0.03 | 0.05 | 10.38** | 0.53** | -1.67** | 0.47** | 0.79 | -0.55** | 83.43** |
| H–86 X 15/TLCV-2 | 1.31** | 1.37** | 2.98* | 1.43** | 0.2 | 0.24* | -5.91** | 0.63 | -0.44** | -0.19 | 0.47** | 10.47** | 0.40** | 1.00** | -0.4** | 0.48 | 0.09 | -99.24** |
| H-86 X 14/TLCV-3 | -0.47 | 2.13** | 2.62* | 1.67** | -0.07 | 0.18 | 4.02** | 0.18 | 0.18** | 0.26 | 0.01 | -6.42** | -0.43** | 0.5** | -0.21 | -0.82 | 0.35** | 50.12** |
| H-86 X 14/TLCV-1 | 0.36 | -2.72** | -7.06** | -1.67** | -0.33* | -0.06 | 1.97** | -0.1 | -0.1* | -0.1 | 0.53** | -14.43** | -0.5** | 0.17 | 0.15 | -0.46 | 0.11 | -34.31** |
| H-24 X 15/TLCV-4 | 0.22 | 0 | 2.41* | -0.58** | -0.15 | 0.04 | 0.54 | -0.17 | -0.29** | 0.02 | 0.01 | -6.68** | -0.31** | 0.19 | 0.19 | -2.17** | -0.62** | -71.52** |
| H-24 X 15/TLCV-2 | 0.72* | 0.85** | 0.9 | 0.65** | 0.25 | 0.44 | 2.27** | 0.89 | -0.03 | -0.24 | 0.49** | -14.06** | 0.06 | -0.54** | -0.48** | -0.45 | 0.16 | -0.45 |
| H-24 X 14/TLCV-3 | -0.39 | -1.76** | -7.43** | -1.72** | -0.02 | -0.42** | -1.95** | 1.52** | -0.7** | -0.02 | 0.37* | -7.24** | -0.23* | -0.8** | -0.21 | 0.65 | 0.20* | -164.62** |
| H-24 X 14/TLCV-1 | 0.56 | 0.91** | 4.12** | 1.65** | -0.08 | -0.06 | -0.86 | -2.24** | 1.02** | 0.24 | 0.85** | 27.98** | 0.49** | 1.15** | 0.68** | 1.97** | 2.26** | 236.59** |
| SE | 0.29 | 0.23 | 1.18 | 0.21 | 0.13 | 0.11 | 0.58 | 0.49 | 0.05 | 0.23 | 0.16 | 0.96 | 0.09 | 0.13 | 0.11 | 0.45 | 0.10 | 11.09 |

*Significant at P = 0.05 level, ** Significant at P = 0.01 level

1. Days to 50% flowering 2.No. of branches per plant 3.Plant height (cm) 4.Number of fruit cluster per plant
5. Number of flowers per cluster 6. Number of fruits per cluster 7.Number of fruits per plant 8.Days to first fruit harvest
9. Fruit yield per plant (kg) 10.Fruit length (cm) 11.Fruit diameter (cm) 12.Average fruit weight (g)
13. Number of locules per fruit 14.Pericarp thickness (mm) 15.Total soluble solids (ºBrix) 16.Ascorbic acid content (mg/100g) 17. Dry matter% of fruit 18.Fruit yield per hectare (q)

## Conclusions

The principal aim of any breeding programme is to increase the yield potential. The concept of combining ability is gaining importance in plant breeding as it provides valuable genetic information about the parents and the characters under study. It helps in assessing the breeding value of parental lines in terms of their superiority in hybrid combinations and also provides the information regarding the nature and extent of gene action involved in controlling the inheritance of characters in question, like yield and yield attributing characters, thus helps in deciding upon the future breeding strategy.

It was concluding that, the lines Kashi Anupam, H-86, H-24 and the testers 2014/TOLCVRES-3, 2015/TOLCVRES-2, 2014/TOLCVRES-1 were identified as top GCA combiners while, the cross combinations PR X 14/TLCV-3, KA X 15/TLCV-2, KA X 14/TLCV-3, H-86 X 15/TLCV-4, H-86 X 14/TLCV-3 and H-24 X 14/TLCV-1 were identified as top SCA combiners for multiple traits in tomato for fruit yield and its contributing characters.

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