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## Research Article

# Assessment of combining ability for yield and yield contributing traits in sweet corn

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**Abstract**
An investigation was carried out to assess the combining ability and nature of gene action in sweet corn genotypes using Line x Tester mating design using ten lines and five testers. Investigation on combining ability indicated the predominance of non-additive gene action for all the traits under study. The variance due to genotypes was highly significant among the parents and hybrids for all the traits studied. This result strongly suggests the utilisation of heterosis breeding methods to exploit hybrid vigour. The lines $L_1$, $L_8$, $L_7$, $L_{10}$ and testers $T_1$, $T_5$ had superior *per se* performance for yield and yield contributing traits. The results also revealed that, the lines $L_1$, $L_7$ and testers $T_1$, $T_5$ had high *per se* performance coupled with high *gca* for most of the yield attributing traits. Based on *per se* performance and *sca* effects, the hybrids $L_2$ x $T_2$, $L_1$ x $T_1$, $L_1$ x $T_5$, $L_7$x $T_4$and $L_4$x $T_1$ were found to be good. Among these hybrids,$L_2$ x $T_2$ was considered best because it recorded highest *per se* performance coupled with high *sca* for yield and yield contributing traits.

**Key words**
Sweet corn, line x tester analysis, combining ability

## INTRODUCTION

Maize is one of the most important cereal crops next to wheat and rice in the tropics. Sweet corn has arisen as a mutant from field corn in the 19th century**.** Due to its sweet taste and tenderness, cultivation of sweet corn is the first choice of the farmers now a days for green fodder and green cobs. Therefore, development of sweet corn varieties with enhanced sugar content is gaining popularity not only in India but in international markets as well (Kumar,2008).

Sweet corn has a sugary rather than a starchy endosperm with a creamy texture. The low starch level makes the kernel wrinkled rather than plumpy. Sweet corn varies from normal corn essentially for gene(s) that affect starch synthesis in the seed endosperm wherein, one or more simple recessive alleles in the seed endosperm elevate the level of water soluble polysaccharides (sugars) and decrease starch (Dinges *et al*., 2001). In earlier history of sweet corn, corn lines with only the sugary (*su1*) allele on chromosome 4 used to be referred to as sweet corn. Currently, several endosperm genes that affect carbohydrate synthesis in the endosperm are being used either singly or in combination for the development of sweet corn varieties (Tracy, 1997). Four most useful mutants are shrunken 2 (*sh2*), brittle (*bt*), sugary (*su1*) and sugary enhancer (*se*).The *sh2* and *bt* genes are located in the chromosome 3 and 5 respectively and are classified as class 1 mutants ,su1 and se are located in chromosome 4 and 2 respectively are class 2 mutants.

Sweet corn is simpler to grow, labour-saving, less prone to insect pest infestation .It is the raw material for industrial products such as dextrose and starch syrup. It is also a very good source of B-complex group of vitamins such as thiamin, niacin, pantothenic acid, riboflavin, and pyridoxine. Sweet corn is gaining importance in premier hotels for preparation of delicacies like soups, sweets, jams, manchurian etc and are also eaten fresh due to its sweetness. Hence often times, growing sweet corn is found to be more profitable than growing corn for grain purpose.

For systematic breeding programme, it is necessary to identify the parents as well as crosses which could be exploited in order to bring about further genetic improvement in yield. Nature of gene action of each yield contributing traits play important role in deciding the appropriate breeding method. Knowledge on combining ability of parents is useful to identify suitable parents in terms of performance of their hybrids. With this background, a study was undertaken in sweet corn to study the gene action and combining ability of parents for important yield contributing traits.

## MATERIALS AND METHODS

This study was taken up by crossing ten lines and five testers of sweet corn in aLine x Tester fashion. The list of lines and testers used in present investigation is provided in **Table 1.** Hand emasculation and pollination method was used as crossing method. The newly synthesized fifty hybrids along with the fifteen parents were evaluated along with standard check, Sugar 75. Each entry was grown in two rows each of 4m length in RBD. The recommended package of practices was followed and biometrical observations were recorded on five randomly selected plants for 17 quantitative traits and three qualitative traits. The mean data were subjected to analysis of variance under Lx T design as suggested by Kempthrone (1957).

## RESULTS AND DISCUSSION

The analysis of variance showed highly significant differences among the genotypes for all the traits under study. It also revealed significant differences among the parents and hybrids for all the traits under consideration and highly significant variance estimates for all the traits studied (**Table 2**). Highly significant differences among the genotypes for all the characters indicated the presence of sufficient genetic variability (Amiruzzaman *et al.*2010).Variance due to lines was significant for cob placement height, tassel length, days to silking, number of kernel rows per cob. Variance due to tester was found to be significant for tassel branches, days to tasselling, total sugar and non-reducing sugar. Variance due to interaction effects of lines and testers were significant for all the characters except days to 50% silking (**Table 3**).This indicates divergence between the hybrids.

**Table 1. List of lines and testers used in the Line x Tester analysis**

| Sl .No | Code No. | Name of the lines |
|---|---|---|
| 1 | $L_1$ | USC 1-2-3 |
| 2 | $L_2$ | USC -10-3 |
| 3 | $L_3$ | USC 1378-5-1 |
| 4 | $L_4$ | USC 1421-5-2-2 |
| 5 | $L_5$ | USC 11-2 |
| 6 | $L_6$ | WNC 12012-2 |
| 7 | $L_7$ | WNC 12069-2 |
| 8 | $L_8$ | WNC 12068-2 |
| 9 | $L_9$ | WNC 12084-1 |
| 10 | $L_{10}$ | USC 8324 |
| | **Code No.** | **Name of testers** |
| 11 | $T_1$ | 12039-1 |
| 12 | $T_2$ | SC 11-2 |
| 13 | $T_3$ | 1413-6-2-2 |
| 14 | $T_4$ | 1421-5-2-1 |
| 15 | $T_5$ | SC 1107 |

The estimates of general combining ability variance (GCA) and specific combining ability variance (SCA) for different traits studied are presented in **Table 3**. The SCA variance was found to be greater than GCA variance for all the traits. This indicated the predominance of non-additive gene action in governing the inheritance of these traits and suitability of heterosis breeding to exploit hybrid vigour. The results obtained were in accordance with Thulasimani (2015), and Bahr *et al.*(2015)for cob length, cob diameter, number of kernel rows per cob, number of kernels per row, hundred seed weight, grain yield per plant. Shantha kumara *et al.* (2013) also indicated pre dominance of non- additive gene action for twelve quantitative and six qualitative characters in sweet corn and suggested heterosis breeding. The contribution of lines was greater than the testers in his study.

It was observed in this study that the parents differed in their combining ability for different traits and that no parent can be a good combiner for all the traits (**Table 4**).Majumder and Bhowal (1998) also reported parallelism between *per se* performance and *gca* effects for the improvement of any character. The lines $L_1$, $L_7$ and testers $T_1$, $T_5$ were identified as best as they recorded high *per se* performance coupled with high *gca* effects for most of the yield and yield contributing traits *viz.,* green cob yield, cob length, cob breadth, number of kernel rows per cob, number of kernels per row, hundred seed weight. Similar results of high *gca* effects was reported by Abdallah (2014) and Meseka and Ishaaq (2012)for yield and yield attributing traits. Line $L_3$ and tester $T_3$ had high *per se* performance coupled with high *gca* for total sugars.

**Table 2. Mean squares analysis of variances**

| Characters | Sources of variation | | | | |
|---|---|---|---|---|---|
| | Genotypes | Hybrids | Parents | Parents vs hybrids | Error |
| Days to 50% tasseling | 13.39** | 13.48** | 12.72** | 18.28** | 3.24 |
| Days to 50% silking | 27.54** | 26.61** | 21.97 | 151.04** | 15.64 |
| ASI | 3.38** | 2.55** | 6.36** | 2.38** | 0.23 |
| Plant height | 840.30** | 606.1054** | 924.12** | 11142.42** | 13.7330 |
| Tassel length | 21.63** | 22.77** | 18.90** | 3.74** | 5.34 |
| Tassel branches | 42.06** | 42.42** | 43.60** | 2.92** | 6.23 |
| Cob placement height | 591.05** | 568.89** | 504.36** | 2890.89** | 17.250 |
| Green cob weight | 5611.76** | 4854.11** | 8143.04** | 7298.87** | 120.84 |
| Cob length | 7.18** | 5.43** | 13.23** | 8.39 | 2.27 |
| Cob breadth | 4.61** | 3.86** | 7.44** | 2.14 | 1.33 |
| Number of kernel rows per cob | 96.74** | 79.98** | 144.37** | 251.70** | 9.60 |
| Number of kernels per row | 10.62** | 9.39** | 13.50** | 30.52** | 1.70 |
| Green cob yield | 4.30** | 4.52** | 2.65** | 17.13** | 0.20 |
| Dry cob weight | 771.04** | 634.31** | 926.50** | 5293.92** | 15.23 |
| Seed weight per cob | 542.21** | 447.76** | 642.63** | 3765.11** | 24.68 |
| Shank weight | 29.10** | 27.64** | 30.76** | 77.56** | 4.64 |
| 100 seed weight | 8.39** | 7.17** | 9.50** | 52.49** | 0.81 |
| Total sugar | 41.63** | 40.05** | 50.05** | 0.94 | 0.38 |
| Reducing sugar | 0.29** | 0.22** | 0.40** | 0.41** | 0.08 |
| Non reducing sugar | 42.75** | 41.61** | 49.74** | 0.64 | 1.02 |

*-significant at 5% level **-significant at 1% level.

**Table 3. Mean squares from analysis of variances for combining ability**

| Characters | Sources of variation | | | |
|---|---|---|---|---|
| | Lines | Tester | Lines X Tester | Error |
| Days 50% tasseling | 19.96 | 22.99 | 10.80** | 3.06 |
| Days to50% silking | 47.33 | 20.37 | 22.13 | 19.47 |
| ASI | 4.15 | 3.22 | 2.08** | 0.22 |
| Plant height | 681.86 | 653.08 | 581.95** | 15.60 |
| Tassel length | 41.14* | 30.159 | 17.357** | 4.01 |
| Tassel branches | 40.09 | 152.87** | 30.731** | 5.81 |
| Cob placement height | 1303.02** | 210.82 | 425.14** | 19.00 |
| Green cob weight | 5935.918 | 3409.29 | 4744.19** | 146.37 |
| Cob length | 4.56 | 6.85 | 5.486** | 2.18 |
| Cob breadth | 5.16 | 4.73 | 3.43** | 0.959 |
| Number of kernel rows per cob | 156.14* | 84.80 | 60.40** | 9.44 |
| Number of kernels per row | 12.98 | 12.12 | 8.19** | 1.77 |
| Green cob yield | 6.67 | 4.10 | 4.02** | 0.20 |
| Dry cob weight | 469.85 | 61.33 | 739.10** | 14 |
| Seed weight per cob | 374.21 | 108.05 | 503.89** | 26.10 |
| Shank weight | 36.87 | 14.18 | 26.83** | 4.37 |
| 100 seed weight | 7.13 | 1.35 | 7.83** | 0.903 |
| Total sugar | 28.25 | 174.73** | 28.04** | 0.32 |
| Reducing sugar | 0.09 | 0.06 | 0.27** | 0.08 |
| Non reducing sugar | 22.534 | 168.45** | 32.29** | 1.15 |

*-significant at 5% level **-significant at 1% level.

**Table 4.General combining ability (*gca*) effects of parents for yield and yield related traits**

| Parents | CW | CL | CB | KRC | NKR | GCY | TS | 100 SW |
|---|---|---|---|---|---|---|---|---|
| L1 | 3.57 ns | 0.13 ns | 0.36 ns | 1.72 ** | 1.84 * | 2.89 ** | 2.06 ** | -0.49 * |
| L2 | -24.17 ** | -0.95 * | -1.32 ** | -1.17 ** | -8.20 ** | 0.86 ** | -1.77 ** | 0.72 ** |
| L3 | -0.55 ns | 0.72 ns | 0.11 ns | -0.88 * | -0.44 ns | -0.76 ** | 2.47 ** | 0.45 ns |
| L4 | 3.90 ns | -0.60 ns | -0.08 ns | -0.26 ns | 0.74 ns | -1.16 ** | -0.83 ** | -1.07 ** |
| L5 | 12.82 ** | 0.55 ns | 0.70 ** | -0.21 ns | 1.36 ns | -2.13 ** | -0.49 ** | -0.00 ns |
| L6 | 3.23 ns | -0.57 ns | 0.10 ns | 1.30 ** | -2.56 ** | -0.72 ** | -0.43 ** | -0.03 ns |
| L7 | 18.38 ** | 0.31 ns | 0.46 ns | -0.48 ns | 1.18 ns | 1.09 ** | 0.69 ** | 1.34 ** |
| L8 | 20.59 ** | 0.36 ns | 0.44 ns | 0.65 ns | 2.01 * | -0.28 ns | -1.02 ** | -0.12 ns |
| L9 | -16.71 ** | -0.16 ns | -0.34 ns | -0.28 ns | 2.37 ** | 0.18 ns | 0.19 ns | -0.20 ns |
| L10 | -21.06 ** | 0.20 ns | -0.43 ns | -0.39 ns | 1.70 * | 0.03 ns | -0.87 ** | -0.59 * |
| T1 | 25.56 ** | 0.13 ns | 0.64 ** | 1.09 ** | -1.70 ** | 0.97 ** | -3.95 ** | -0.15 ns |
| T2 | -6.26 ** | -0.33 ns | 0.06 ns | -0.17 ns | 0.00 ns | -0.49 ** | 1.92 ** | 0.16 ns |
| T3 | -0.37 ns | 0.74 ** | -0.14 ns | -0.21 ns | 2.50 ** | -0.94 ** | 1.35 ** | 0.22 ns |
| T4 | -7.67 ** | -0.05 ns | -0.42 * | -0.59 * | -1.36 * | -0.09 ns | -0.65 ** | -0.29 ns |
| T5 | -11.25 ** | -0.49 ns | -0.14 ns | -0.11 ns | 0.56 ns | 0.55 ** | 1.33 ** | 0.06 ns |
| SE(*gca*of lines) | 3.12 | 0.38 | 0.25 | 0.34 | 0.79 | 0.25 | 0.15 | 0.25 |
| SE(*gca*of testers) | 2.20 | 0.27 | 0.18 | 0.24 | 0.56 | 0.17 | 0.10 | 0.17 |

Specific combining ability helps in identification of best cross combination to exploit hybrid vigour. Specific combing ability of hybrids for green cob yield was high in $L_2$ x $T_2$. Among the hybrids, fifteen hybrids showed positive significant *sca* effects (**Table 5**).The hybrids $L_2$x$T_2$, $L_1$ x$T_1$, $L_7$ x $T_4$, $L_4$ x $T_1$ and $L_1$x $T_5$were identified as good specific combiners and also exhibited high *per se* performance for green cob yield. The hybrid $L_2$x$T_2$registered high *per se* performance coupled with good *sca* for the characters *viz*., cob weight, 100 seed weight and green cob yield (**Table 7**). Similar results of high *sca* was reported by Kanta *et al.*(2005), Reddy *et al.* (2011)and Shantha kumara (2011)for plant height, ear height, ear length, ear circumference, kernel rows per ear, kernel per row, 100-seed weight, and grain yield per plant. All the hybrids which expressed significant *sca* effects were from different types of parental *gca* combinations like high x low, low x high and high x high. These desirable *sca* effects may be due to combination of favorable genes from corresponding parents coupled with non-additive gene action. For instance, green cob yield in the $L_2$ x $T_2$ is associated with high general combining ability of the parent $L_1$ while the parent $T_2$ exhibited lower *gca*. Thus high yield may be due to dominance or epistatic effect of one inbred. Three hybrids $L_5$ x$T_1$, $L_1$x$T_5$ and $L_3$ x $T_2$registered high *per se* performance for total sugars while the hybrids $L_5$ x$T_1$, $L_5$ x$T_2$ and $L_7$ x $T_4$ registered better *sca* . However, only one hybrid $L_5$ x $T_2$ showed good *per se* performance coupled with high gca.

**Table 7. List of top performing hybrids based on mean performance and *sca.***

| Sl.No. | Characters | Mean | *Sca* | Mean and *sca* |
|---|---|---|---|---|
| 1. | Cob weight (g) | $L_4$ x $T_1$ (283.2 ), $L_1$ x $T_1$(259.1), $L_5$ x $T_3$(228.9), $L_8$x $T_1$(227.5) | $L_4$ x $T_1$(73.84**), $L_2$ x $T_2$(61.84**), $L_1$ x $T_1$(50.06**), $L_9$x $T_4$(45.56**) | $L_4$ x $T_1$, $L_1$ x $T_1$, |
| 2. | Cob length (cm) | $L_2$ x $T_3$(20.9), $L_9$ x $T_4$(20.1), $L_1$ x $T_1$(20.08), $L_8$x $T_3$(18.2) | $L_2$ x $T_3$(3.19**), $L_9$ x $T_4$(2.65**), $L_2$ x $T_2$(2.20*) | $L_2$ x $T_3$, $L_9$ x $T_4$ |
| 3. | Cob breadth (cm) | $L_4$ x $T_1$(16.5), $L_7$ x $T_1$(15.63), $L_6$ x $T_1$(15.54), $L_5$x $T_2$(15.48) | $L_2$ x $T_3$(2.03**), $L_4$ x $T_1$(1.81**), $L_2$ x $T_2$(1.52**), $L_9$ x $T_4$(1.19*) | $L_4$ x $T_1$ |
| 4. | Number of kernel rows per cob | $L_1$ x $T_1$(18), $L_4$ x $T_1$(18), $L_6$ x $T_1$(18), $L_5$x $T_5$(17) | $L_1$ x $T_1$(5.16**), $L_2$ x $T_3$ (3.01**), $L_5$ x $T_5$(2.51**), $L_4$ x $T_1$(2.47**) | $L_1$ x $T_1$, $L_4$ x $T_1$, $L_5$ x $T_5$ |
| 5. | Number of kernels per row | $L_8$ x $T_3$(44), $L_7$ x $T_3$(41), $L_{10}$ x $T_5$(41), $L_5$x $T_3$(40) | $L_2$ x $T_2$(10.82**), $L_2$ x $T_3$ (5.99**), $L_4$ x $T_1$(4.58*), $L_2$ x $T_5$(4.26*) | - |
| 6. | Green cob yield (t/ha) | $L_2$ x $T_2$(19.1), $L_1$ x $T_1$(18.3), $L_1$ x $T_5$(18.1), $L_7$x $T_4$(15.8), $L_1$x $T_4$(14.21), $L_4$x $T_1$(14.2) | $L_2$ x $T_2$(7.18**), $L_7$ x $T_4$(3.25**), $L_1$ x $T_5$(3.11**), $L_8$x $T_5$(3.00**), $L_4$ x $T_1$(2.83**), $L_1$x $T_1$(2.88**), $L_9$ x $T_4$(1.43*) | $L_2$ x $T_2$, $L_1$ x $T_5$, $L_1$ x $T_1$, $L_4$x $T_1$ $L_7$ x $T_4$ |
| 7. | Total sugars (%) | $L_5$ x $T_2$ and $L_1$ x $T_3$ (21.33), $L_3$ x $T_3$ (21.2), $L_3$ x $T_2$ (21.17) | $L_5$ x $T_1$ (6.74*) $L_5$ x$T_2$ (4.60*), $L_7$x$T_4$ (4.16*) | $L_5$ x $T_2$ |
| 8. | 100 seed weight (g) | $L_2$ x $T_2$(14.9), $L_2$x $T_5$(13.7), $L_7$ x $T_4$(13.6), $L_7$x $T_3$(12.9) | $L_2$ x $T_2$(3.43**), $L_2$ x $T_5$(2.38**), $L_7$ x $T_4$(1.96**), $L_5$x $T_2$(1.66**), $L_4$ x $T_1$(1.50**), | $L_2$ x $T_2$, $L_2$x $T_5$, $L_7$ x $T_4$, |

**Table 5.Specific combining ability (*sca)* effects of hybrids for yield and yield related traits**

| | CW | CL | CB | KRC | NKR | GCY | TS | 100 SW |
|---|---|---|---|---|---|---|---|---|
| $L_1$ x $T_1$ | 50.06 ** | -1.84 * | 0.90 ns | 5.16 ** | 3.48 ns | 2.88 ** | 0.75 * | 0.42 ns |
| $L_1$ x $T_2$ | 1.20 ns | 0.41 ns | 0.39 ns | -0.25 ns | 1.11 ns | -0.54 ns | -0.62 ns | -1.32 * |
| $L_1$ x $T_3$ | -38.68 ** | -1.23 ns | -1.10 ns | -2.32 ** | -5.28 ** | -5.28 ** | 2.61 ** | 0.69 ns |
| $L_1$ x $T_4$ | 21.51 ** | 0.25 ns | 0.72 ns | -0.50 ns | 3.03 ns | -0.18 ns | -2.91 ** | 1.05 ns |
| $L_1$ x $T_5$ | -34.09 ** | -1.26 ns | -0.91 ns | -2.09 ** | -2.34 ns | 3.11 ** | 0.17 ns | -0.83 ns |
| $L_2$ x $T_1$ | -33.98 ** | -3.70 ** | -3.48 ** | -2.62 ** | -13.15 ** | -2.06 ** | -2.65 ** | -3.84 ** |
| $L_2$ x $T_2$ | 61.84 ** | 2.20 * | 1.52 ** | 0.41 ns | 10.82 ** | 7.18 ** | -0.28 ns | 3.43 ** |
| $L_2$ x $T_3$ | 26.95 ** | 3.19 ** | 2.03 ** | 3.01 ** | 5.99 ** | -1.55 ** | 2.68 ** | 0.89 ns |
| $L_2$ x $T_4$ | -71.42 ** | -2.02 * | -1.22 * | -2.05 ** | -7.93 ** | -2.79 ** | -1.61 ** | -2.85 ** |
| $L_2$ x $T_5$ | 16.60 * | 0.34 ns | 1.16 * | 1.25 ns | 4.26 * | -0.79 ns | 1.87 ** | 2.38 ** |
| $L_3$ x $T_1$ | -20.71 ** | -0.46 ns | 0.16 ns | -1.13 ns | -0.23 ns | 0.08 ns | -1.43 ** | 0.37 ns |
| $L_3$ x $T_2$ | -26.23 ** | -0.74 ns | -0.23 ns | 0.12 ns | -2.38 ns | -0.34 ns | 1.47 ** | -0.53 ns |
| $L_3$ x $T_3$ | 11.88 ns | -0.34 ns | 0.24 ns | 1.06 ns | -1.65 ns | -0.10 ns | 2.07 ** | 0.23 ns |
| $L_3$x $T_4$ | 15.18 * | 0.58 ns | -0.31 ns | 0.33 ns | 1.20 ns | 0.21 ns | 1.47 ** | 0.32 ns |
| $L_3$ x $T_5$ | 19.87 ** | 0.96 ns | 0.14 ns | -0.37 ns | 3.06 ns | 0.15 ns | -3.58 ** | -0.40 ns |
| $L_4$ x $T_1$ | 73.84 ** | 1.64 ns | 1.81 ** | 2.47 ** | 4.58 * | 2.83 ** | 1.20 ** | 1.50 ** |
| $L_4$ x $T_2$ | -12.67 ns | 0.08 ns | -0.09 ns | -0.50 ns | 1.77 ns | -3.36 ** | -0.93 ** | 1.03 ns |
| $L_4$x $T_3$ | -40.78 ** | -0.47 ns | -1.24 * | -1.12 ns | -0.40 ns | 1.44 ** | -1.76 ** | -1.06 ns |
| $L_4$ x $T_4$ | -28.93 ** | -1.71 * | -0.52 ns | -0.52 ns | 0.18 ns | -1.39 * | 3.94 ** | -1.83 ** |
| $L_4$ x $T_5$ | 8.54 ns | 0.46 ns | 0.03 ns | -0.33 ns | -6.13 ** | 0.47 ns | -2.45 ** | 0.36 ns |
| $L_5$ x $T_1$ | -68.30 ** | -1.15 ns | -0.68 ns | -2.46 ** | 0.08 ns | -2.48 ** | -0.79 * | 1.27 * |
| $L_5$ x $T_2$ | 4.29 ns | -0.06 ns | 0.56 ns | -0.76 ns | -4.96 ** | -0.26 ns | 4.60 ** | 1.66 ** |
| $L_5$ x $T_3$ | 36.51 ** | 0.04 ns | 0.45 ns | 0.83 ns | -0.12 ns | 1.68 ** | -3.57 ** | -0.87 ns |
| $L_5$ x $T_4$ | 13.81 * | 0.82 ns | -0.39 ns | -0.12 ns | 3.74 * | 1.06 ns | -0.12 ns | -1.19 * |
| $L_5$ x $T_5$ | 13.68 ns | 0.35 ns | 0.05 ns | 2.51 ** | 1.26 ns | 0.01 ns | -0.11 ns | -0.88 ns |
| $L_6$ x $T_1$ | 12.62 ns | 0.74 ns | 0.64 ns | 0.91 ns | -1.68 ns | -0.93 ns | 6.74 ** | -1.67 ** |
| $L_6$ x $T_2$ | 15.10 * | 0.24 ns | 0.37 ns | -0.05 ns | -1.49 ns | 0.40 ns | 0.59 ns | 1.21 * |
| $L_6$ x $T_3$ | 12.55 ns | 0.27 ns | 0.20 ns | -0.45 ns | 3.34 ns | 1.15 * | -5.13 ** | 0.57 ns |
| $L_6$ x $T_4$ | -16.59 * | -0.19 ns | -0.52 ns | 1.03 ns | 1.65 ns | 1.28 * | -5.24 ** | 0.66 ns |
| $L_6$ x $T_5$ | -23.68 ** | -1.06 ns | -0.70 ns | -1.44 ns | -1.83 ns | -1.90 ** | 3.03 ** | -0.77 ns |
| $L_7$ x $T_1$ | -5.64 ns | 0.49 ns | 0.38 ns | -0.65 ns | 2.37 ns | 0.57 ns | -4.77 ** | -0.81 ns |
| $L_7$ x $T_2$ | -36.05 ** | -0.73 ns | -0.98 ns | 0.39 ns | -1.44 ns | -2.56 ** | -4.57 ** | -1.68 ** |
| $L_7$ x $T_3$ | 15.62 * | -0.20 ns | 0.42 ns | -0.01 ns | 1.17 ns | -0.46 ns | 2.21 ** | 0.75 ns |
| $L_7$x $T_4$ | 18.69 ** | 0.05 ns | -0.05 ns | 1.04 ns | -3.75 * | 3.25 ** | 4.16 ** | 1.96 ** |
| $L_7$ x $T_5$ | 7.38 ns | 0.40 ns | 0.24 ns | -0.78 ns | 1.66 ns | -0.81 ns | 2.98 ** | -0.21 ns |
| $L_8$x $T_1$ | 1.42 ns | -0.24 ns | 0.15 ns | -1.11 ns | 3.70 * | -2.19 ** | 1.16 ** | 0.77 ns |
| $L_8$ x $T_2$ | -1.04 ns | -0.15 ns | -0.57 ns | 0.15 ns | -3.05 ns | -0.28 ns | 1.26 ** | -0.41 ns |
| $L_8$x $T_3$ | 13.41 ns | 0.24 ns | 0.23 ns | 0.64 ns | 3.44 ns | 1.46 ** | 1.27 ** | -1.62 ** |
| $L_8$ x $T_4$ | 7.37 ns | -0.07 ns | 1.12 * | -0.54 ns | -1.03 ns | -1.99 ** | -1.14 ** | 1.31 * |
| $L_8$ x $T_5$ | -21.16 ** | 0.23 ns | -0.93 ns | 0.87 ns | -3.06 ns | 3.00 ** | -2.55 ** | -0.04 ns |
| $L_9$ x $T_1$ | -11.55 ns | 0.61 ns | 0.12 ns | -0.73 ns | 1.23 ns | -0.12 ns | -0.48 ns | 1.37 * |
| $L_9$x $T_2$ | -39.40 ** | -1.86 * | -1.28 * | -0.48 ns | -2.19 ns | -1.58 ** | -0.77 * | -2.58 ** |
| $L_9$ x $T_3$ | -17.07 * | -1.04 ns | -0.80 ns | -0.87 ns | -2.69 ns | 1.44 * | -2.35 ** | 1.03 ns |
| $L_9$ x $T_4$ | 45.56 ** | 2.65 ** | 1.19 * | 0.83 ns | 3.06 ns | 1.43 * | 1.76 ** | 0.97 ns |
| $L_9$ x $T_5$ | 22.47 ** | -0.36 ns | 0.77 ns | 1.25 ns | 0.58 ns | -1.16 * | 1.85 ** | -0.79 ns |
| $L_{10}$x $T_1$ | 2.24 ns | 0.25 ns | -0.00 ns | 0.16 ns | -0.38 ns | 1.41 * | 0.28 ns | 0.61 ns |
| $L_{10}$x $T_2$ | 32.95 ** | 0.61 ns | 0.31 ns | 0.97 ns | 1.81 ns | 1.34 * | -0.76 * | -0.81 ns |
| $L_{10}$x $T_3$ | -20.38 ** | -0.46 ns | -0.44 ns | -0.76 ns | -3.80 * | 0.21 ns | 1.98 ** | -0.60 ns |
| $L_{10}$x $T_4$ | -5.19 ns | -0.34 ns | -0.02 ns | 0.50 ns | -0.16 ns | -0.89 ns | -0.31 ns | -0.38 ns |
| $L_{10}$x $T_5$ | -9.62 ns | -0.06 ns | 0.15 ns | -0.87 ns | 2.53 ns | -2.07 ** | -1.20 ** | 1.18 * |
| **S.E** | 2.52 | 0.85 | 0.57 | 0.77 | 1.77 | 0.55 | 0.33 | 0.55 |

**CW- Cob weight, CL- Cob length, CB- Cob breadth, KC- Number of kernel rows per cob, KR- Number of kernels per row, GCY- Green cob yield, TS – Total sugars SW- Hundred seed weight**

In case of parents $L_1$, $L_7$ among the lines and tester $T_1$ were found to possess good *per se* performance and *gca* for yield attributing traits (**Table 6**).Out of 50 hybrids studied, the hybrid $L_2$ x $T_2$ was identified as the best hybrid since it possessed highest *per se* performance and *sca* for green cob yield and hundred seed weight. The hybrids $L_1$ x $T_1$ and $L_4$ x $T_1$werealsoidentified as best hybrids which recorded high *per se* performance coupled with high *sca* effect for green cob yield, green cob weight and number of kernel rows per cob. Thus these hybrids could be commercialised after extensive yield trial.

**Table 6. List of top performing parents based on mean performance and *gca.***

| Sl.No. | Characters | Mean | | *Gca* | | Mean and *gca* | |
|---|---|---|---|---|---|---|---|
| | | Lines | Testers | Lines | Testers | Lines | Tester |
| 1. | Cob weight (g) | $L_1$(277.3), $L_7$(234.7) | $T_1$(232.7), $T_5$(211) | $L_8$(20.59**), $L_7$(18.38**) | $T_1$(25.56**) | $L_7$ | $T_1$ |
| 2. | Cob length (cm) | $L_7$(19.8), $L_8$(19.2) | $T_1$(19.9), $T_2$(18.6) | - | $T_3$(0.74**) | - | - |
| 3. | Cob breadth (cm) | $L_7$(16), $L_1$(15.3) | $T_1$(16.2), $T_5$(14.7) | $L_5$(0.70**) | $T_1$(0.64**) | - | $T_1$ |
| 4. | Number of kernel rows per cob | $L_1$(16), $L_5$(15) | $T_1$(16), $T_5$(16) | $L_1$(1.72**), $L_6$(1.30**) | $T_1$(1.09**) | $L_1$ | $T_1$ |
| 5. | Number of kernels per row | $L_7$(39), $L_1$(37) | $T_2$(40), $T_5$(37) | $L_9$(2.37**), $L_8$(2.01*) | $T_3$(2.50**) | - | - |
| 6. | Green cob yield (t/ha) | $L_1$(11.2), $L_8$ (11.2), $L_7$(10.9), $L_{10}$(10.1) | $T_1$(14), $T_5$(13.2) | $L_1$(2.89**), $L_7$(1.09**) | $T_1$(0.97**), $T_5$(0.55**) | $L_1$, $L_7$ | $T_1$, $T_5$ |
| 7. | Total Sugar (%) | $L_3$ (21.32), $L_{10}$(19.31) | $T_3$ (21.84), $T_1$(18.93) | $L_3$ (2.47*) L1 (2.06*) | $T_2$ (1.92*) $T_3$(1.35*) | L3 | T3 |
| 8. | 100 seed weight (g) | $L_6$(11.9), $L_7$(13.2) | $T_1$(10.2), $T_5$(9.5) | $L_7$(1.34**) | - | $L_7$ | - |

## REFERENCES


Abdallah, T.A.E., 2014. Combining ability estimates using Line× Tester analysis to develop high yielding Maize hybrids. *Egypt J. Plant Breed.,***18**(1):45-55.

Amiruzzaman, M., Islam,M.A., Hassan,L and Rohman.M.M. 2010. Combining ability and heterosis for yield and component characters in Maize. *Acad. J.Plant Sci.,* **3**(2):79-84.

Bahr, A., Singh,N.K., Verma,S.S., Jaiswal,J.P and Shukla, P.S. 2015 Combining ability analysis and nature of gene action for grain yield in Maize hybrids. *IJOR***1**(8):1-4.

Dinges,J.R., C.Colleoni. A.M.Myers and M.G.James, 2001. Molecular structure of the three mutations at the maize sugary 1 locus and their allele specific phenotypic effects. Plant physiol., **125**:1406-1418

Kanta, G., Sigh,H.B., SharmaJ.K and Guleria.S.K. 2005. Heterosis and combinig ability studies for yield and related traits in maize. *Crop Res.,***30**(2):221-226.

Kumar, A. 2008. Direct and residual effect of nutrient management in maize (*Zea mays*)–wheat (*Triticum aestivum*) cropping system. *Ind J. Agron.,* **53**(1):37-41.

Kempthrone, O.1957. An introduction to genetic statistics.New York:John Wiley & Sons

Majumder,P. K. and Bhowal,J. G. 1998. Combining ability in a few varieties of *T. aestivum*, *T. compactum* and *T. sphaerococcum***.** *Indian J. Genet.,* **48**(1):43-48.

Meseka, S. and Ishaaq, J. 2012. Combining ability analysis among Sudanese and IITA maize germplasm at Gezira Research Station. *J. App Bio sci.* **5:**4198-4207.

Reddy, V.R., Rao, A.S and Sudarshan, M.R. 2011. Heterosis and combining ability for grain yield and its components in maize (*Zea mays* L.). *J. Res., ANGRAU.* **39** (3): 6-15.

Shantha kumara. B. 2011 Genetic studies on hybrids and their inbreds of sweet corn. *M.Sc., Thesis,* Tamil Nadu Agricultural University, Coimbatore, India.

Shanthakumara,N, K.N.Ganesan, G.Nallathambi and N.Senthil.2013. Heterosis of single cross sweet corn hybrids developed with inbreds of domestic genepool. *Madras Agric.J.* , **100**(1-3): 52-56,

Thulasimani, K. 2015 Line x Tester analysis of tropical inbreds and their single cross hybrids in maize(*Zea mays* L.). *M.Sc thesis.,* Tamil Nadu Agricultural University Coimbatore.

Tracy,W.F. 1997.History ,genetics and Plant breeding of super sweet (shrunken 2) sweet corn. *Plant Breeding Reviews*, **14**: 189-236