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# Study of standard heterosis and combining ability effects for various traits in sweet corn (*Zea mays* L. Ssp. *saccharata*) hybrids

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## Abstract

The present study was conducted to estimate heterosis and combining ability effects in sweet corn (*Zea mays* L. Ssp. *saccharata*) hybrids and to screen out hybrids having high green cob and fodder yield and high TSS content. About 66 genotypes comprising of 45 sweet corn hybrids, 18 parental lines and 3 standard checks (Priya, Madhuri and Sugar-75) were evaluated in RBD in three different environments ($E_1$ at Instructional Farm, RCA, Udaipur during Kharif-2019, $E_2$ at ARS, Banswara during Kharif-2019 and $E_3$ at Instructional Farm, RCA, Udaipur during Rabi-2019-20) in RBD with three replications for twenty diverse traits. Maximum and positively significant heterosis over the best check was shown by the sweet corn hybrid $L_7$ x $T_1$ (73.68%) for green cob weight/ plant. Highest and positively perceptible economic heterosis for green fodder yield (kg/ ha) and TSS content of green grain was observed for the sweet corn hybrids $L_4$ x $T_2$ (86.24%) and $L_{11}$ x $T_1$ (17.89%) respectively. On the basis of specific combining ability effects, among the selected best five hybrids, sweet corn hybrids $L_5$ x $T_2$ and $L_6$ x $T_3$ were best for green cob yield, green fodder yield and green cob weight plant$^{-1}$ while the hybrid $L_{10}$ x $T_1$ was best for green cob yield, green cob weight plant$^{-1}$ and TSS content of green grain. Combining ability analysis for green cob yield and green cob weight/ plant revealed that lines $L_2$, $L_3$, $L_7$, $L_8$, $L_{11}$, $L_{12}$ and $L_{13}$ were good general combiners over the three environments. Sweet corn hybrid $L_5$ x $T_2$ was identified to exhibit highest and positively significant specific combining ability effect for green cob yield (4090.05) over the three environments.

**Keywords:** Combining ability, green cob yield, heterosis, sweet corn, TSS

## Introduction

Sweet corn has high nutritional values, delicate texture and sweet taste within pericarp and endosperm and is treated as vegetable. The flavor, texture and sweetness of sweet corn kernels is due to presence of some endosperm mutant which alter the starch biosynthesis pathway in endosperm. The most useful mutations among them, *sh2*, *bt1*, *su1* and *se*, function either by accumulating sugar at the expense of starch or by changing types and proportions of different polysaccharides stored in endosperm (Boyer and Shannon 1984) [1]. Total sugar content in sweet corn at milky stage ranges from 25-30% as compared to 2-5% of normal corn (Sadaiah *et al.*, 2013) [8]. Popularity of sweet corn is increasing in the national and international market due to the sweetness and tenderness of its kernels and its appetizing taste, which has in turn resulted in its increased cultivation in the country, ensuring good return to the farmers. Further, the left over plant after the harvest of cobs can be used as fresh or dry fodder for the animals. Sweet corn breeding aims to improve quality and appearance as well as cob yield however, the genetic base of sweet corn breeding programme is relatively narrow and related inbreds often are crossed to make hybrids that meet the strict market requirements on quality and appearance (Tracy, 1994) [11]. Sweet corn breeders have often focused on improving quality and ear appearance, rather than on enhancing yield (Tracy, 1993). But emphasis on kernel sweetness along with yield needs to be considered as the major objective of sweet corn improvement. The quality parameters are relatively more important especially because of direct consumption of sweet corn as vegetable and the preference of the consumers. Keeping in view the above facts and the growing demand of sweet corn in the domestic and international market, development of hybrids exhibiting hybrid vigor using parents with superior combining ability has been taken as objective of first importance of the research.

## Material and Methods

Eighteen diverse sweet corn inbred lines, collected from different parts of the country were used as parents (fifteen females and three testers) (Table 1). The crosses were made in line x tester matting design at Instructional Farm, RCA, Udaipur during *kharif* 2018. Total 66 genotypes comprising of 45 sweet corn hybrids, 18 parental lines and 3 standard checks (Priya, Madhuri and Sugar-75) were evaluated in RBD in three different environments ($E_1$ at Instructional Farm, RCA, Udaipur during Kharif-2019, $E_2$ at ARS, Banswara during Kharif-2019 and $E_3$ at Instructional Farm, RCA, Udaipur during Rabi-2019-20) in RBD with three replications.

Recommended agronomic practices were used to raise a healthy crop. Observations were recorded for 20 yield attributing quantitative and qualitative characters like days to 50 per cent tasseling, days to 50 per cent silking, plant height, ear height, number of leaves/ plant, length of leaf, breadth of leaf, days to green cob harvest, number of ear/ plant, ear length, ear girth, number of grain rows/ ear, number of grains/ row, 100 fresh seed weight, green cob weight/ plant, moisture per cent of green grain, green cob yield, green fodder yield, TSS content of green grain and protein content.Ten plants were taken from each row for recording observations from each replication. TSS content was recorded using hand refrectrometer.

Estimation was done over the three environments on pooled basis. Estimates of standard heterosis was calculated according to Virmani *et al*. (1982) [12] and the significance of heterosis was tested Using‘t’ test. The analysis of variance for general and specific combining ability effects over the environments and in three individual environments was done for different characters under the study using line x tester mating design provided by Kempthorne (1957) [4].

**Table 1:** List of genotypes used

| S. No | Symbol | Pedigree | S. No | Symbol | Pedigree |
|---|---|---|---|---|---|
| 1. | $L_1$ | SC-7-2-1-2-6-1 | 10. | $L_{10}$ | BAJ-SC-17-2 |
| 2. | $L_2$ | SC-18728 | 11. | $L_{11}$ | BAJ-SC-17-1 |
| 3. | $L_3$ | BAJ-SC-17-6 | 12. | $L_{12}$ | DMSC-28 |
| 4. | $L_4$ | BAJ-SC-17-10 | 13. | $L_{13}$ | Mas Madu (sh2 sh2) |
| 5. | $L_5$ | BAJ-SC-17-12 | 14. | $L_{14}$ | MRCSC-12 |
| 6. | $L_6$ | BAJ-SC-17-9 | 15. | $L_{15}$ | SC-33 |
| 7. | $L_7$ | BAJ-SC-17-11 | 16. | $T_1$ | SC-35 |
| 8. | $L_8$ | BAJ-SC-17-8 | 17. | $T_2$ | SC-32 |
| 9. | $L_9$ | BAJ-SC-17-4 | 18. | $T_3$ | DMRSC-1 |

## Result and Discussion

The estimation of standard heterosis was done over the best check Sugar-75 over the three environments for all the characters under study**.** The analysis of data for economic heterosis for green cob yield over the three environments revealed that the sweet corn hybrid $L_7$ x $T_1$ exhibited highest estimates of positively significant standard heterosis against the best check Sugar-75 (71.40%). Maximum and positively significant heterosis over the best check was shown by the sweet corn hybrid $L_7$ x $T_1$ (73.68%) for green cob weight/ plant. Highest and positively perceptible economic heterosis for green fodder yield (kg/ ha) and TSS content of green grain was observed for the sweet corn hybrids $L_4$ x $T_2$ (86.24%) and $L_{11}$ x $T_1$ (17.89%) respectively. For ear length, maximum estimate of economic heterosis in positively significant direction was reported for the sweet corn hybrid $L_3$ x $T_1$ (40.59%). The sweet corn hybrid $L_1$ x $T_3$ (14.45%) exhibited highest and positively significant standard heterosis for number of grain rows/ ear. Further, $L_8$ x $T_1$ (41.66%) showed maximum estimate of significant and positive heterosis for number of grains/ row. The present findinds were in close agreement with earlier findings of Dagla *et al.* (2014) [3] and Kumari *et al*. (2018) [5]. None of the sweet corn hybrids were reported to exhibit significant economic heterosis in required direction for the characters days to 50 per cent tasseling, plant height, days to green cob harvest, ear girth and protein content over the three environments against the best check Sugar-75.

The general combining ability effects are considered to be the function of the additive gene effects and additive x additive type of non allelic interactions. Combining ability analysis for green cob yield and green cob weight/ plant revealed that lines $L_2$, $L_3$, $L_7$, $L_8$, $L_{11}$, $L_{12}$ and $L_{13}$ were good general combiners over the three environments. Similarly, for green fodder yield, lines $L_1$, $L_2$, $L_3$, $L_4$, $L_7$, $L_{11}$, $L_{12}$ and $L_{13}$, for TSS content of green grain, lines $L_1$, $L_5$, $L_7$, $L_{10}$, $L_{11}$, $L_{13}$ and $L_{14}$ and for protein content, line $L_{12}$ were identified as superior general combiners over the three environments on the basis of general combining ability analysis. Among the testers, $T_1$ was identified as good general combiner for green cob yield, green cob weight plant$^{-1}$ and TSS content of green grain on the basis of general combining ability estimates over the three environments. Similarly testers $T_1$ and $T_2$ were reported as superior combiners for green fodder yield on the basis of general combining ability analysis in pooled environments**.**

Sweet corn hybrid $L_5$ x $T_2$ was identified to exhibit highest and positively significant specific combining ability effect for green cob yield (4090.05) over the three environments (Table 2). The five best sweet corn crosses which possessed significantly positive specific combining ability effects for green cob yield on pooled basis were $L_5$ x $T_2$, $L_{15}$ x $T_3$, $L_{10}$ x $T_1$, $L_6$ x $T_3$, and $L_9$ x $T_1$, among which $L_5$ x $T_2$, $L_{10}$ x $T_1$ and $L_9$ x $T_1$ exhibited positively significant standard heterosis over the best check Sugar-75. The sweet corn hybrids $L_5$ x $T_2$, $L_{15}$ x $T_3$ and $L_6$ x $T_3$ were cross between poor general combining ability effects parents, while the hybrids $L_{10}$ x $T_1$ and $L_9$ x $T_1$ were cross between poor x good and average x good general combining ability effects parents. For green fodder yield, the best five sweet corn hybrids that showed maximum and positively significant specific combining ability effects were $L_4$ x $T_2$ followed by $L_{13}$ x $T_1$, $L_5$ x $T_2$, $L_6$ x $T_3$ and $L_8$ x $T_3$ on pooled basis (Table 3). The sweet corn hybrids $L_4$ x $T_2$ and $L_{13}$ x $T_1$ were cross between parents with good general combining ability effects while the hybrids $L_6$ x $T_3$ and $L_8$ x $T_3$ were cross between parents with poor general combining ability effects. Hybrid $L_5$ x $T_2$ was cross between the parents with poor x good general combining ability effects. Analysis for green cob weight plant$^{-1}$ identified $L_5$ x $T_2$, $L_{10}$ x $T_1$, $L_{15}$ x $T_3$, $L_6$ x $T_3$ and $L_7$ x $T_1$ as top five sweet corn hybrids to exhibit highest and positively significant specific combining ability effects on pooled basis. Hybrids $L_5$ x $T_2$, $L_{15}$ x $T_3$ and $L_6$ x $T_3$ were produced by crossing both parents with poor general combining ability effects, while $L_{10}$ x $T_1$ was cross between parents with poor x good general ability combining ability effects. The hybrid $L_7$ x $T_1$ was cross between both parents with good general combining ability effects. Analysis for TSS content of green grain over the three environments identified $L_{14}$ x $T_2$, $L_{12}$ x $T_1$, $L_2$ x $T_3$, $L_1$ x $T_3$ and $L_{10}$ x $T_3$ as the best five sweet corn hybrids possessing highest and significantly positive specific combining ability effects. The sweet corn hybrids $L_{14}$ x $T_2$, $L_1$ x $T_3$ and $L_{10}$ x $T_3$ were cross between good x poor general combining ability effects parents, $L_{12}$ x $T_1$ between poor x good general combining ability effects parents while $L_2$ x $T_3$ between parents with average x poor combining ability effects. Ola *et al.* (2018) [7], Chinthiya *et al.* (2019) [2], Nanditha *et al.* (2019), Sharma *et al.* (2019) [9] and Tesfaye *et al.* (2019) [10] reported similar results for combining ability analysis on maize.

**Table 2:** Five best sweet corn hybrids for green cob yield on the basis of specific combining ability effects over the three environments

| S. No | Sweet corn Hybrids/parents | SCA effects | Economic heterosis (%) | Mean green cob yield kg ha$^{-1}$ |
|---|---|---|---|---|
| 1 | $L_5$ x $T_2$ | 4090.05** | 35.12** | 15,222.22 |
| 2 | $L_{15}$ x $T_3$ | 3584.42** | -19.2** | 9,101.11 |
| 3 | $L_{10}$ x $T_1$ | 3551.09** | 30.47** | 14,695.56 |
| 4 | $L_6$ x $T_3$ | 3463.68** | 1.28 | 11,407.78 |
| 5 | $L_9$ x $T_1$ | 1999.60** | 38.92** | 15,646.67 |

**Table 3:** Five best sweet corn hybrids for green fodder yield on the basis of specific combining ability effects over the three environments

| S. No | Sweet corn Hybrids/parents | SCA/GCA effects | Economic heterosis (%) | Mean fodder yield kg ha$^{-1}$ |
|---|---|---|---|---|
| 1 | $L_4$ x $T_2$ | 13,377.43** | 86.24** | 37,163.33 |
| 2 | $L_{13}$ x $T_2$ | 8,799.65** | 75.11** | 35,061.11 |
| 3 | $L_5$ x $T_2$ | 8,237.06** | 44.16** | 28,765.56 |
| 4 | $L_6$ x $T_3$ | 7,598.84** | -1.11 | 19,732.22 |
| 5 | $L_8$ x $T_3$ | 6,938.47** | 14.23* | 22,794.44 |

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**Authors' contribution**

Conceptualization of research (Divya Chouhan); Designing of the experiments (Dr. R. B. Dubey); Contribution of experimental materials (Dr. Dilip Singh); Execution of field/lab experiments and data collection (Divya Chouhan and Piyush Choudhary); Analysis of data and interpretation (Divya Chouhan); Preparation of the manuscript (Divya Chouhan and Dr. R. B. Dubey).

**Declaration:** The authors do not have any conflict of interest.

## References

1. Boyer CD, Shannon JC. The use of endosperm genes for sweet corn improvement. Plant Breeding Reviews 1984;1:193-161.
2. Chinthiya A, Ganesan KN, Ravikesavan R, Senthil N. Combining ability and association studies on different yield contributing traits for enhanced green cob yield in sweet corn (*Zea mays* Ssp *saccharata*). Electronic Journal of Plant Breeding 2019;10(2):500-511.
3. Dagla MC, Gadag RN, Sharma OP, Kumar N. Estimation of heterosis for grain yield and quality traits in sweet corn (*Zea mays* Ssp *sacharata*). Electronic Journal of Plant Breeding 2014;5(4):775-780.
4. Kempthorne O. An introduction to genetic statistics. New York: John Wiley and sons, Inc; London: Chapman & Hall, Ltd 1957.
5. Kumari R, Singh AK, Suman S. Quantitative studies on heterosis and inbreeding depression in maize (*Zea mays* L.). Journal of Applied and Natural Science 2018;10(1):64-69.
6. Nandhitha G, Ganesan KN, Ravikesavan R. Heterosis and combining ability studies in single cross hybrids synthesized with diverse inbred lines of maize (*Zea mays* L.). Electronic Journal of Plant Breeding 2019;9(4):1503-1511.
7. Ola B, Dubey RB, Singh M, Ameta KD. Combining ability analysis in medium maturing yellow seeded maize (*Zea mays* L.) hybrids. Journal of Pharmacognosy and Phytochemistry 2018;7(3):1354-1359.
8. Sadaiah K, Reddy VN, Sudheer Kumar S. Heterosis and combining ability studies for sugar content in sweet corn (*Zea mays saccharata* L.). IJSRP 2013;3:1-5.
9. Sharma P, Kamboj MC, Punia MS. Assessment of combining ability effects using quality protein maize donors as testers for yield and yield traits in maize. Electronic Journal of Plant Breeding 2019;10(4):3365-3368.
10. Tesfaye D, Abakemal D, Habte E. Combining ability of highland adapted double haploid maize inbred lines using line x tester mating design. East African Journal of Sciences 2019;13(2):121-134.
11. Tracy WF. Sweet corn. In: A. R. Haullauer (ed.) Specialty types of maize. CRC Press, Boca Raton, Fla, 1994, pp. 147-187.
12. Virmani SS, Aquino RO, Khush GS. Heterosis breeding in Rice (*Oryza sativa* L.) 1982.