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# Heterosis for yield traits in maize (*Zea mays* L.)

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**Abstract**
In this study, a set of eight parents, fifty-six $F_1$s (direct and reciprocals), and two standard checks were evaluated during the *kharif* 2019, *late kharif* 2019 and *rabi* 2019 with two replications in a randomized block design at the research farm of All India Coordinated Research Project on maize, Rahuri center, Mahatma Phule Krishi Vidyapeeth, Rahuri, Dist. Ahmednagar. The cross combination DS-NP/R-8-42 x 52099 exhibited high per se performance and highly significant standard heterosis for almost all the studied characters. Similarly, the combinations 52099 x IC-331144, DS-NP/R-8-42 x IC-331144, and 52099 x DML-1112 showed high per se performance with highly significant better parent and standard heterosis for kernel yield, yield-contributing characters, and quality traits across all three environments. Among all the crosses, DS-NP/R-8-42 x 52099 emerged as the superior hybrid, ranking 1st for per se performance and displaying the highest magnitude of standard heterosis for kernel yield per plant, along with other desirable traits. These crosses warrant further evaluation in multilocation trials and hold potential for utilization as high-performing hybrids.

**Keywords:** Heterosis, yield, hybrid vigor and maize

## Introduction

Maize, scientifically known as *Zea mays*, stands as one of the most extensively cultivated cereal grains worldwide, celebrated for its adaptability and nutritional significance. Originating from the Americas, maize has served as a fundamental crop for millennia, acting as a dietary cornerstone for civilizations such as the Mayans, Aztecs, and various Native American tribes (Sarvari and Pepo, 2014) [17]. Today, it occupies a pivotal role in agriculture, playing a vital part in sustaining both human and livestock populations globally. Characterized by towering, grassy stalks adorned with large, broad leaves and distinctive tassel-like flowers known as inflorescences (Shao *et al.*, 2021) [18], maize exhibits its kernels in rows on cylindrical cobs, displaying a spectrum of colors from yellow and white to blue and purple. This diversity enables a wide range of culinary applications. With its abundance in carbohydrates, fiber, vitamins, and minerals, maize significantly contributes to global food security (Erenstein *et al*., 2022) [3] and serves as a crucial source of sustenance in various forms, including cornmeal, cornflour, corn oil, and as a whole grain.

Among the countries cultivating maize, India holds the 4th position in terms of area and the 7th in production, representing approximately 4% of the world's maize area and 2% of total production. The primary maize-growing states contributing more than 80% of the total production include Andhra Pradesh (20.9%), Karnataka (16.5%), Rajasthan (9.9%), Maharashtra (9.1%), Bihar (8.9%), Uttar Pradesh (6.1%), Madhya Pradesh (5.7%), and Himachal Pradesh (4.4%). Despite these production levels, amidst a burgeoning population and the challenges posed by climate change (Malhi *et al*., 2021) [12], enhancing maize yield remains a primary focus. Historically, the exploitation of heterosis for yield traits in India has received insufficient attention (Li *et al*., 2021) [10]. Hence, the current study aims to unlock the heterosis potential for grain yield by developing and identifying single-cross hybrids in maize.

## Materials and Methods

A set of eight inbred lines (Table.1) were crossed in full diallel mating design (Griffing, Model-I, Method-I) (Griffing, 1956) [6] during *Rabi* 2018 to generate 56 full- diallel crosses (reciprocals included). The final evaluation trial comprising of eight parents, fifty six $F_1$'s

(Direct and reciprocals) and two standard checks was conducted in *kharif* 2019, *late kharif* 2019 and *rabi*, 2019 with two replications in randomized block design at research farm of All India Coordinated Research Project on Maize, Rahuri center, at Mahatma Phule Krishi Vidyapeeth, Rahuri Dist. Ahmednagar, on a uniform piece of land. All the standard package of practices was followed to raise a good crop. The data were recorded on, days to 50 percent tasseling, days to 50 percent silking, days to maturity, plant height (cm), earhead height (cm), number of nodes per plant, number of leaves per plant, number of ears per plant, ear length (cm), ear girth (cm), number of kernel rows per ear, number of kernel per row, number of kernel per ear, 100 kernel weight(g), kernel weight per ear (g), kernel yield per plant (g), kernel color and kernel shape. Heterobeltiosis was estimated following Fonseca and Patterson (1968) [4].

**Table 1:** Salient features of inbred lines used.

| Sr. No. | Name of genotype | Salient features |
|---|---|---|
| 1. | 52327 | Dwarf, white silk, betained tassel, two cob, golden yellow |
| 2. | 52099 | Mid tall, high yield, wide leaf |
| 3. | 52212 | Mid tall, high yield, wide and long leaf, stained tassel, yellow cap |
| 4. | IC-280427 | Mid tall, good plant vigor, high yield, yellow dent |
| 5. | DML-1336 | Mid tall, good plant vigor, high yield, yellow dent |
| 6. | IC-331144 | Semi dwarf, high yield, yellow roundish |
| 7. | DS-NP/R-8-42 | Semi dwarf, good plant vigor, yellow round grain |
| 8. | DML1112 | Mid tall, high yield, yellow squares |

## Results and Discussion

Heterosis, commonly referred to as hybrid vigor, is a pivotal phenomenon in maize breeding, reflecting the superior performance of hybrids compared to their parent plants. Breeding efforts often focus on harnessing this phenomenon to anticipate hybrid performance and accumulate desirable genes by crossing genetically dissimilar parents. Significant heterosis in crucial traits is invaluable for developing synthetic varieties, composite varieties, hybrids, and stable-yielding lines. Heterosis can manifest as either positive or negative, with negative heterosis playing a crucial role in traits like earhead height and earliness in maturity.

The effective exploitation of hybrid vigor (Heterosis) relies on the high mean performance of hybrids compared to superior standard hybrids employed as benchmarks (Birchler *et al*., 2010) [2]. In the current investigation, favorable heterosis is observed for yield-related traits across three environments, including the number of kernels per row, number of kernels per ear, 100-kernel weight (g), kernel weight per ear (g), and kernel yield per plant (g). The outcomes for each trait are comprehensively presented and discussed below.

### Number of kernel per row

The study investigated heterosis for the number of kernels per ear across three different environments. In Environment-I, heterosis ranged from -59.05% to 58.23% over the superior parent, with 22 crosses showing significant positive heterosis. Similar trends were observed over comparison checks Rajarshi and Phule Maharshi. Notable cross combinations included 52099 x IC-280427, DS-NP/R-8-42 x 52099, and DS-NP/R-8-42 x IC-331144.

In Environment-II, heterosis ranged from -61.45% to 73.6% over the superior parent, with 22 crosses showing significant positive heterosis. Significant positive heterosis was also observed over the comparison checks. Key cross combinations included 52212 x IC-331144, 52099 x IC-280427, and DS-NP/R-8-42 x 52099.

In Environment-III, heterosis ranged from -57.41% to 58.63% over the superior parent, with 22 crosses exhibiting significant positive heterosis. Significant positive heterosis was also observed over the comparison checks. Key cross combinations included IC-280427 x 52099, 52099 x DML-1112, and 52099 x IC-331144.

Overall, the study showed consistent positive heterosis for the number of kernels per ear across environments, with several cross combinations displaying statistically significant results. These findings align with prior research on maize heterosis. Here, better parent heterosis results are in correspondence with Kumawat *et al*. (2020) [9]; Sabitha *et al*. (2021) [16]; Yadav and Gangwar (2021) [24]; Kamal *et al*. (2022) [7]; Mogesse *et al*. (2022) [13]; Shafiq-Ur- Rehman *et al*. (2022) [20].

### Number of kernel per ear

In Environment-I, heterosis for the number of kernels per ear showed wide variation, ranging from -60.76% to 54.19% over the superior parent. Similar trends were observed against the reference parents Rajarshi and Phule Maharshi. Out of fifty-six crosses, twenty-two exhibited statistically significant positive heterosis over the superior parent, while fourteen and six crosses displayed significant positive heterosis over Rajarshi and Phule Maharshi, respectively. Notable cross combinations included 52099 x IC-280427, DS-NP/R-8-42 x 52099, and 52327 x DS-NP/R-8-42, aligning with previous research findings.

In Environment-II, heterosis varied from -50.93% to 68.33% over the superior parent, with twenty-seven crosses showing statistically significant positive heterosis. Thirteen and ten crosses displayed significant positive heterosis over Rajarshi and Phule Maharshi, respectively. Key cross combinations included 52327 x 52099, IC-331144 x 52327, and 52327 x 52212, consistent with prior research findings.

In Environment-III, heterosis ranged from -59.23% to 59.68% over the superior parent, with eighteen crosses exhibiting statistically significant positive heterosis. Eighteen and ten crosses displayed significant positive heterosis over Rajarshi and Phule Maharshi, respectively. Noteworthy cross combinations included DS-NP/R-8-42 x 52099, 52327 x DS-NP/R-8-42, and 52327 x IC-331144, aligning with previous studies. Similar results were observed by Onejeme *et al*. (2020) [14]; Tolley *et al*. (2021) [22]; Yadav and Gangwar (2021) [24]; Li *et al*. (2022) [11], reported similar findings for mid parent, better parent and standard heterosis in maize.

**100 kernel weight (g)**

In Environment-I, 100-kernel weight heterosis ranged from -24.08% to 22.73% over the better parent, with twenty-seven crosses showing significant positive heterosis. Similarly, twenty-nine crosses over Rajarshi and six crosses over Phule Maharshi displayed significant positive heterosis. Key cross combinations such as 52327 x DS-NP/R-8-42, 52099 x IC-331144, and DS-NP/R-8-42 x IC-331144 demonstrated significant positive heterosis.

In Environment-II, 100-kernel weight heterosis ranged from -22.12% to 26.57% over the better parent, with thirty-two crosses showing significant positive heterosis. Additionally, thirty-six crosses over Rajarshi and two crosses over Phule Maharshi exhibited significant positive heterosis. Notable cross combinations included IC-280427 x 52099, 52327 x 52099, and 52099 x 52327. These results are consistent with prior research.

In Environment-III, 100-kernel weight heterosis ranged from -26.47% to 20.97% over the better parent, with seventeen crosses showing significant positive heterosis. Additionally, thirty-two crosses over Rajarshi and two crosses over Phule Maharshi exhibited significant positive heterosis. Promising cross combinations included IC-331144 x DML-1112, IC-280427 x 52099, and 52099 x DML-1112.Better parent heterosis results are in accordance Onejeme *et al*. (2020) [14]; Sabitha *et al*. (2021) [16]; Vinoth *et al.* (2021) [23]; Yadav and Gangwar (2021) [24]; Tabu *et al.* (2023) [21].

**Kernel weight per ear (g)**

In Environment-I, heterosis for kernel weight per ear varied widely, ranging from -60.41% to 85.4% over the superior parent. Significant positive heterosis was observed over the reference varieties Rajarshi and Phule Maharshi. Among fifty-six crosses, thirty-one exhibited significant positive heterosis over the better parent, with sixteen and fourteen crosses showing highly significant positive heterosis over Rajarshi and Phule Maharshi, respectively. Notable cross combinations included IC-280427 x IC-331144, DS-NP/R-8-42 x 52099, and DS-NP/R-8-42 x IC-331144, with significant positive heterosis.

In Environment-II, heterosis ranged from -59.46% to 99.84% over the superior parent, with twenty-nine crosses showing significant positive heterosis over the better parent. Sixteen crosses exhibited highly significant positive heterosis over Rajarshi, and thirteen crosses showed such heterosis over Phule Maharshi. Noteworthy cross combinations included 52099 x IC-331144, DS-NP/R-8-42 x 52099, and DS-NP/R-8-42 x IC-331144, displaying substantial positive heterosis.

In Environment-III, heterosis ranged from -59.86% to 95.11% over the superior parent. Twenty-seven crosses exhibited significant positive heterosis over the better parent, with seventeen and fourteen crosses displaying highly significant positive heterosis over Rajarshi and Phule Maharshi, respectively. Notable cross combinations included 52099 x DML-1112, IC-331144 x DML-1112, and IC-331144 x 52099, showing substantial positive heterosis. Better parent findings were similar with Saleh *et al*. (2002) [19]; Karim *et al.* (2018) [8]; Abed and Hassan (2020) [1]; Yadav and Gangwar (2021) [24].

**Kernel yield per plant (g)**

In Environment-I, heterosis for kernel yield per plant varied widely, from -60.42% to 133.62% over the superior parent, and from -61.96% to 36.67% over Rajarshi. Similarly, over Phule Maharshi, it ranged from -64.79% to 26.51%. Out of fifty-six crosses, thirty-two showed highly significant positive heterosis over the superior parent, and twenty-eight and twenty-one crosses exhibited the same over Rajarshi and Phule Maharshi, respectively. Notable cross combinations included DS-NP/R-8-42 x 52099 (130.92%), 52099 x IC-331144 (83.95%), and DS-NP/R-8-42 x IC-331144 (75.09%) over the superior parent, while DS-NP/R-8-42 x DML-1336 (33.33%), IC-331144 x DML-1336 (32.98%), and 52099 x IC-331144 (27.22%) exhibited significant positive heterosis over Rajarshi, and DS-NP/R-8-42 x DML-1336 (23.42%), IC-331144 x DML-1336 (23.09%), and 52099 x IC-331144 (17.76%) showed highly significant positive heterosis over Phule Maharshi.

In Environment-II, heterosis ranged from -61.35% to 147.66% over the superior parent, from -64.55% to 30.64% over Rajarshi, and from -65.48% to 27.21% over Phule Maharshi. Out of fifty-six crosses, thirty-two demonstrated highly significant positive heterosis over the superior parent, while twenty-five and twenty-seven crosses displayed the same over Rajarshi and Phule Maharshi, respectively. Noteworthy cross combinations included DS-NP/R-8-42 x 52099 (134.00%), DS-NP/R-8-42 x IC-331144 (90.32%), and 52099 x IC-331144 (79.71%) over the superior parent, as well as DS-NP/R-8-42 x DML-1336 (28.46%), IC-331144 x DML-1336 (27.94%), and 52327 x IC-331144 (25.5%) over Rajarshi, and DS-NP/R-8-42 x DML-1336 (25.09%), IC-331144 x DML-1336 (24.59%), and 52327 x IC-331144 (22.21%) over Phule Maharshi.

In Environment-III, heterosis for kernel yield per plant varied widely, ranging from -61.34% (DML-1112 x IC-280427) to 149.74% (52099 x DML-1112) over the superior parent, and from -61.36% (DML-1112 x IC-280427) to 36.86% (52212 x DML-1112) over Rajarshi. Over Phule Maharshi, heterosis ranged from -64.06% (DML-1112 x IC-280427) to 27.28% (52212 x DML-1112). Among fifty-six F1 crosses, twenty-nine showed highly significant positive heterosis over the superior parent, while twenty-seven and twenty-two crosses exhibited highly significant positive heterosis over Rajarshi and Phule Maharshi, respectively.

The most notable cross combinations for positive heterosis over the superior parent were IC-280427 x 52099 (132.28%), IC-331144 x 52099 (79.33%), and IC-331144 x DML-1112 (76.06%). For the Rajarshi check, DML-1112 x IC-280427 (34.24%), DML-1336 DS-NP/R-8-42 (33.42%), and 52099 x DML-1112 (32.52%) displayed significant positive heterosis. Over Phule Maharshi, DML-1336 x DML-1112 (24.84%), DML-1336 x DS-NP/R-8-42 (24.08%), and 52099 x DML-1112 (23.24%) showed highly significant positive heterosis. Better parent results were in tune with Onejeme *et al.* (2020) [14]; Vinoth *et al.* (2021) [23]; Pawar *et al.*, (2021) [15]; Sabitha *et al.* (2021) [16]; Yadav and Gangwar (2021) [24]; Shafiq-Ur-Rehman *et al.* (2022) [20] reported mid parent, better parent and standard heterosis for this trait in maize.

**Table 2:** Percent heterosis over better parent and standard checks for number of kernels per row in maize

| Sr. No. | Crosses | | Number of kernels per row | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | E-1 | | | E-2 | | | E-3 | | |
| | | | BP | Rajarshi | Phule Maharshi | BP | Rajarshi | Phule Maharshi | BP | Rajarshi | Phule Maharshi |
| 1 | 52327 x 52099 | D | 4.86 * | -1.38 | -7.48 ** | 20.65 ** | 15.85 ** | 11.30 ** | 7.16 ** | -3.43 | -9.44 ** |
| 2 | 52099 x 52327 | R | 7.90 ** | 1.48 | -4.79 * | 20.82 ** | 16.02 ** | 11.46 ** | 9.88 ** | -0.98 | -7.14 ** |
| 3 | 52327 x 52212 | D | 8.03 ** | 1.60 | -4.68 * | 19.26 ** | 14.51 ** | 10.02 ** | 7.18 ** | -3.41 | -9.42 ** |
| 4 | 52212 x 52327 | R | 7.77 ** | 1.36 | -4.91 * | 19.20 ** | 14.46 ** | 9.96 ** | 7.02 ** | -3.56 | -9.56 ** |
| 5 | 52327 x IC-280427 | D | 2.69 | 0.65 | -5.58 ** | 15.21 ** | 14.53 ** | 10.04 ** | -0.43 | -5.99 ** | -11.84 ** |
| 6 | IC-280427 x 52327 | R | 8.41 ** | 21.36 ** | 13.86 ** | 12.38 ** | 28.55 ** | 23.50 ** | 10.45 ** | 15.75 ** | 8.55 ** |
| 7 | 52327 x DML-1336 | D | -4.54 | -10.22 ** | -15.77 ** | -4.27 | -8.08 ** | -11.69 ** | -3.11 | -12.69 ** | -18.12 ** |
| 8 | DML-1336 x 52327 | R | -7.19 ** | -12.71 ** | -18.11 ** | -8.36 ** | -12.00 ** | -15.46 ** | -5.77 * | -15.09 ** | -20.37 ** |
| 9 | 52327 x IC- 331144 | D | 27.12 ** | 14.91 ** | 7.80 ** | 30.29 ** | 20.21 ** | 15.49 ** | 25.35 ** | 9.93 ** | 3.10 |
| 10 | IC-331144 x 52327 | R | 19.17 ** | 7.72 ** | 1.06 | 22.62 ** | 13.14 ** | 8.70 ** | 15.37 ** | 1.18 | -5.12 * |
| 11 | 52327 x DS-NP/R-8-42 | D | 37.77 ** | 24.53 ** | 16.83 ** | 34.72 ** | 24.30 ** | 19.42 ** | 30.93 ** | 14.83 ** | 7.69 ** |
| 12 | DS-NP/R-8-42 x 52327 | R | 20.58 ** | 18.19 ** | 10.88 ** | 21.88 ** | 21.17 ** | 16.41 ** | 21.42 ** | 14.64 ** | 7.50 ** |
| 13 | 52327 x DML-1112 | D | -18.60 ** | -8.88 ** | -14.51 ** | -20.31 ** | -8.85 ** | -12.43 ** | -25.93 ** | -22.38 ** | -27.21 ** |
| 14 | DML-1112 x 52327 | R | -4.69 | -13.84 ** | -19.17 ** | -5.14 | -12.48 ** | -15.92 ** | -15.72 ** | -26.08 ** | -30.68 ** |
| 15 | 52099 x 52212 | D | -49.13 ** | -52.15 ** | -55.11 ** | -45.67 ** | -47.83 ** | -49.88 ** | -56.12 ** | -60.46 ** | -62.92 ** |
| 16 | 52212 x 52099 | R | -56.93 ** | -61.06 ** | -63.47 ** | -55.65 ** | -59.08 ** | -60.69 ** | -57.41 ** | -62.65 ** | -64.97 ** |
| 17 | 52099 x IC-280427 | D | 51.05 ** | 10.62 ** | 3.78 | 50.42 ** | 10.37 ** | 6.04 * | 49.95 ** | 5.46 * | -1.10 |
| 18 | IC-280427 x 52099 | R | 58.23 ** | -23.24 ** | -27.99 ** | 73.60 ** | -16.14 ** | -19.44 ** | 58.63 ** | -22.94 ** | -27.74 ** |
| 19 | 52099 x DML-1336 | D | -22.31 ** | -23.85 ** | -28.56 ** | -15.54 ** | -16.03 ** | -19.33 ** | -18.88 ** | -23.41 ** | -28.17 ** |
| 20 | DML-1336x 52099 | R | -3.97 * | 7.50 ** | 0.85 | -4.15 | 9.64 ** | 5.33 * | -0.45 | 4.33 | -2.16 |
| 21 | 52099 x IC-331144 | D | 39.28 ** | 7.03 ** | 0.41 | 41.92 ** | 10.24 ** | 5.92 * | 42.47 ** | 5.43 * | -1.13 |
| 22 | IC-331144 x 52099 | R | -15.76 ** | -20.77 ** | -25.67 ** | -15.69 ** | -19.04 ** | -22.22 ** | -15.04 ** | -23.44 ** | -28.20 ** |
| 23 | 52099 x DS-NP/R-8-42 | D | 19.16 ** | 7.71 ** | 1.05 | 18.95 ** | 9.75 ** | 5.44 * | 19.92 ** | 5.17 * | -1.37 |
| 24 | DS-NP/R-8-42 x 52099 | R | 47.02 ** | 7.67 ** | 1.01 | 50.00 ** | 10.06 ** | 5.74 * | 44.96 ** | 1.95 | -4.39 * |
| 25 | 52099 x DML- 1112 | D | 12.38 ** | -17.70 ** | -22.79 ** | 13.04 ** | -17.06 ** | -20.32 ** | 0.96 | -29.00 ** | -33.41 ** |
| 26 | DML- 1112 x 52099 | R | -14.23 ** | -15.94 ** | -21.14 ** | -16.65 ** | -17.13 ** | -20.39 ** | -25.00 ** | -29.19 ** | -33.60 ** |
| 27 | 52212 x IC-280427 | D | -32.35 ** | -24.27 ** | -28.95 ** | -33.93 ** | -24.43 ** | -27.39 ** | -38.64 ** | -35.69 ** | -39.70 ** |
| 28 | IC-280427x 52212 | R | 1.66 | -21.88 ** | -26.71 ** | -5.66 | -26.72 ** | -29.60 ** | -16.60 ** | -38.29 ** | -42.13 ** |
| 29 | 52212 x DML-1336 | D | -48.31 ** | -51.39 ** | -54.39 ** | -50.15 ** | -52.13 ** | -54.01 ** | -45.65 ** | -51.02 ** | -54.07 ** |
| 30 | DML-1336 x 52212 | R | -26.81 ** | -33.84 ** | -37.94 ** | -15.67 ** | -22.19 ** | -25.25 ** | -26.82 ** | -35.82 ** | -39.82 ** |
| 31 | 52212 x IC-331144 | D | 43.24 ** | -30.51 ** | -34.81 ** | 59.86 ** | -22.78 ** | -25.81 ** | 31.46 ** | -36.15 ** | -40.12 ** |
| 32 | IC-331144x 52212 | R | -9.02 ** | -33.37 ** | -37.49 ** | 5.17 | -22.83 ** | -25.86 ** | -8.91 ** | -35.94 ** | -39.92 ** |
| 33 | 52212 x DS-NP/R-8-42 | D | -47.46 ** | -48.51 ** | -51.69 ** | -51.94 ** | -52.23 ** | -54.10 ** | -49.71 ** | -52.52 ** | -55.47 ** |
| 34 | DS-NP/R-8-42 x 52212 | R | 20.12 ** | 34.47 ** | 26.16 ** | 24.06 ** | 41.91 ** | 36.34 ** | 17.27 ** | 22.89 ** | 15.25 ** |
| 35 | 52212 x DML-1112 | D | -41.18 ** | -54.80 ** | -57.60 ** | -38.45 ** | -52.19 ** | -54.07 ** | -35.29 ** | -52.12 ** | -55.10 ** |
| 36 | DML-1112 x 52212 | R | -26.29 ** | -27.76 ** | -32.23 ** | -29.77 ** | -30.18 ** | -32.92 ** | -29.16 ** | -33.12 ** | -37.28 ** |
| 37 | IC-280427 x DML-1336 | D | -33.13 ** | -34.46 ** | -38.51 ** | -34.43 ** | -34.82 ** | -37.38 ** | -32.67 ** | -36.44 ** | -40.39 ** |
| 38 | DML-1336 x IC-280427 | R | -33.30 ** | -34.63 ** | -38.67 ** | -33.88 ** | -34.27 ** | -36.85 ** | -32.55 ** | -36.32 ** | -40.28 ** |
| 39 | IC-280427 x IC-331144 | D | -30.03 ** | -31.42 ** | -35.66 ** | -30.84 ** | -31.24 ** | -33.94 ** | -39.02 ** | -42.42 ** | -46.01 ** |
| 40 | IC-331144 x IC-280427 | R | -31.61 ** | -32.97 ** | -37.12 ** | -33.51 ** | -33.90 ** | -36.50 ** | -41.78 ** | -45.03 ** | -48.45 ** |
| 41 | IC-280427 x DS-NP/R-8-42 | D | -44.69 ** | -38.08 ** | -41.91 ** | -46.09 ** | -38.34 ** | -40.76 ** | -50.82 ** | -48.46 ** | -51.67 ** |
| 42 | DS-NP/R-8-42 x IC-280427 | R | -50.86 ** | -51.84 ** | -54.82 ** | -49.00 ** | -49.29 ** | -51.29 ** | -46.38 ** | -49.38 ** | -52.53 ** |
| 43 | IC-280427 x DML-1112 | D | -59.36 ** | -54.51** | -57.32 ** | -61.45 ** | -55.91 ** | -57.64 ** | -56.69 ** | -54.61 ** | -57.44 ** |
| 44 | DML-1112 x IC-280427 | R | -54.49 ** | -49.05 ** | -52.20 ** | -58.96 ** | -53.05 ** | -54.89 ** | -52.85 ** | -50.59 ** | -53.66 ** |
| 45 | DML-1336 x IC-331144 | D | -47.99 ** | -41.78 ** | -45.38 ** | -51.60 ** | -44.64 ** | -46.81 ** | -47.44 ** | -44.92 ** | -48.35 ** |
| 46 | IC-331144 x DML-1336 | R | 8.97 ** | 21.99 ** | 14.44 ** | 9.37 ** | 25.11 ** | 20.19 ** | 14.21 ** | 19.69 ** | 12.25 ** |
| 47 | DML-1336 x DS-NP/R-8-42 | D | -50.14 ** | -44.18 ** | -47.64 ** | -48.80 ** | -41.43 ** | -43.73 ** | -45.51 ** | -42.89 ** | -46.44 ** |
| 48 | DS-NP/R-8-42 xDML-1336 | R | 17.71 ** | 31.77 ** | 23.62 ** | 17.88 ** | 34.84 ** | 29.54 ** | 16.85 ** | 22.46 ** | 14.84 ** |
| 49 | DML-1336x DML-1112 | D | -53.27 ** | -47.69 ** | -50.92 ** | -54.68 ** | -48.16 ** | -50.19 ** | -49.82 ** | -47.42 ** | -50.69 ** |
| 50 | DML-1112 x DML-1336 | R | -44.68 ** | -47.97 ** | -51.19 ** | -46.35 ** | -48.49 ** | -50.51 ** | -42.67 ** | -48.33 ** | -51.55 ** |
| 51 | IC-331144 x DS-NP/R-8-42 | D | 30.07 ** | 17.58 ** | 10.31 ** | 27.61 ** | 17.74 ** | 13.12 ** | 28.62 ** | 12.80 ** | 5.78 ** |
| 52 | DS-NP/R-8-42 x IC-331144 | R | 44.43 ** | 10.99 ** | 4.12 * | 46.66 ** | 13.93 ** | 9.45 ** | 42.38 ** | 5.36 * | -1.19 |
| 53 | IC-331144 x DML-1112 | D | -37.26 ** | -51.79 ** | -54.77 ** | -34.77 ** | -49.33 ** | -51.32 ** | -29.72 ** | -48.00 ** | -51.23 ** |
| 54 | DML-1112 x IC-331144 | R | 36.15 ** | 4.62 * | -1.85 | 41.40 ** | 9.84 ** | 5.53 * | 36.53 ** | 1.03 | -5.25 * |
| 55 | DS-NP/R-8-42 x DML-1112 | D | 20.32 ** | 17.93 ** | 10.63 ** | 21.51 ** | 20.80 ** | 16.06 ** | 21.08 ** | 14.31 ** | 7.20 ** |
| 56 | DML-1112 x DS-NP/R-8-42 | R | -6.81 ** | 4.32 | -2.13 | -7.08 ** | 6.29 * | 2.11 | -2.67 | 2.00 | -4.35 * |
| | S.E.D. | | 0.63 | 0.63 | 0.63 | 0.67 | 0.67 | 0.67 | 0.68 | 0.68 | 0.68 |
| | CD 5% | | 1.26 | 1.26 | 1.26 | 1.33 | 1.33 | 1.33 | 1.35 | 1.35 | 1.35 |
| | CD 1% | | 1.67 | 1.67 | 1.67 | 1.77 | 1.77 | 1.77 | 1.79 | 1.79 | 1.79 |

**Table 3:** Percent heterosis over better parent and standard checks for number of kernels per ear in maize

| Sr. No. | Crosses | | Number of kernels per ear | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | E-1 | | | E-2 | | | E-3 | | |
| | | | BP | Rajarshi | Phule Maharshi | BP | Rajarshi | Phule Maharshi | BP | Rajarshi | Phule Maharshi |
| 1 | 52327 x 52099 | D | 7.86 ** | -7.85 ** | -18.12 ** | 53.37 ** | 22.57 ** | 9.00 ** | 4.03 * | -4.11 * | -13.95 ** |
| 2 | 52099 x 52327 | R | 6.36 ** | -9.13 ** | -19.25 ** | 51.47 ** | 21.05 ** | 7.65 ** | 2.91 | -5.14 ** | -14.88 ** |
| 3 | 52327 x 52212 | D | 4.05 * | -11.10 ** | -21.01 ** | 51.48 ** | 21.06 ** | 7.66 ** | 5.22 * | -3.01 | -12.97 ** |
| 4 | 52212 x 52327 | R | 4.29 * | -10.90 ** | -20.82 ** | 51.46 ** | 21.04 ** | 7.65 ** | 2.11 | -5.88 ** | -15.54 ** |
| 5 | 52327 x IC-280427 | D | -0.84 | -10.47 ** | -20.44 ** | 32.86 ** | 24.07 ** | 10.34 ** | 0.81 | -6.57 ** | -16.17 ** |
| 6 | IC-280427 x 52327 | R | 27.40 ** | 28.05 ** | 13.78 ** | 1.21 | -5.48 ** | -15.94 ** | 18.28 ** | 26.14 ** | 13.18 ** |
| 7 | 52327 x DML-1336 | D | 4.53 ** | -1.58 | -12.55 ** | 0.48 | -10.40 ** | -20.32 ** | -8.11 ** | -12.42 ** | -21.41 ** |
| 8 | DML-1336 x 52327 | R | -0.97 | -15.39 ** | -24.81 ** | 45.61 ** | 16.36 ** | 3.49 * | -8.14 ** | -15.33 ** | -24.03 ** |
| 9 | 52327 x IC- 331144 | D | 39.04 ** | 18.45 ** | 5.25 ** | 20.51 ** | -4.75 * | -15.29 ** | 42.22 ** | 23.75 ** | 11.04 ** |
| 10 | IC-331144 x 52327 | R | 19.09 ** | 1.46 | -9.85 ** | 52.75 ** | 20.72 ** | 7.36 ** | 24.51 ** | 8.34 ** | -2.78 |
| 11 | 52327 x DS-NP/R-8-42 | D | 43.68 ** | 22.41 ** | 8.77 ** | 46.30 ** | 15.63 ** | 2.83 | 46.36 ** | 27.36 ** | 14.28 ** |
| 12 | DS-NP/R-8-42 x 52327 | R | 39.78 ** | 26.21 ** | 12.15 ** | -7.80 ** | -13.90 ** | -23.43 ** | 38.93 ** | 28.75 ** | 15.53 ** |
| 13 | 52327 x DML-1112 | D | -12.55 ** | -12.11 ** | -21.90 ** | -8.52 ** | -14.57 ** | -24.02 ** | -30.13 ** | -25.48 ** | -33.13 ** |
| 14 | DML-1112 x 52327 | R | -6.53 ** | -12.00 ** | -21.80 ** | -47.17 ** | -52.89 ** | -58.10 ** | -21.66 ** | -25.33 ** | -33.00 ** |
| 15 | 52099 x 52212 | D | -52.53 ** | -59.44 ** | -63.96 ** | -43.62 ** | -54.94 ** | -59.93 ** | -53.90 ** | -57.50 ** | -61.87 ** |
| 16 | 52212 x 52099 | R | -60.26 ** | -66.15 ** | -69.92 ** | 23.39 ** | -2.48 | -13.27 ** | -59.20 ** | -64.49 ** | -68.14 ** |
| 17 | 52099 x IC-280427 | D | 53.89 ** | 5.98 ** | -5.83 ** | 15.26 ** | -21.78 ** | -30.43 ** | 59.68 ** | 12.34 ** | 0.81 |
| 18 | IC-280427 x 52099 | R | 21.96 ** | -14.56 ** | -24.08 ** | 18.60 ** | -19.51 ** | -28.42 ** | -0.83 | -27.01 ** | -34.51 ** |
| 19 | 52099 x DML-1336 | D | -8.82 ** | -17.67 ** | -26.84 ** | 4.72 * | -2.21 | -13.03 ** | -24.20 ** | -29.75 ** | -36.97 ** |
| 20 | DML-1336x 52099 | R | 3.43 * | 3.96 * | -7.62 ** | 7.84 ** | 0.71 | -10.44 ** | 1.27 | 8.00 ** | -3.09 |
| 21 | 52099 x IC-331144 | D | 9.42 ** | 3.02 | -8.45 ** | -12.15 ** | -21.66 ** | -30.33 ** | 19.24 ** | 13.65 ** | 1.98 |
| 22 | IC-331144 x 52099 | R | -11.35 ** | -24.26 ** | -32.70 ** | 24.25 ** | -0.71 | -11.70 ** | -15.51 ** | -22.12 ** | -30.11 ** |
| 23 | 52099 x DS-NP/R-8-42 | D | 23.20 ** | 4.95 ** | -6.74 ** | 26.53 ** | 0.00 | -11.07 ** | 29.82 ** | 12.97 ** | 1.37 |
| 24 | DS-NP/R-8-42 x 52099 | R | 50.77 ** | 3.83 * | -7.74 ** | 8.45 ** | -26.40 ** | -34.54 ** | 58.22 ** | 11.32 ** | -0.11 |
| 25 | 52099 x DML- 1112 | D | 13.14 ** | -20.74 ** | -29.57 ** | 6.00 * | -28.97 ** | -36.83 ** | -12.36 ** | -35.51 ** | -42.13 ** |
| 26 | DML- 1112 x 52099 | R | -15.68 ** | -23.87 ** | -32.35 ** | -23.83 ** | -28.87 ** | -36.74 ** | -30.44 ** | -35.53 ** | -42.15 ** |
| 27 | 52212 x IC-280427 | D | -25.14** | -24.75 ** | -33.14 ** | -25.28 ** | -30.22 ** | -37.94 ** | -41.88 ** | -38.02 ** | -44.38 ** |
| 28 | IC-280427x 52212 | R | -24.80 ** | -29.20 ** | -37.09 ** | -42.89 ** | -49.07 ** | -54.70 ** | -38.98 ** | -41.84 ** | -47.81 ** |
| 29 | 52212 x DML-1336 | D | -51.33 ** | -58.42 ** | -63.05 ** | -11.04 ** | -28.91 ** | -36.78 ** | -51.71 ** | -55.49 ** | -60.06 ** |
| 30 | DML-1336 x 52212 | R | -25.26 ** | -36.33 ** | -43.42 ** | -16.10 ** | -33.69 ** | -41.03 ** | -24.62 ** | -34.41 ** | -41.14 ** |
| 31 | 52212 x IC-331144 | D | -10.19 ** | -37.08 ** | -44.09 ** | -2.46 | -33.80 ** | -41.13 ** | -10.37 ** | -34.03 ** | -40.81 ** |
| 32 | IC-331144x 52212 | R | -14.39 ** | -40.02 ** | -46.71 ** | -19.00 ** | -45.72 ** | -51.73 ** | -14.90 ** | -37.37 ** | -43.80 ** |
| 33 | 52212 x DS-NP/R-8-42 | D | -52.09 ** | -56.74 ** | -61.56 ** | 68.33 ** | 57.19 ** | 39.80 ** | -48.69 ** | -52.45 ** | -57.33 ** |
| 34 | DS-NP/R-8-42 x 52212 | R | 54.19 ** | 54.98 ** | 37.71 ** | -50.93 ** | -54.18 ** | -59.25 ** | 34.24 ** | 43.16 ** | 28.46 ** |
| 35 | 52212 x DML-1112 | D | -55.52 ** | -58.12 ** | -62.79 ** | -28.62 ** | -36.35 ** | -43.39 ** | -53.77 ** | -55.93 ** | -60.46 ** |
| 36 | DML-1112 x 52212 | R | -31.58 ** | -38.23 ** | -45.11 ** | -30.64 ** | -35.23 ** | -42.39 ** | -30.22 ** | -35.34 ** | -41.98 ** |
| 37 | IC-280427 x DML-1336 | D | -33.11 ** | -39.60 ** | -46.33 ** | -33.20 ** | -37.62 ** | -44.53 ** | -29.99 ** | -35.12 ** | -41.78 ** |
| 38 | DML-1336 x IC-280427 | R | -33.99 ** | -40.40 ** | -47.04 ** | -26.68 ** | -31.53 ** | -39.11 ** | -32.40 ** | -37.35 ** | -43.78 ** |
| 39 | IC-280427 x IC-331144 | D | -34.23 ** | -40.61 ** | -47.23 ** | -30.73 ** | -35.31 ** | -42.47 ** | -42.20 ** | -46.44 ** | -51.94 ** |
| 40 | IC-331144 x IC-280427 | R | -34.35 ** | -40.72 ** | -47.33 ** | -31.70 ** | -36.22 ** | -43.28 ** | -44.97 ** | -49.00 ** | -54.24 ** |
| 41 | IC-280427 x DS-NP/R-8-42 | D | -44.91 ** | -44.62 ** | -50.79 ** | -43.00 ** | -46.77 ** | -52.66 ** | -52.42 ** | -49.26 ** | -54.47 ** |
| 42 | DS-NP/R-8-42 x IC-280427 | R | -48.12 ** | -51.16 ** | -56.60 ** | -49.51 ** | -52.85 ** | -58.07 ** | -48.33 ** | -50.75 ** | -55.81 ** |
| 43 | IC-280427 x DML-1112 | D | -60.76 ** | -60.56 ** | -64.95 ** | -43.24 ** | -47.00 ** | -52.86 ** | -59.23 ** | -56.53 ** | -60.99 ** |
| 44 | DML-1112 x IC-280427 | R | -58.39 ** | -58.18 ** | -62.84 ** | -35.68 ** | -39.93 ** | -46.58 ** | -57.84 ** | -55.04 ** | -59.66 ** |
| 45 | DML-1336 x IC-331144 | D | -48.45 ** | -48.19 ** | -53.96 ** | 34.91 ** | 25.99 ** | 12.05 ** | -47.00 ** | -43.48 ** | -49.28 ** |
| 46 | IC-331144 x DML-1336 | R | 32.34 ** | 33.02 ** | 18.20 ** | -36.83 ** | -41.01 ** | -47.54 ** | 30.90 ** | 39.59 ** | 25.26 ** |
| 47 | DML-1336 x DS-NP/R-8-42 | D | -49.95 ** | -49.70 ** | -55.30 ** | 46.07 ** | 36.40 ** | 21.31 ** | -49.18 ** | -45.80 ** | -51.37 ** |
| 48 | DS-NP/R-8-42 xDML-1336 | R | 34.60 ** | 35.29 ** | 20.21 ** | -38.31 ** | -42.39 ** | -48.77 ** | 33.13 ** | 41.98 ** | 27.40 ** |
| 49 | DML-1336x DML-1112 | D | -53.92 ** | -53.68 ** | -58.84 ** | -38.68 ** | -42.74 ** | -49.07 ** | -50.90 ** | -47.63 ** | -53.01 ** |
| 50 | DML-1112 x DML-1336 | R | -47.40 ** | -50.48 ** | -56.00 ** | 15.08 ** | 2.62 | -8.73 ** | -44.99 ** | -47.57 ** | -52.95 ** |
| 51 | IC-331144 x DS-NP/R-8-42 | D | 18.15 ** | 11.24 ** | -1.15 | 16.91 ** | 4.25 * | -7.28 ** | 25.85 ** | 19.96 ** | 7.64 ** |
| 52 | DS-NP/R-8-42 x IC-331144 | R | 12.83 ** | 6.23 ** | -5.61 ** | -34.57 ** | -41.65 ** | -48.11 ** | 22.56 ** | 16.82 ** | 4.83 ** |
| 53 | IC-331144 x DML-1112 | D | -48.93 ** | -51.92 ** | -57.28 ** | 9.44 ** | -2.40 | -13.20 ** | -45.78 ** | -48.32 ** | -53.62 ** |
| 54 | DML-1112 x IC-331144 | R | 7.08 ** | 0.81 | -10.42 ** | 31.54 ** | 17.30 ** | 4.32 * | 13.65 ** | 8.33 ** | -2.79 |
| 55 | DS-NP/R-8-42 x DML-1112 | D | 28.13 ** | 20.63 ** | 7.19 ** | 4.53 * | -2.39 | -13.19 ** | 33.55 ** | 27.30 ** | 14.23 ** |
| 56 | DML-1112 x DS-NP/R-8-42 | R | -0.50 | 0.01 | -11.13 ** | 6.37 ** | -0.66 | -11.66 ** | 1.93 | 8.70 ** | -2.46 |
| | S.E.D. | | 6.15 | 6.15 | 6.15 | 7.14 | 7.14 | 7.14 | 7.55 | 7.55 | 7.55 |
| | CD 5% | | 12.29 | 12.29 | 12.29 | 14.27 | 14.27 | 14.27 | 15.10 | 15.10 | 15.10 |
| | CD 1% | | 16.33 | 16.33 | 16.33 | 18.97 | 18.97 | 18.97 | 20.07 | 20.07 | 20.07 |

**Table 4:** Percent heterosis over better parent and standard checks for 100 kernel weight (g) in maize

| Sr. No. | Crosses | | 100 kernel weight (g) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | E-1 | | | E-2 | | | E-3 | | |
| | | | BP | Rajarshi | Phule Maharshi | BP | Rajarshi | Phule Maharshi | BP | Rajarshi | Phule Maharshi |
| 1 | 52327 x 52099 | D | 1.88 | 4.99 | -10.80 ** | 26.57 ** | 26.83 ** | 5.91 * | -7.33 ** | 5.74 * | -17.47 ** |
| 2 | 52099 x 52327 | R | 0.08 | 3.14 | -12.37 ** | 25.17 ** | 25.43 ** | 4.74 | -7.28 ** | 5.80 * | -17.43 ** |
| 3 | 52327 x 52212 | D | 0.06 | 3.12 | -12.39 ** | 25.35 ** | 25.61 ** | 4.89 | -6.56 ** | 6.62 * | -16.79 ** |
| 4 | 52212 x 52327 | R | 0 | 3.06 | -12.44 ** | 24.52 ** | 24.77 ** | 4.19 | -7.28 ** | 5.80 * | -17.43 ** |
| 5 | 52327 x IC-280427 | D | -2.9 | 3.55 | -12.02 ** | 23.05 ** | 27.76 ** | 6.68 * | -7.56 ** | 5.78 * | -17.44 ** |
| 6 | IC-280427 x 52327 | R | 16.79 ** | 24.98 ** | 6.18 * | 13.01 ** | 17.99 ** | -1.47 | 10.48 ** | 26.56 ** | -1.22 |
| 7 | 52327 x DML-1336 | D | 7.54 * | 10.83 ** | -5.84 * | 4.47 | 4.68 | -12.59 ** | 3.89 | 18.54 ** | -7.48 ** |
| 8 | DML-1336 x 52327 | R | 8.27 ** | 11.58 ** | -5.2 | 4.22 | 4.43 * | -12.79 * | 4.05 | 18.73 ** | -7.34 ** |
| 9 | 52327 x IC- 331144 | D | 17.02 ** | 20.02 ** | 1.97 | 20.60 ** | 19.73 * | -0.02 | 12.62 ** | 25.16 ** | -2.32 |
| 10 | IC-331144 x 52327 | R | 13.71 ** | 16.63 ** | -0.91 | 11.29 ** | 10.49 * | -7.74 ** | 8.35 ** | 20.42 ** | -6.02 ** |
| 11 | 52327 x DS-NP/R-8-42 | D | 21.35 ** | 24.47 ** | 5.75 * | 23.38 ** | 22.49 ** | 2.28 | 13.92 ** | 26.60 ** | -1.19 |
| 12 | DS-NP/R-8-42 x 52327 | R | 12.82 ** | 20.32 ** | 2.23 | 12.56 ** | 16.86 ** | -2.41 | 11.85 ** | 27.99 ** | -0.11 |
| 13 | 52327 x DML-1112 | D | 16.55 ** | 24.72 ** | 5.96 * | 12.14 ** | 17.09 ** | -2.23 | -18.27 ** | -6.37 * | -26.93 ** |
| 14 | DML-1112 x 52327 | R | 16.83 ** | 19.83 ** | 1.81 | 13.25 ** | 12.43 ** | -6.11 * | -11.89 ** | -2.08 | -23.57 ** |
| 15 | 52099 x 52212 | D | -15.29 ** | -12.70 ** | -25.83 ** | -14.59 ** | -14.41 ** | -28.53 ** | -21.33 ** | -10.24 ** | -29.94 ** |
| 16 | 52212 x 52099 | R | -21.58 ** | -19.57 ** | -31.67 ** | -15.57 ** | -16.18 ** | -30.00 ** | -25.68 ** | -17.40 ** | -35.54 ** |
| 17 | 52099 x IC-280427 | D | 14.89 ** | 16.97 ** | -0.62 | 20.57 ** | 19.60 ** | -0.13 | 18.95 ** | 25.99 ** | -1.67 |
| 18 | IC-280427 x 52099 | R | 3.24 | 2.69 | -12.75 ** | 26.32 ** | 25.29 ** | 4.62 | -0.65 | 5.23 | -17.87 ** |
| 19 | 52099 x DML-1336 | D | -3.38 | 3.04 | -12.46 ** | 18.24 ** | 22.76 ** | 2.51 | -10.96 ** | 1.89 | -20.48 ** |
| 20 | DML-1336x 52099 | R | 5.44 | 12.83 ** | -4.14 | 8.44 ** | 13.22 ** | -5.45 * | 9.42 ** | 25.34 ** | -2.18 |
| 21 | 52099 x IC-331144 | D | 20.83 ** | 20.19 ** | 2.12 | 17.79 ** | 16.84 ** | -2.43 | 17.03 ** | 23.96 ** | -3.26 |
| 22 | IC-331144 x 52099 | R | 5.96 | 9.20 ** | -7.22 ** | 8.21 * | 8.43 * | -9.45 ** | -3.35 | 10.28 ** | -13.93 ** |
| 23 | 52099 x DS-NP/R-8-42 | D | 16.89 ** | 19.89 ** | 1.86 | 18.14 ** | 17.29 ** | -2.06 | 9.62 ** | 21.82 ** | -4.92 * |
| 24 | DS-NP/R-8-42 x 52099 | R | 17.95 ** | 20.09 ** | 2.02 | 17.93 ** | 16.98 ** | -2.32 | 18.14 ** | 25.14 ** | -2.34 |
| 25 | 52099 x DML- 1112 | D | 18.39 ** | 20.54 ** | 2.41 | 14.35 ** | 13.43 ** | -5.28 | -7.95 ** | -7.57 ** | -27.86 ** |
| 26 | DML- 1112 x 52099 | R | 5.88 * | 12.91 ** | -4.07 | 4.75 | 8.75 ** | -9.19 ** | -16.54 ** | -4.5 | -25.46 ** |
| 27 | 52212 x IC-280427 | D | 8.45 ** | 16.05 ** | -1.4 | 3.85 | 8.43 * | -9.45 ** | -20.88 ** | -9.36 ** | -29.26 ** |
| 28 | IC-280427x 52212 | R | 18.01 ** | 20.15 ** | 2.08 | 13.24 ** | 12.32 ** | -6.21 * | -10.50 ** | -10.14 ** | -29.86 ** |
| 29 | 52212 x DML-1336 | D | -17.08 ** | -14.55 ** | -27.40 ** | -13.60 ** | -13.42 ** | -27.70 ** | -20.34 ** | -9.10 ** | -29.05 ** |
| 30 | DML-1336 x 52212 | R | 16.43 ** | 19.42 ** | 1.46 | 0.48 | -0.24 | -16.70 ** | -9.25 ** | 0.85 | -21.29 ** |
| 31 | 52212 x IC-331144 | D | 13.66** | 13.06 ** | -3.94 | 3.67 | 2.83 | -14.13 ** | -11.36 ** | -6.11 * | -26.72 ** |
| 32 | IC-331144x 52212 | R | 10.06 ** | 12.06 ** | -4.8 | 4.28 | 3.44 | -13.62 ** | -2.01 | -1.61 | -23.21 ** |
| 33 | 52212 x DS-NP/R-8-42 | D | -19.89 ** | -14.57 ** | -27.42 ** | -17.07 ** | -13.90 ** | -28.10 ** | -18.75 ** | -7.02 * | -27.43 ** |
| 34 | DS-NP/R-8-42 x 52212 | R | 16.93 ** | 25.13 ** | 6.31 * | 18.81 ** | 24.05 ** | 3.59 | 12.35 ** | 28.70 ** | 0.44 |
| 35 | 52212 x DML-1112 | D | -6.31 | -12.01 ** | -25.25 ** | -4.95 | -13.62 ** | -27.87 ** | -7.62 ** | -10.42 ** | -30.09 ** |
| 36 | DML-1112 x 52212 | R | -3.56 | 2.84 | -12.62 ** | -0.41 | 3.39 | -13.66 ** | -3.72 | 10.18 ** | -14.01 ** |
| 37 | IC-280427 x DML-1336 | D | -7.53 * | -1.39 | -16.22 ** | -4.85 | -1.22 | -17.51 ** | -7.44 ** | 5.92 * | -17.33 ** |
| 38 | DML-1336 x IC-280427 | R | -5.58 | 0.7 | -14.45 ** | -3.09 | 0.61 | -15.98 ** | -4.61 | 9.16 ** | -14.81 ** |
| 39 | IC-280427 x IC-331144 | D | -14.66 ** | -8.99 ** | -22.67 ** | 16.54 ** | 21.00 ** | 1.04 | -17.91 ** | -6.07 * | -26.69 ** |
| 40 | IC-331144 x IC-280427 | R | -16.77 ** | -11.24 ** | -24.59 ** | 11.49 ** | 15.76 ** | -3.34 | -15.60 ** | -3.42 | -24.62 ** |
| 41 | IC-280427 x DS-NP/R-8-42 | D | -12.50 ** | -6.37 * | -20.45 ** | 13.55 ** | 18.56 ** | -1.00 | -19.21 ** | -7.45 ** | -27.77 ** |
| 42 | DS-NP/R-8-42 x IC-280427 | R | -16.33 ** | -10.77 ** | -24.19 ** | -12.41 ** | -9.06 ** | -24.06 ** | -18.14 ** | -6.33 * | -26.89 ** |
| 43 | IC-280427 x DML-1112 | D | -24.08 ** | -18.76 ** | -30.97 ** | -22.12 ** | -18.69 ** | -32.10 ** | -26.47 ** | -15.77 ** | -34.27 ** |
| 44 | DML-1112 x IC-280427 | R | -16.61 ** | -10.77 ** | -24.19 ** | -14.94 ** | -11.18 ** | -25.83 ** | -18.30 ** | -6.41 * | -26.96 ** |
| 45 | DML-1336 x IC-331144 | D | -8.05 ** | -1.6 | -16.40 ** | -7.99 * | -3.93 | -19.78 ** | -7.16 ** | 6.35 * | -17.00 ** |
| 46 | IC-331144 x DML-1336 | R | 19.88 ** | 28.29 ** | 8.99 ** | 16.95 ** | 22.11 ** | 1.96 | 10.47 ** | 26.54 ** | -1.24 |
| 47 | DML-1336 x DS-NP/R-8-42 | D | -10.89 ** | -4.65 | -18.99 ** | -8.77 ** | -4.74 | -20.46 ** | -10.95 ** | 2.02 | -20.38 ** |
| 48 | DS-NP/R-8-42 xDML-1336 | R | 16.31 ** | 24.47 ** | 5.75 * | 17.08 ** | 22.24 ** | 2.08 | 10.80 ** | 26.93 ** | -0.94 |
| 49 | DML-1336x DML-1112 | D | -9.05 ** | -2.67 | -17.31 ** | -9.83 ** | -5.85 | -21.38 ** | -13.56 ** | -0.98 | -22.72 ** |
| 50 | DML-1112 x DML-1336 | R | -8.56 ** | -5.77 | -19.94 ** | -9.59 ** | -9.40 ** | -24.34 ** | -10.74 ** | 1.85 | -20.51 ** |
| 51 | IC-331144 x DS-NP/R-8-42 | D | 17.02 ** | 20.02 ** | 1.97 | 14.68 ** | 13.86 ** | -4.92 | 15.62 ** | 28.50 ** | 0.29 |
| 52 | DS-NP/R-8-42 x IC-331144 | R | 20.55 ** | 19.91 ** | 1.88 | 19.21 ** | 18.24 ** | -1.26 | 19.49 ** | 26.56 ** | -1.22 |
| 53 | IC-331144 x DML-1112 | D | -11.54 ** | -9.93 ** | -23.48 ** | -13.44 ** | -14.14 ** | -28.31 ** | 1.62 | 2.04 | -20.37 ** |
| 54 | DML-1112 x IC-331144 | R | 22.73 ** | 15.25 ** | -2.08 | 20.59 ** | 9.59 ** | -8.49 ** | 20.97 ** | 17.30 ** | -8.45 ** |
| 55 | DS-NP/R-8-42 x DML-1112 | D | 15.86 ** | 23.56 ** | 4.98 | 13.45 ** | 17.79 ** | -1.64 | 9.96 ** | 25.83 ** | -1.8 |
| 56 | DML-1112 x DS-NP/R-8-42 | R | 4.19 | 11.50 ** | -5.27 | 8.33 ** | 13.11 ** | -5.55 * | 2.63 | 17.57 ** | -8.24 ** |
| | S.E.D. | | 0.72 | 0.7 | 0.72 | 0.70 | 0.70 | 0.70 | 0.67 | 0.67 | 0.67 |
| | CD 5% | | 1.44 | 1.44 | 1.44 | 1.41 | 1.41 | 1.41 | 1.35 | 1.35 | 1.35 |
| | CD 1% | | 1.92 | 1.92 | 1.92 | 1.88 | 1.88 | 1.88 | 1.79 | 1.79 | 1.79 |

**Table 5:** Percent heterosis over better parent and standard checks for kernel weight per ear (g) in maize

| Sr. No. | Crosses | | Kernel weight per ear (g) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | E-1 | | | E-2 | | | E-3 | | |
| | | | BP | Rajarshi | Phule Maharshi | BP | Rajarshi | Phule Maharshi | BP | Rajarshi | Phule Maharshi |
| 1 | 52327 x 52099 | D | 12.88 ** | -0.08 | -8.22 ** | 25.14 ** | 4.87 ** | 2.39 | 9.12 ** | -2.53 | -11.89 ** |
| 2 | 52099 x 52327 | R | 10.25 ** | -2.41 * | -10.36 ** | 23.79 ** | 3.74 * | 1.29 | 7.94 ** | -3.58 * | -12.84 ** |
| 3 | 52327 x 52212 | D | 7.85 ** | -4.52 ** | -12.30 ** | 18.67 ** | -0.55 | -2.90 | 6.78 ** | -4.62 ** | -13.78 ** |
| 4 | 52212 x 52327 | R | 5.45 ** | -6.65 ** | -14.26 ** | 14.88 ** | -3.72 * | -6.00 ** | 4.70 ** | -6.48 ** | -15.46 ** |
| 5 | 52327 x IC-280427 | D | 2.19 | -8.55 ** | -16.00 ** | 15.18 ** | -2.32 | -4.63 ** | 2.81 | -7.18 ** | -16.10 ** |
| 6 | IC-280427 x 52327 | R | 43.65 ** | 33.01 ** | 22.17 ** | 41.72 ** | 23.70 ** | 20.78 ** | 45.38 ** | 35.79 ** | 22.75 ** |
| 7 | 52327 x DML-1336 | D | 6.21 ** | -5.98 ** | -13.64 ** | 8.01 ** | -9.49 ** | -11.63 ** | 9.30 ** | -2.37 | -11.75 ** |
| 8 | DML-1336 x 52327 | R | 5.02 ** | -7.03 ** | -14.61 ** | 5.18 ** | -11.85 ** | -13.94 ** | 7.89 ** | -3.63 * | -12.89 ** |
| 9 | 52327 x IC- 331144 | D | 43.53 ** | 26.72 ** | 16.39 ** | 44.18 ** | 20.72 ** | 17.87 ** | 46.57 ** | 30.66 ** | 18.10 ** |
| 10 | IC-331144 x 52327 | R | 23.09 ** | 8.68 ** | -0.18 | 24.34 ** | 4.11 ** | 1.65 | 26.39 ** | 12.66 ** | 1.84 |
| 11 | 52327 x DS-NP/R-8-42 | D | 46.71 ** | 29.53 ** | 18.98 ** | 51.37 ** | 26.74 ** | 23.75 ** | 46.94 ** | 30.98 ** | 18.40 ** |
| 12 | DS-NP/R-8-42 x 52327 | R | 43.87 ** | 28.76 ** | 18.27 ** | 42.32 ** | 20.69 ** | 17.84 ** | 49.01 ** | 34.53 ** | 21.60 ** |
| 13 | 52327 x DML-1112 | D | 3.89 ** | -3.81 ** | -11.65 ** | 3.71 * | -9.48 ** | -11.62 ** | -4.16 * | -10.48 ** | -19.08 ** |
| 14 | DML-1112 x 52327 | R | 10.15 ** | -2.75 * | -10.67 ** | 6.18 ** | -11.10 ** | -13.20 ** | -0.06 | -10.91 ** | -19.47 ** |
| 15 | 52099 x 52212 | D | -57.36 ** | -62.25 ** | -65.33 ** | -56.23 ** | -63.32 ** | -64.18 ** | -52.37 ** | -57.45 ** | -61.54 ** |
| 16 | 52212 x 52099 | R | -59.69 ** | -64.41 ** | -67.31 ** | -59.46 ** | -66.06 ** | -66.86 ** | -59.86 ** | -64.22 ** | -67.66 ** |
| 17 | 52099 x IC-280427 | D | 85.40 ** | 19.00 ** | 9.30 ** | 99.84 ** | 23.51 ** | 20.59 ** | 95.11 ** | 23.97 ** | 12.06 ** |
| 18 | IC-280427 x 52099 | R | 29.71 ** | -5.61 ** | -13.30 ** | 27.24 ** | -12.30 ** | -14.37 ** | 20.18 ** | -12.65 ** | -21.04 ** |
| 19 | 52099 x DML-1336 | D | 7.46 ** | -3.83 ** | -11.66 ** | 1.48 | -13.95 ** | -15.98 ** | -5.02 ** | -14.26 ** | -22.49 ** |
| 20 | DML-1336x 52099 | R | 24.98 ** | 15.71 ** | 6.29 ** | 24.41 ** | 8.59 ** | 6.03 ** | 30.69 ** | 22.06 ** | 10.34 ** |
| 21 | 52099 x IC-331144 | D | 75.31 ** | 27.52 ** | 17.13 ** | 70.86 ** | 20.77 ** | 17.92 ** | 76.45 ** | 30.27 ** | 17.76 ** |
| 22 | IC-331144 x 52099 | R | -1.19 | -12.53 ** | -19.66 ** | 0.54 | -15.74 ** | -17.73 ** | 1.02 | -9.76 ** | -18.43 ** |
| 23 | 52099 x DS-NP/R-8-42 | D | 27.11 ** | 12.22 ** | 3.08 ** | 27.43 ** | 6.70 ** | 4.18 ** | 39.83 ** | 24.64 ** | 12.67 ** |
| 24 | DS-NP/R-8-42 x 52099 | R | 68.62 ** | 8.23 ** | -0.59 | 65.46 ** | 2.26 | -0.16 | 93.30 ** | 22.82 ** | 11.02 ** |
| 25 | 52099 x DML- 1112 | D | 27.79 ** | -7.00 ** | -14.58 ** | 22.06 ** | -15.87 ** | -17.86 ** | 13.79 ** | -17.29 ** | -25.24 ** |
| 26 | DML- 1112 x 52099 | R | -0.78 | -11.20 ** | -18.44 ** | -7.94 ** | -21.93 ** | -23.77 ** | -14.43 ** | -22.75 ** | -30.17 ** |
| 27 | 52212 x IC-280427 | D | -9.12 ** | -15.86 ** | -22.71 ** | -11.60 ** | -22.84 ** | -24.67 ** | -17.94 ** | -23.36 ** | -30.72 ** |
| 28 | IC-280427x 52212 | R | 14.28 ** | -16.87 ** | -23.65 ** | 3.58 | -26.79 ** | -28.52 ** | -0.46 | -26.51 ** | -33.57 ** |
| 29 | 52212 x DML-1336 | D | -51.67 ** | -57.21 ** | -60.70 ** | -50.23 ** | -58.29 ** | -59.28 ** | -47.58 ** | -53.18 ** | -57.67 ** |
| 30 | DML-1336 x 52212 | R | -9.23 ** | -19.86 ** | -26.39 ** | -14.92 ** | -28.76 ** | -30.45 ** | -22.01 ** | -30.48 ** | -37.16 ** |
| 31 | 52212 x IC-331144 | D | 2.69 | -25.27 ** | -31.36 ** | 2.51 | -29.35 ** | -31.02 ** | -4.55 * | -30.62 ** | -37.29 ** |
| 32 | IC-331144x 52212 | R | 3.34 * | -24.79 ** | -30.92 ** | 1.32 | -30.16 ** | -31.81 ** | -3.27 | -29.69 ** | -36.45 ** |
| 33 | 52212 x DS-NP/R-8-42 | D | -40.37 ** | -46.64 ** | -50.99 ** | -39.13 ** | -48.38 ** | -49.60 ** | -38.33 ** | -44.32 ** | -49.67 ** |
| 34 | DS-NP/R-8-42 x 52212 | R | 47.80 ** | 36.85 ** | 25.70 ** | 49.09 ** | 30.13 ** | 27.05 ** | 51.22 ** | 41.25 ** | 27.68 ** |
| 35 | 52212 x DML-1112 | D | -42.30 ** | -58.01 ** | -61.43 ** | -42.52 ** | -59.37 ** | -60.33 ** | -40.80 ** | -56.29 ** | -60.49 ** |
| 36 | DML-1112 x 52212 | R | -20.29 ** | -28.66 ** | -34.47 ** | -19.15 ** | -31.44 ** | -33.06 ** | -19.41 ** | -27.24 ** | -34.23 ** |
| 37 | IC-280427 x DML-1336 | D | -20.68 ** | -29.01 ** | -34.80 ** | -20.61 ** | -32.68 ** | -34.27 ** | -20.42 ** | -28.15 ** | -35.05 ** |
| 38 | DML-1336 x IC-280427 | R | -22.10 ** | -30.28 ** | -35.96 ** | -21.47 ** | -33.41 ** | -34.98 ** | -20.62 ** | -28.33 ** | -35.22 ** |
| 39 | IC-280427 x IC-331144 | D | -18.95 ** | -27.46 ** | -33.37 ** | -20.87 ** | -32.89 ** | -34.48 ** | -27.82 ** | -34.84 ** | -41.10 ** |
| 40 | IC-331144 x IC-280427 | R | -18.61 ** | -27.16 ** | -33.10 ** | -21.14 ** | -33.13 ** | -34.71 ** | -26.96 ** | -34.06 ** | -40.40 ** |
| 41 | IC-280427 x DS-NP/R-8-42 | D | -22.53 ** | -28.27 ** | -34.12 ** | -24.59 ** | -34.18 ** | -35.74 ** | -29.16 ** | -33.84 ** | -40.19 ** |
| 42 | DS-NP/R-8-42 x IC-280427 | R | -38.62 ** | -45.06 ** | -49.54 ** | -36.75 ** | -46.36 ** | -47.63 ** | -30.11 ** | -36.90 ** | -42.97 ** |
| 43 | IC-280427 x DML-1112 | D | -60.41 ** | -63.34 ** | -66.33 ** | -59.22 ** | -64.40 ** | -65.25 ** | -57.05 ** | -59.89 ** | -63.74 ** |
| 44 | DML-1112 x IC-280427 | R | -48.91 ** | -52.70 ** | -56.55 ** | -48.84 ** | -55.35 ** | -56.40 ** | -42.01 ** | -45.84 ** | -51.04 ** |
| 45 | DML-1336 x IC-331144 | D | -28.33 ** | -33.64 ** | -39.05 ** | -26.11 ** | -35.50 ** | -37.03 ** | -27.65 ** | -32.42 ** | -38.91 ** |
| 46 | IC-331144 x DML-1336 | R | 44.26 ** | 33.57 ** | 22.69 ** | 46.15 ** | 27.56 ** | 24.54 ** | 43.32 ** | 33.87 ** | 21.01 ** |
| 47 | DML-1336 x DS-NP/R-8-42 | D | -30.87 ** | -35.99 ** | -41.21 ** | -30.20 ** | -39.08 ** | -40.52 ** | -26.42 ** | -31.28 ** | -37.88 ** |
| 48 | DS-NP/R-8-42 xDML-1336 | R | 49.75 ** | 38.65 ** | 27.36 ** | 49.54 ** | 30.52 ** | 27.43 ** | 48.26 ** | 38.48 ** | 25.17 ** |
| 49 | DML-1336x DML-1112 | D | -32.16 ** | -37.18 ** | -42.30 ** | -30.55 ** | -39.38 ** | -40.81 ** | -30.74 ** | -35.31 ** | -41.53 ** |
| 50 | DML-1112 x DML-1336 | R | -29.58 ** | -37.66 ** | -42.74 ** | -27.70 ** | -39.41 ** | -40.84 ** | -29.19 ** | -36.75 ** | -42.83 ** |
| 51 | IC-331144 x DS-NP/R-8-42 | D | 41.55 ** | 24.98 ** | 14.80 ** | 44.14 ** | 20.69 ** | 17.84 ** | 45.59 ** | 29.78 ** | 17.31 ** |
| 52 | DS-NP/R-8-42 x IC-331144 | R | 66.59 ** | 21.18 ** | 11.31 ** | 63.75 ** | 15.75 ** | 13.01 ** | 81.11 ** | 33.71 ** | 20.87 ** |
| 53 | IC-331144 x DML-1112 | D | -15.17 ** | -38.30 ** | -43.32 ** | -15.80 ** | -40.49 ** | -41.89 ** | -14.70 ** | -37.02 ** | -43.07 ** |
| 54 | DML-1112 x IC-331144 | R | 42.66 ** | 3.82 ** | -4.64 ** | 38.37 ** | -2.19 | -4.51 ** | 43.19 ** | 5.71 ** | -4.44 ** |
| 55 | DS-NP/R-8-42 x DML-1112 | D | 42.34 ** | 27.38 ** | 17.00 ** | 44.76 ** | 22.76 ** | 19.86 ** | 46.70 ** | 32.44 ** | 19.71 ** |
| 56 | DML-1112 x DS-NP/R-8-42 | R | 11.97 ** | 3.68 ** | -4.77 ** | 11.19 ** | -2.95 | -5.24 ** | 13.83 ** | 6.32 ** | -3.89 ** |
| | S.E.D. | | 1.16 | 1.16 | 1.1 | 1.52 | 1.52 | 1.52 | 1.55 | 1.55 | 1.55 |
| | CD 5% | | 2.33 | 2.33 | 2.33 | 3.04 | 3.04 | 3.04 | 3.10 | 3.10 | 3.10 |
| | CD 1% | | 3.09 | 3.09 | 3.09 | 4.04 | 4.04 | 4.04 | 4.12 | 4.12 | 4.12 |

**Table 6:** Percent heterosis over better parent and standard checks for kernel yield per plant (g) in maize

| Sr. No. | Crosses | | Kernel yield per plant (g) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | E-1 | | | E-2 | | | E-3 | | |
| | | | BP | Rajarshi | Phule Maharshi | BP | Rajarshi | Phule Maharshi | BP | Rajarshi | Phule Maharshi |
| 1 | 52327 x 52099 | D | 38.43 ** | 24.39 ** | 15.14 ** | 35.63 ** | 17.40 ** | 14.32 ** | 33.01 ** | 22.00 ** | 13.46 ** |
| 2 | 52099 x 52327 | R | 39.27 ** | 25.14 ** | 15.84 ** | 38.51 ** | 19.89 ** | 16.75 ** | 24.12 ** | 13.85 ** | 5.87 ** |
| 3 | 52327 x 52212 | D | 38.01 ** | 24.01 ** | 14.79 ** | 35.96 ** | 17.69 ** | 14.60 ** | 24.25 ** | 13.96 ** | 5.98 ** |
| 4 | 52212 x 52327 | R | 37.65 ** | 23.68 ** | 14.49 ** | 36.71 ** | 18.33 ** | 15.23 ** | 26.10 ** | 15.66 ** | 7.56 ** |
| 5 | 52327 x IC-280427 | D | 23.58 ** | 14.85 ** | 6.32 ** | 26.82 ** | 12.42 ** | 9.47 ** | 11.38 ** | 6.00 ** | -1.42 |
| 6 | IC-280427 x 52327 | R | 27.56 ** | 24.00 ** | 14.79 ** | 29.04 ** | 18.34 ** | 15.23 ** | 29.31 ** | 29.25 ** | 20.20 ** |
| 7 | 52327 x DML-1336 | D | 21.76 ** | 9.41 ** | 1.27 | 25.78 ** | 8.87 ** | 6.01 ** | 25.12 ** | 14.76 ** | 6.72 ** |
| 8 | DML-1336 x 52327 | R | 17.79 ** | 5.84 ** | -2.03 | 22.54 ** | 6.07 ** | 3.29 * | 20.46 ** | 10.49 ** | 2.75 |
| 9 | 52327 x IC- 331144 | D | 42.56 ** | 23.17 ** | 14.02 ** | 51.55 ** | 25.50 ** | 22.21 ** | 40.45 ** | 24.19 ** | 15.49 ** |
| 10 | IC-331144 x 52327 | R | 40.17 ** | 21.10 ** | 12.10 ** | 40.74 ** | 16.55 ** | 13.49 ** | 48.03 ** | 30.89 ** | 21.73 ** |
| 11 | 52327 x DS-NP/R-8-42 | D | 44.09 ** | 24.50 ** | 15.24 ** | 42.77 ** | 18.23 ** | 15.13 ** | 42.36 ** | 25.88 ** | 17.07 ** |
| 12 | DS-NP/R-8-42 x 52327 | R | 31.23 ** | 21.97 ** | 12.91 ** | 33.23 ** | 18.11 ** | 15.01 ** | 31.28 ** | 24.94 ** | 16.19 ** |
| 13 | 52327 x DML-1112 | D | 6.33 ** | 3.36 * | -4.32 ** | 20.42 ** | 10.44 ** | 7.54 ** | 6.30 ** | 6.24 ** | -1.19 |
| 14 | DML-1112 x 52327 | R | 20.64 ** | 4.23 ** | -3.52 * | 30.15 ** | 7.78 ** | 4.95 ** | 19.38 ** | 5.56 ** | -1.83 |
| 15 | 52099 x 52212 | D | -55.56 ** | -60.07 ** | -63.03 ** | -56.40 ** | -62.26 ** | -63.25 ** | -55.08 ** | -58.80 ** | -61.68 ** |
| 16 | 52212 x 52099 | R | -55.98 ** | -61.96 ** | -64.79 ** | -56.05 ** | -63.61 ** | -64.56 ** | -55.20 ** | -60.39 ** | -63.16 ** |
| 17 | 52099 x IC-280427 | D | 133.62 ** | 22.38 ** | 13.28 ** | 147.66 ** | 24.26 ** | 21.00 ** | 132.38 ** | 23.30 ** | 14.67 ** |
| 18 | IC-280427 x 52099 | R | 74.71 ** | 6.82 ** | -1.12 | 77.55 ** | 2.70 | 0.01 | 59.42 ** | -0.46 | -7.43 ** |
| 19 | 52099 x DML-1336 | D | 14.12 ** | 6.07 ** | -1.82 | 14.43 ** | 1.44 | -1.22 | 3.75 * | -1.26 | -8.18 ** |
| 20 | DML-1336x 52099 | R | 24.23 ** | 20.77 ** | 11.79 ** | 27.06 ** | 16.53 ** | 13.47 ** | 31.82 ** | 31.75 ** | 22.53 ** |
| 21 | 52099 x IC-331144 | D | 83.95 ** | 27.22 ** | 17.76 ** | 79.71 ** | 18.14 ** | 15.04 ** | 79.33 ** | 25.72 ** | 16.92 ** |
| 22 | IC-331144 x 52099 | R | -12.46 ** | -21.34 ** | -27.19 ** | -13.47 ** | -25.10 ** | -27.06 ** | -12.42 ** | -19.67 ** | -25.30 ** |
| 23 | 52099 x DS-NP/R-8-42 | D | 40.12 ** | 21.06 ** | 12.06 ** | 42.41 ** | 17.93 ** | 14.83 ** | 41.22 ** | 24.87 ** | 16.13 ** |
| 24 | DS-NP/R-8-42 x 52099 | R | 130.92 ** | 20.97 ** | 11.97 ** | 134.00 ** | 17.41 ** | 14.33 ** | 149.74 ** | 32.52 ** | 23.24 ** |
| 25 | 52099 x DML- 1112 | D | 22.93 ** | -24.84 ** | -30.42 ** | 36.04 ** | -21.31 ** | -23.37 ** | 20.45 ** | -24.80 ** | -30.06 ** |
| 26 | DML- 1112 x 52099 | R | -21.04 ** | -26.61 ** | -32.07 ** | -12.93 ** | -22.81 ** | -24.83 ** | -21.90 ** | -25.68 ** | -30.88 ** |
| 27 | 52212 x IC-280427 | D | -27.16 ** | -29.19 ** | -34.45 ** | -19.13 ** | -25.83 ** | -27.78 ** | -29.05 ** | -29.09 ** | -34.05 ** |
| 28 | IC-280427x 52212 | R | -1.42 | -31.82 ** | -36.89 ** | 12.81 ** | -25.84 ** | -27.78 ** | -0.67 | -30.36 ** | -35.24 ** |
| 29 | 52212 x DML-1336 | D | -51.55 ** | -56.46 ** | -59.70 ** | -51.98 ** | -58.44 ** | -59.53 ** | -51.97 ** | -55.95 ** | -59.03 ** |
| 30 | DML-1336 x 52212 | R | -18.22 ** | -29.34 ** | -34.59 ** | -17.72 ** | -31.87 ** | -33.65 ** | -28.36 ** | -36.66 ** | -41.09 ** |
| 31 | 52212 x IC-331144 | D | 15.64 ** | -29.30 ** | -34.55 ** | 16.05 ** | -32.87 ** | -34.63 ** | 1.93 | -36.35 ** | -40.81 ** |
| 32 | IC-331144x 52212 | R | 15.87 ** | -29.16 ** | -34.42 ** | 14.27 ** | -33.90 ** | -35.64 ** | 1.84 | -36.41 ** | -40.87 ** |
| 33 | 52212 x DS-NP/R-8-42 | D | -46.58 ** | -50.35 ** | -54.04 ** | -46.41 ** | -52.49 ** | -53.74 ** | -46.87 ** | -49.44 ** | -52.98 ** |
| 34 | DS-NP/R-8-42 x 52212 | R | 40.59 ** | 36.67 ** | 26.51 ** | 42.45 ** | 30.64 ** | 27.21 ** | 36.93 ** | 36.86 ** | 27.28 ** |
| 35 | 52212 x DML-1112 | D | -42.43 ** | -60.18 ** | -63.14 ** | -42.04 ** | -61.89 ** | -62.89 ** | -41.22 ** | -58.80 ** | -61.68 ** |
| 36 | DML-1112 x 52212 | R | -27.70 ** | -32.81 ** | -37.80 ** | -27.15 ** | -35.42 ** | -37.11 ** | -28.71 ** | -32.15 ** | -36.90 ** |
| 37 | IC-280427 x DML-1336 | D | -27.72 ** | -32.82 ** | -37.82 ** | -27.26 ** | -35.52 ** | -37.21 ** | -27.25 ** | -30.77 ** | -35.62 ** |
| 38 | DML-1336 x IC-280427 | R | -28.23 ** | -33.29 ** | -38.25 ** | -27.99 ** | -36.16 ** | -37.84 ** | -28.89 ** | -32.32 ** | -37.06 ** |
| 39 | IC-280427 x IC-331144 | D | -25.98 ** | -31.20 ** | -36.31 ** | -26.02 ** | -34.42 ** | -36.14 ** | -33.46 ** | -36.68 ** | -41.11 ** |
| 40 | IC-331144 x IC-280427 | R | -26.49 ** | -31.68 ** | -36.76 ** | -27.54 ** | -35.76 ** | -37.45 ** | -35.22 ** | -38.35 ** | -42.66 ** |
| 41 | IC-280427 x DS-NP/R-8-42 | D | -29.75 ** | -31.71 ** | -36.79 ** | -30.47 ** | -36.23 ** | -37.91 ** | -39.12 ** | -39.15 ** | -43.41 ** |
| 42 | DS-NP/R-8-42 x IC-280427 | R | -44.71 ** | -48.61 ** | -52.43 ** | -44.54 ** | -50.83 ** | -52.12 ** | -44.20 ** | -46.90 ** | -50.62 ** |
| 43 | IC-280427 x DML-1112 | D | -60.42 ** | -61.53 ** | -64.39 ** | -61.35 ** | -64.55 ** | -65.48 ** | -61.34 ** | -61.36 ** | -64.06 ** |
| 44 | DML-1112 x IC-280427 | R | -49.50 ** | -50.91 ** | -54.56 ** | -49.20 ** | -53.41 ** | -54.63 ** | -50.41 ** | -50.43 ** | -53.90 ** |
| 45 | DML-1336 x IC-331144 | D | -36.32 ** | -38.09 ** | -42.70 ** | -37.65 ** | -42.82 ** | -44.32 ** | -35.88 ** | -35.91 ** | -40.40 ** |
| 46 | IC-331144 x DML-1336 | R | 36.79 ** | 32.98 ** | 23.09 ** | 39.51 ** | 27.94 ** | 24.59 ** | 33.49 ** | 33.42 ** | 24.08 ** |
| 47 | DML-1336 x DS-NP/R-8-42 | D | -38.78 ** | -40.49 ** | -44.91 ** | -35.96 ** | -41.27 ** | -42.81 ** | -37.50 ** | -37.54 ** | -41.91 ** |
| 48 | DS-NP/R-8-42 xDML-1336 | R | 37.16 ** | 33.33 ** | 23.42 ** | 40.07 ** | 28.46 ** | 25.09 ** | 34.31 ** | 34.24 ** | 24.84 ** |
| 49 | DML-1336x DML-1112 | D | -37.06 ** | -38.82 ** | -43.37 ** | -36.95 ** | -42.17 ** | -43.69 ** | -39.20 ** | -39.23 ** | -43.48 ** |
| 50 | DML-1112 x DML-1336 | R | -34.30 ** | -40.97 ** | -45.36 ** | -35.22 ** | -43.92 ** | -45.40 ** | -34.70 ** | -40.11 ** | -44.30 ** |
| 51 | IC-331144 x DS-NP/R-8-42 | D | 39.68 ** | 20.68 ** | 11.71 ** | 40.77 ** | 16.57 ** | 13.52 ** | 40.39 ** | 24.14 ** | 15.45 ** |
| 52 | DS-NP/R-8-42 x IC-331144 | R | 75.09 ** | 21.09 ** | 12.09 ** | 90.32 ** | 25.12 ** | 21.83 ** | 76.06 ** | 23.42 ** | 14.78 ** |
| 53 | IC-331144 x DML-1112 | D | -16.33 ** | -42.13 ** | -46.44 ** | -17.17 ** | -45.54 ** | -46.97 ** | -14.64 ** | -40.16 ** | -44.35 ** |
| 54 | DML-1112 x IC-331144 | R | 73.68 ** | 20.12 ** | 11.19 ** | 76.86 ** | 16.27 ** | 13.22 ** | 73.52 ** | 21.64 ** | 13.13 ** |
| 55 | DS-NP/R-8-42 x DML-1112 | D | 30.56 ** | 21.34 ** | 12.32 ** | 35.29 ** | 19.94 ** | 16.79 ** | 30.46 ** | 24.15 ** | 15.46 ** |
| 56 | DML-1112 x DS-NP/R-8-42 | R | 23.19 ** | 19.75 ** | 10.85 ** | 25.58 ** | 15.17 ** | 12.15 ** | 21.62 ** | 21.56 ** | 13.05 ** |
| | S.E.D. | | 1.76 | 1.7 | 1.76 | 1.78 | 1.78 | 1.78 | 2.09 | 2.09 | 2.09 |
| | CD 5% | | 3.52 | 3.52 | 3.52 | 3.56 | 3.56 | 3.56 | 4.18 | 4.18 | 4.18 |
| | CD 1% | | 4.68 | 4.68 | 4.68 | 4.74 | 4.74 | 4.74 | 5.56 | 5.56 | 5.56 |

## Conclusions

In conclusion, among the tested cross combinations, DS-NP/R-8-42 x 52099 emerged as particularly notable, showcasing high per se performance and significant standard heterosis across multiple studied characters. Moreover, combinations such as 52099 x IC-331144, DS-NP/R-8-42 x IC-331144, and 52099 x DML-1112 also demonstrated commendable performance in terms of kernel yield and yield-contributing traits across varied environments. Notably, DS-NP/R-8-42 x 52099 stood out as the superior hybrid, ranking first in per se performance and exhibiting the highest magnitude of standard heterosis for kernel yield per plant among other traits. These findings underscore the potential of these identified crosses for further evaluation in multilocation trials, with implications for their adoption as high-performing hybrids in maize cultivation. Further research and field testing are essential to validate and fully harness the potential of these promising hybrids in enhancing maize productivity.

## Future Scope

These hybrids could be evaluated in multilocation trials, and their yield can be estimated. The hybrids performing better than check could be given to farmers for cultivation after release.

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