**Studies on mean performance for earliness and growth trait of bottle gourd [*Lagenaria siceraria* (Molina) standl.]. in different environment.**

**ABSTRACT**

The experiment was conducted on a vegetable research farm, BAU, Bhagalpur, on nine traits, *viz.,* days to first male and female flower opening and harvest, number of nodes to first male and female flower appearance, vine length, inter-nodal length, number of primary branches, and peduncle length. 30 F1 hybrid was developed by six parents with a 6 x 6 full diallel mating design, namely, Narendra Joyti (NJ), BRBG-23 (BG-23), BRBG-65 (BG-65), Pusa Naveen (PN), BRBG-21-2 (BG-21-2) and Round Bottle Gourd (RBG). Three trials were conducted in February, May, and September 2022, with RBD design. Among parents observed that the parent RBG took minimum days in earliness traits and NJ x PN and PN x NJ for male flower, PN x NJ for female flower and first harvest, BG-65 x BG-21-2 for nodes to first male and NJ x BG-23 for female flower appearance took minimum node, while BG-21-2 and PN x BG-65 had maximum vine length, BG-65 and BG-65 x PN had maximum inter-nodal length whereas RBG and RBG x NJ had maximum peduncle length and NJ and NJ x PN had maximum number of primary branches over check in all three environments and pooled.

**Keywords: RBD design, Pooled analysis, Full diallel, Bottle gourd.**

**INTRODUCTION**

Bottle gourd [*Lagenaria siceraria* (Molina) standl.] is one of the popular cucurbitaceous vegetables among cucurbits family. It is monoecious & cross-pollinated cucurbits with 2n = 2x = 22. It is native to South Africa. It is most commonly grown in tropical and subtropical regions for its tender fleshy fruits during both the kharif & summer seasons in India. The fruits contain 96.3 % moisture, 2.9 % carbohydrate, 0.2 % protein, 0.1 % fat, 0.5 % mineral matter and 11 mg of vitamin C (Ascorbic acid) per 100 g fresh weight (Thamburaj and Singh, 2005). Currently, in India, the per capita daily availability of vegetables is 175 grams, falling short of the recommended 280 grams per capita per day (Vishnu Swarup, 2022). The pulp possesses antioxidant activity, laxative, cardioprotective, diuretic and used for overcoming constipation, cough, night blindness etc. the fruit of bottle gourd also used as vegetable sweet dishes, rayta and pickle. Bottle gourd is a rich source of essential minerals, including iron, protein, and dietary fibre, which aids in digestion and employed for alleviating issues like constipation, cough, and night blindness. It also acts as an antidote for certain poisons. The seeds are used for treating dropsy and it contains omega-3 oil, which is recognized for its potential to enhance energy levels, support brain function, and contribute to overall human vitality. The fruit pulp is a valuable source of carbohydrate without fibre, while the fruit pericarp is a source of crude fibre. The mature fruit's dried shells, known for their hardness, shave multiple uses as containers, floats for fishing nets, utensils, musical instruments, or decorative items. In India, bottle gourd is cultivated in an area of 0.19 mha with a production of 3.17 mt (PIB, Govt. of India 2020-2021). In recent year, demand of bottle gourd is increasing due to its growing ability in all the three seasons and their nutritional importance. However, its productivity in Bihar is very low as compared to other tropical countries and national productivity. Now days need to devolved early maturing and high yielding varieties The scarcity of high yielding and stable varieties may be one of the probable reasons, which provide great opportunity for research in bottle gourd.

**MATERIALS AND METHODS**

The experiment was conducted at the Vegetable Research Farm, Department of Horticulture (Vegetable and Floriculture), Bihar Agricultural College, Bihar Agricultural University, Sabour, Bhagalpur during 2022 in Summer (February 2022), Rainy (May, 2022) and winter (September, 2022), E1, E2 and E3 respectively. To study the mean performance using diallel mating design. Ggeographically the experimental site falls under humid sub-tropical climate and is situated in between 82.12o and 83.98o E longitude and 24.47o and 26.56o N latitude at an altitude of 75m above the mean sea level in the Indo- Gangetic Plains of North Eastern India. The soil of the experimental site was sandy loam. Hybridization program was done in 2021, male and female flowers, which appeared to open during next day were covered in the evening with help of cotton to avoid the contamination and pollination was done next day after noon between 1.30- 4.0 PM after pollination covered with cotton. Six parent namely BRBG-23 (BG-23), BRBG-65 (BG-65), BRBG-21-2 (BG-21-2), Round bottle gourd (RBG), Narendra Joyti (NJ), Pusa Naveen (PN) used for evolution and 30F1 hybrids obtained through full diallel mating design. The experiment was evaluated with RBD design along with 37 treatments [6 Parents+30 F1 hybrids and one check (Kashi Ganga)] whereas 4m x 3 m plot size with 8 number of plants each plot. Statical analysis was done with the help of Panse and Sukhatme (1967).

**RESULTS AND DISCUSSION**

**A. For earliness traits**

Among parents, on pooled analysis observed that the parent RBG and BG-23 took minimum days to first male flower opening and parents namely RBG, BG-23 and NJ took minimum days to first female flower opening while parents RBG, BG-23 and BG-21-2 took minimum days to first harvest whereas parents namely RBG and BG-21-2 took minimum number of nodes to first male flower appearance while RBG, NJ and BG-23 took minimum number of nodes to first female flower appearance among parents, which is desirable for crop improvements similar result was reported by sohi *et al.* (2021), Singh *et al.* (2023) and Paratpararao *et al.* (2023) presented in Table 1 to Table 5.

Among 30 F1 hybrids, on the basis of pooled analysis observed that The F1 hybrids namely, NJ x PN, PN x NJ, NJ x BG-23, RBG x NJ and RBG x PN were found the best over check (Kashi Ganga) as these recorded minimum values for days to first male flower opening and F1 hybrids, namely, PN x NJ, BG-23 x RBG, RBG x NJ, NJ x BG-23 and NJ x PN were found the best over check (Kashi Ganga) as these recorded minimum values for days to first female flower opening. For the trait days to first harvest F1 hybrids namely, PN x NJ, BG-23 x RBG, RBG x NJ and NJ x PN were the best over check (Kashi Ganga) as these took minimum days to first harvest. While for the trait number of nodes to first male flower appearance F1 hybrid namely, BG-65 x BG-21-2, NJ x PN, RBG x PN, BG-23 x BG-65, PN x BG-23 and PN x BG-21-2 recorded minimum nodes to first male flower appearance and F1 hybrid namely namely NJ x BG-23, PN x BG-21-2, PN x RBG and BG-23 x BG-65, were the best over check (Kashi Ganga) as these recorded minimum values for number of nodes first female flower, result was conformed with Gaonkar *et al.* (2023), Gaddam *et al.* (2023) and Harika *et al*. (2012) showed in Table 1 to Table 5.

**B. For growth traits**

Among the parents, on pooled analysis observed that the parents namely, BG-21-2, PN and BG-23 had maximum vine length and parents namely BG-65, RBG and BG-21-2 having maximum internodal length, whereas parents namely RBG, BG-65 and BG-23 had maximum peduncle length and parents NJ, RBG and PN had maximum number of primary branches, which is desirable for crop improvements similar result was reported by sohi *et al.* (2021), Bhavanasi *et al.* (2022) and Jamal *et al.* (2014), presented in Table 1 to Table 5.

Among the 30 F1 hybrids, on the basis of pooled analysis observed that F1 hybrids namely PN x BG-65, BG-65 x PN, PN x NJ, BG-21-2 x NJ and BG-65 x RBG were the best over check (Kashi Ganga) as these recorded maximum values for vine length at the time of final harvesting. For the trait internodal length F1 hybrids namely BG-65 x PN, NJ x BG-23, BG-23 x NJ, RBG x BG-21-2, and BG-21-2 x BG-23, were the best over check (Kashi Ganga). For the trait peduncle length F1 hybrid namely RBG x NJ, RBG x BG-65, BG-23 x PN and RBG x BG-23 had maximum peduncle length over check, however for the trait number of primary branches F1 hybrids namely NJ x PN, BG-23 x RBG, PN x BG-21-2, PN x NJ, and BG-23 x PN produced more number of primary branches per plant than the check (Kashi Ganga) results conformed with Bhavanasi et al. (2022), Paratpararao et al. (2023) and Gaonkar et al. (2023), presented Table 1 to Table 5.

**CONCLUSION**

Finaly concluded that parent RBG was well performed in pooled over the environments for earliness and growth trait of bottle gourd. While among the F1 hybrids namely NJ x PN and PN x NJ took minimum days for earliness trait in bottle gourd. While for growth traits F1 hybrids namely PN x NJ were better mean over check (Kashi Ganga) for vine length and primary branch while BG-65 x PN for internodal length and RBG x NJ for peduncle length had better mean over check (Kashi Ganga).

**Table-1.Mean performance of hybrid and parents and check in pooled over environments for days to first male flower and days to first female flower.**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | Days to first male flower opening | | | | Days to first female flower opening | | | |
|  |  | E1 | E2 | E3 | Pooled | E1 | E2 | E3 | Pooled |
| T1 | NJ x BG-23 | 38.33 | 40.67 | 42.67 | 40.56 | 48.00 | 43.33 | 48.00 | 46.44 |
| T2 | NJ x BG-65 | 46.33 | 44.00 | 53.00 | 47.78 | 48.67 | 49.00 | 60.33 | 52.67 |
| T3 | NJ x PN | 39.33 | 39.00 | 40.67 | 39.67 | 49.00 | 42.00 | 42.67 | 44.56 |
| T4 | NJ x BG-21-2 | 47.33 | 44.00 | 48.67 | 46.67 | 49.67 | 49.00 | 54.67 | 51.11 |
| T5 | NJ x RBG | 38.33 | 45.67 | 46.33 | 43.44 | 42.33 | 50.33 | 52.00 | 48.22 |
| T6 | BG-23 x NJ | 46.33 | 46.67 | 49.67 | 47.56 | 48.67 | 50.33 | 52.33 | 50.44 |
| T7 | BG -23 x BG-65 | 44.67 | 40.67 | 46.67 | 44.00 | 49.67 | 43.67 | 51.33 | 48.22 |
| T8 | BG-23 x PN | 46.67 | 44.00 | 53.00 | 47.89 | 49.67 | 47.67 | 58.00 | 51.78 |
| T9 | BG-23 x BG-21-2 | 42.67 | 43.67 | 49.67 | 45.33 | 48.00 | 49.67 | 56.33 | 51.33 |
| T10 | BG-23 x RBG | 39.33 | 40.33 | 42.33 | 40.67 | 43.33 | 44.00 | 44.33 | 43.89 |
| T11 | BG-65 x NJ | 45.00 | 43.67 | 48.33 | 45.67 | 48.67 | 49.00 | 54.67 | 50.78 |
| T12 | BG-65 x BG-23 | 46.67 | 45.67 | 53.67 | 48.67 | 48.67 | 49.33 | 58.67 | 52.22 |
| T13 | BG-65 x PN | 45.33 | 43.67 | 48.67 | 45.89 | 48.00 | 45.67 | 52.00 | 48.56 |
| T14 | BG-65 x BG-21-2 | 46.67 | 45.33 | 53.00 | 48.33 | 51.67 | 51.00 | 56.67 | 53.11 |
| T15 | BG-65 x RBG | 44.33 | 44.00 | 49.00 | 45.78 | 48.00 | 49.33 | 53.33 | 50.22 |
| T16 | PN x NJ | 38.67 | 39.33 | 41.00 | 39.67 | 42.67 | 42.33 | 43.33 | 42.78 |
| T17 | PN x BG-23 | 44.33 | 44.33 | 50.33 | 46.33 | 51.33 | 50.33 | 53.33 | 51.67 |
| T18 | PN x BG-65 | 46.67 | 47.00 | 48.33 | 47.33 | 48.33 | 50.67 | 52.33 | 50.44 |
| T19 | PN x BG-21-2 | 40.00 | 43.67 | 47.33 | 43.67 | 44.67 | 47.33 | 52.33 | 48.11 |
| T20 | PN x RBG | 46.33 | 43.67 | 48.33 | 46.11 | 48.00 | 48.33 | 53.33 | 49.89 |
| T21 | BG-21-2 x NJ | 43.33 | 45.00 | 50.67 | 46.33 | 46.33 | 48.33 | 54.67 | 49.78 |
| T22 | BG-21-2 x BG-23 | 42.67 | 40.33 | 51.33 | 44.78 | 44.00 | 43.67 | 57.33 | 48.33 |
| T23 | BG-21-2 x BG-65 | 43.33 | 45.33 | 49.33 | 46.00 | 45.33 | 50.67 | 56.33 | 50.78 |
| T24 | BG -21-2 x PN | 40.67 | 45.33 | 49.67 | 45.22 | 48.00 | 49.00 | 55.67 | 50.89 |
| T25 | BG-21-2 x RBG | 42.33 | 45.67 | 48.67 | 45.56 | 47.67 | 49.67 | 55.33 | 50.89 |
| T26 | RBG x NJ | 39.33 | 39.67 | 45.33 | 41.44 | 44.33 | 41.67 | 47.33 | 44.44 |
| T27 | RBG x BG-23 | 43.33 | 44.33 | 50.33 | 46.00 | 48.67 | 47.33 | 54.67 | 50.22 |
| T28 | RBG x BG-65 | 40.67 | 43.67 | 47.00 | 43.78 | 43.33 | 48.33 | 51.33 | 47.67 |
| T29 | RBG x PN | 38.67 | 45.00 | 41.00 | 41.56 | 42.67 | 50.67 | 44.33 | 45.89 |
| T30 | RBG x BG21-2 | 42.33 | 40.67 | 51.33 | 44.78 | 48.67 | 44.00 | 54.67 | 49.11 |
|  | **Cross mean** | **43.00** | **43.47** | **48.18** | **44.88** | **47.20** | **47.52** | **52.72** | **49.15** |
| T31 | NJ | 46.00 | 48.00 | 52.00 | 48.67 | 53.00 | 52.33 | 59.00 | 54.78 |
| T32 | BG-23 | 45.33 | 47.33 | 51.00 | 47.89 | 51.33 | 52.00 | 57.67 | 53.67 |
| T33 | BG-65 | 45.33 | 48.00 | 53.00 | 48.78 | 53.67 | 53.00 | 60.33 | 55.67 |
| T34 | PN | 46.67 | 47.67 | 51.67 | 48.67 | 52.67 | 52.33 | 57.33 | 54.11 |
| T35 | BG-21-2 | 46.67 | 47.33 | 51.67 | 48.56 | 52.00 | 54.67 | 58.67 | 55.11 |
| T36 | RBG | 44.33 | 46.67 | 48.33 | 46.44 | 48.00 | 51.67 | 54.67 | 51.44 |
|  | **Parent mean** | **45.72** | **47.50** | **51.28** | **48.17** | **51.78** | **52.67** | **57.94** | **54.13** |
| T37 | Kashi Ganga | 45.33 | 47.33 | 51.00 | 47.89 | 52.00 | 51.67 | 55.00 | 52.89 |
|  | Common Mean | 43.50 | 44.23 | 48.76 | 45.50 | 48.07 | 48.47 | 53.63 | 50.06 |
|  | C.V. (%) | 5.00 | 4.62 | 5.04 | 5.48 | 5.10 | 5.46 | 5.66 | 6.37 |
|  | S.E. (±) | 1.26 | 1.18 | 1.42 | 0.83 | 1.42 | 1.53 | 1.75 | 1.06 |
|  | C.D. 5% | 3.54 | 3.32 | 4.00 | 2.31 | 3.99 | 4.30 | 4.94 | 2.96 |
|  | C.D. 1% | 4.70 | 4.41 | 5.31 | 3.05 | 5.30 | 5.71 | 6.56 | 3.90 |

**Table 2. Mean performance of hybrid and parents and check in pooled over environments for days to first harvest and no. of nodes to first male flower.**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | Days to firs harvest | | | | No. of nodes to first male flower appearance | | | |
|  |  | E1 | E2 | E3 | Pooled | E1 | E2 | E3 | Pooled |
| T1 | NJ x BG-23 | 56.67 | 53.00 | 55.33 | 55.00 | 5.67 | 9.00 | 6.33 | 7.00 |
| T2 | NJ x BG-65 | 53.67 | 57.00 | 70.00 | 60.22 | 5.33 | 11.00 | 6.00 | 7.44 |
| T3 | NJ x PN | 57.67 | 50.00 | 51.00 | 52.89 | 4.00 | 10.00 | 5.67 | 6.56 |
| T4 | NJ x BG-21-2 | 59.00 | 56.00 | 64.00 | 59.67 | 5.00 | 11.00 | 6.00 | 7.33 |
| T5 | NJ x RBG | 51.67 | 61.00 | 62.33 | 58.33 | 5.00 | 14.00 | 6.33 | 8.44 |
| T6 | BG-23 x NJ | 58.00 | 61.00 | 62.67 | 60.56 | 4.67 | 10.00 | 6.33 | 7.00 |
| T7 | BG -23 x BG-65 | 60.33 | 52.33 | 60.33 | 57.67 | 5.00 | 9.33 | 5.67 | 6.67 |
| T8 | BG-23 x PN | 58.33 | 57.00 | 67.67 | 61.00 | 5.33 | 9.67 | 6.67 | 7.22 |
| T9 | BG-23 x BG-21-2 | 58.33 | 58.00 | 68.33 | 61.56 | 5.00 | 13.00 | 7.67 | 8.56 |
| T10 | BG-23 x RBG | 51.00 | 52.00 | 53.00 | 52.00 | 4.00 | 10.00 | 6.67 | 6.89 |
| T11 | BG-65 x NJ | 58.00 | 57.00 | 62.33 | 59.11 | 6.00 | 13.00 | 6.00 | 8.33 |
| T12 | BG-65 x BG-23 | 57.33 | 58.67 | 68.67 | 61.56 | 5.00 | 12.00 | 5.67 | 7.56 |
| T13 | BG-65 x PN | 56.67 | 53.67 | 59.67 | 56.67 | 6.00 | 11.00 | 6.67 | 7.89 |
| T14 | BG-65 x BG-21-2 | 60.00 | 63.67 | 66.33 | 63.33 | 4.00 | 9.67 | 5.00 | 6.22 |
| T15 | BG-65 x RBG | 57.33 | 58.00 | 60.67 | 58.67 | 5.67 | 11.67 | 6.00 | 7.78 |
| T16 | PN x NJ | 50.67 | 50.33 | 51.67 | 50.89 | 5.33 | 10.00 | 6.67 | 7.33 |
| T17 | PN x BG-23 | 60.33 | 62.00 | 62.67 | 61.67 | 4.67 | 9.00 | 6.33 | 6.67 |
| T18 | PN x BG-65 | 58.67 | 61.33 | 62.33 | 60.78 | 4.33 | 12.33 | 7.00 | 7.89 |
| T19 | PN x BG-21-2 | 53.00 | 56.00 | 60.33 | 56.44 | 5.67 | 9.00 | 5.33 | 6.67 |
| T20 | PN x RBG | 56.00 | 56.33 | 61.33 | 57.89 | 5.33 | 10.00 | 5.67 | 7.00 |
| T21 | BG-21-2 x NJ | 54.33 | 58.00 | 63.33 | 58.56 | 5.67 | 12.33 | 6.00 | 8.00 |
| T22 | BG-21-2 x BG-23 | 52.67 | 52.00 | 68.00 | 57.56 | 5.67 | 10.00 | 6.00 | 7.22 |
| T23 | BG-21-2 x BG-65 | 53.00 | 63.67 | 65.33 | 60.67 | 4.00 | 9.67 | 7.67 | 7.11 |
| T24 | BG -21-2 x PN | 61.67 | 58.33 | 65.33 | 61.78 | 5.67 | 10.00 | 6.00 | 7.22 |
| T25 | BG-21-2 x RBG | 60.00 | 58.67 | 63.67 | 60.78 | 5.67 | 11.00 | 6.00 | 7.56 |
| T26 | RBG x NJ | 56.33 | 49.67 | 54.33 | 53.44 | 5.00 | 9.33 | 6.67 | 7.00 |
| T27 | RBG x BG-23 | 58.33 | 56.00 | 62.33 | 58.89 | 4.00 | 11.33 | 7.00 | 7.44 |
| T28 | RBG x BG-65 | 51.67 | 57.67 | 60.00 | 56.44 | 5.00 | 11.33 | 5.67 | 7.33 |
| T29 | RBG x PN | 51.00 | 60.00 | 51.33 | 54.11 | 4.67 | 9.00 | 6.00 | 6.56 |
| T30 | RBG x BG21-2 | 60.00 | 51.33 | 62.67 | 58.00 | 5.00 | 10.00 | 6.67 | 7.22 |
|  | **Cross mean** | **56.39** | **56.66** | **61.57** | **58.20** | **5.04** | **10.62** | **6.24** | **7.30** |
| T31 | NJ | 65.33 | 61.33 | 69.67 | 65.44 | 6.33 | 13.33 | 7.00 | 8.89 |
| T32 | BG-23 | 61.67 | 62.00 | 66.00 | 63.22 | 6.33 | 12.33 | 7.33 | 8.67 |
| T33 | BG-65 | 65.00 | 62.00 | 69.00 | 65.33 | 6.00 | 12.67 | 7.33 | 8.67 |
| T34 | PN | 63.33 | 62.00 | 67.33 | 64.22 | 7.00 | 12.00 | 7.67 | 8.89 |
| T35 | BG-21-2 | 61.67 | 63.00 | 67.33 | 64.00 | 6.33 | 12.67 | 8.00 | 9.00 |
| T36 | RBG | 60.33 | 60.67 | 63.33 | 61.44 | 5.33 | 11.33 | 7.00 | 7.89 |
|  | **Parent mean** | **62.89** | **61.83** | **67.11** | **63.94** | **6.22** | **12.39** | **7.39** | **8.67** |
| T37 | Kashi Ganga | 61.33 | 61.67 | 64.67 | 62.56 | 6.00 | 10.67 | 7.00 | 7.89 |
|  | Common Mean | 57.58 | 57.63 | 62.55 | 59.25 | 5.26 | 10.91 | 6.45 | 7.54 |
|  | C.V. (%) | 5.37 | 5.23 | 5.94 | 6.68 | 7.83 | 6.24 | 7.05 | 11.34 |
|  | S.E. (±) | 1.78 | 1.74 | 2.15 | 1.32 | 0.24 | 0.39 | 0.26 | 0.29 |
|  | C.D. 5% | 5.03 | 4.90 | 6.05 | 3.67 | 0.67 | 1.11 | 0.74 | 0.79 |
|  | C.D. 1% | 6.68 | 6.51 | 8.03 | 4.84 | 0.89 | 1.47 | 0.98 | 1.05 |

**Table 3. Mean performance of hybrid and parents and check in pooled over environments for no. of nodes to first female flower appearance and vine length at the time of final harvesting.**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | No. of nodes to first female flower appearance | | | | Vine length at the time final harvesting (m) | | | |
|  |  | E1 | E2 | E3 | Pooled | E1 | E2 | E3 | Pooled |
| T1 | NJ x BG-23 | 9.00 | 14.67 | 9.67 | 11.11 | 6.50 | 7.81 | 6.25 | 6.85 |
| T2 | NJ x BG-65 | 10.67 | 15.33 | 10.67 | 12.22 | 6.45 | 9.20 | 5.81 | 7.16 |
| T3 | NJ x PN | 9.67 | 14.33 | 10.33 | 11.44 | 7.34 | 7.53 | 5.46 | 6.77 |
| T4 | NJ x BG-21-2 | 10.33 | 15.00 | 11.00 | 12.11 | 6.70 | 9.66 | 6.53 | 7.63 |
| T5 | NJ x RBG | 10.33 | 19.00 | 10.00 | 13.11 | 6.87 | 8.73 | 5.87 | 7.15 |
| T6 | BG-23 x NJ | 10.67 | 16.00 | 11.00 | 12.56 | 6.56 | 8.36 | 6.28 | 7.07 |
| T7 | BG -23 x BG-65 | 10.00 | 13.00 | 10.00 | 11.00 | 6.78 | 7.39 | 6.31 | 6.83 |
| T8 | BG-23 x PN | 9.67 | 14.33 | 13.00 | 12.33 | 7.10 | 8.02 | 5.50 | 6.87 |
| T9 | BG-23 x BG-21-2 | 8.67 | 19.33 | 11.67 | 13.22 | 7.34 | 8.46 | 5.60 | 7.13 |
| T10 | BG-23 x RBG | 9.00 | 15.67 | 11.00 | 11.89 | 6.68 | 7.41 | 6.33 | 6.81 |
| T11 | BG-65 x NJ | 9.33 | 16.00 | 12.00 | 12.44 | 7.23 | 7.72 | 5.88 | 6.94 |
| T12 | BG-65 x BG-23 | 9.00 | 21.00 | 12.00 | 14.00 | 6.87 | 8.22 | 5.30 | 6.80 |
| T13 | BG-65 x PN | 9.33 | 15.33 | 11.67 | 12.11 | 7.70 | 9.26 | 6.36 | 7.77 |
| T14 | BG-65 x BG-21-2 | 10.67 | 16.33 | 9.00 | 12.00 | 6.90 | 8.12 | 5.93 | 6.99 |
| T15 | BG-65 x RBG | 8.67 | 20.00 | 11.67 | 13.44 | 7.27 | 9.49 | 5.67 | 7.47 |
| T16 | PN x NJ | 10.33 | 14.67 | 11.00 | 12.00 | 7.33 | 10.51 | 5.47 | 7.77 |
| T17 | PN x BG-23 | 9.67 | 14.67 | 10.67 | 11.67 | 6.81 | 8.12 | 5.87 | 6.93 |
| T18 | PN x BG-65 | 9.33 | 16.00 | 11.00 | 12.11 | 7.30 | 10.26 | 6.32 | 7.96 |
| T19 | PN x BG-21-2 | 9.67 | 12.33 | 9.67 | 10.56 | 6.65 | 7.46 | 5.53 | 6.55 |
| T20 | PN x RBG | 9.00 | 12.67 | 11.00 | 10.89 | 7.32 | 8.02 | 5.53 | 6.96 |
| T21 | BG-21-2 x NJ | 9.00 | 14.33 | 12.33 | 11.89 | 7.27 | 9.87 | 6.00 | 7.71 |
| T22 | BG-21-2 x BG-23 | 9.33 | 15.67 | 11.00 | 12.00 | 7.33 | 8.26 | 6.40 | 7.33 |
| T23 | BG-21-2 x BG-65 | 9.67 | 15.00 | 12.00 | 12.22 | 6.63 | 7.69 | 6.37 | 6.90 |
| T24 | BG -21-2 x PN | 10.33 | 14.00 | 12.33 | 12.22 | 6.43 | 8.22 | 6.00 | 6.88 |
| T25 | BG-21-2 x RBG | 9.00 | 14.67 | 11.00 | 11.56 | 6.77 | 7.72 | 5.87 | 6.79 |
| T26 | RBG x NJ | 10.33 | 14.33 | 10.67 | 11.78 | 6.45 | 7.52 | 5.63 | 6.54 |
| T27 | RBG x BG-23 | 9.33 | 15.67 | 9.00 | 11.33 | 6.60 | 8.79 | 6.40 | 7.26 |
| T28 | RBG x BG-65 | 10.67 | 14.67 | 9.00 | 11.44 | 6.80 | 8.46 | 6.37 | 7.21 |
| T29 | RBG x PN | 9.00 | 14.33 | 11.00 | 11.44 | 7.56 | 8.86 | 5.40 | 7.27 |
| T30 | RBG x BG21-2 | 9.67 | 14.00 | 11.00 | 11.56 | 6.45 | 8.52 | 5.23 | 6.74 |
|  | **Cross mean** | **9.64** | **15.41** | **10.91** | **11.99** | **6.93** | **8.46** | **5.92** | **7.10** |
| T31 | NJ | 11.67 | 18.00 | 11.33 | 13.67 | 5.87 | 6.82 | 5.04 | 5.91 |
| T32 | BG-23 | 12.00 | 18.33 | 12.00 | 14.11 | 5.90 | 7.55 | 4.99 | 6.15 |
| T33 | BG-65 | 12.67 | 19.00 | 13.00 | 14.89 | 5.81 | 6.79 | 5.81 | 6.13 |
| T34 | PN | 12.00 | 17.33 | 12.00 | 13.78 | 6.18 | 7.21 | 5.09 | 6.16 |
| T35 | BG-21-2 | 12.33 | 17.67 | 13.33 | 14.44 | 5.67 | 7.50 | 5.47 | 6.21 |
| T36 | RBG | 11.67 | 17.00 | 11.67 | 13.44 | 5.67 | 7.34 | 5.16 | 6.06 |
|  | **Parent mean** | **12.06** | **17.89** | **12.22** | **14.06** | **5.85** | **7.20** | **5.26** | **6.10** |
| T37 | Kashi Ganga | 11.67 | 17.00 | 11.33 | 13.33 | 6.26 | 7.50 | 5.27 | 6.34 |
|  | Common Mean | 10.09 | 15.86 | 11.14 | 12.36 | 6.74 | 8.23 | 5.79 | 6.92 |
|  | C.V. (%) | 5.93 | 6.01 | 6.29 | 10.44 | 7.15 | 8.03 | 7.58 | 9.37 |
|  | S.E. (±) | 0.35 | 0.55 | 0.40 | 0.43 | 0.28 | 0.38 | 0.25 | 0.22 |
|  | C.D. 5% | 0.97 | 1.55 | 1.14 | 1.20 | 0.78 | 1.08 | 0.71 | 0.60 |
|  | C.D. 1% | 1.29 | 2.06 | 1.51 | 1.58 | 1.04 | 1.43 | 0.95 | 0.79 |

**Table 4. Mean performance of hybrid and parents and check in pooled over environments for inter-nodal length (cm)**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | Inter-nodal length (cm) | | | |
|  | NJ x BG-23 | E1 | E2 | E3 | Pooled |
| T1 | NJ x BG-65 | 8.72 | 11.21 | 10.87 | 10.27 |
| T2 | NJ x PN | 9.23 | 10.23 | 9.02 | 9.49 |
| T3 | NJ x BG-21-2 | 9.21 | 9.12 | 8.10 | 8.81 |
| T4 | NJ x RBG | 7.85 | 11.32 | 10.60 | 9.92 |
| T5 | BG-23 x NJ | 8.25 | 9.32 | 8.23 | 8.60 |
| T6 | BG -23 x BG-65 | 9.09 | 11.24 | 10.34 | 10.22 |
| T7 | BG-23 x PN | 9.12 | 10.21 | 9.10 | 9.48 |
| T8 | BG-23 x BG-21-2 | 8.35 | 9.32 | 8.23 | 8.63 |
| T9 | BG-23 x RBG | 7.32 | 10.21 | 9.21 | 8.91 |
| T10 | BG-65 x NJ | 8.34 | 8.35 | 7.14 | 7.94 |
| T11 | BG-65 x BG-23 | 10.20 | 12.21 | 11.34 | 11.25 |
| T12 | BG-65 x PN | 9.10 | 9.32 | 8.32 | 8.91 |
| T13 | BG-65 x BG-21-2 | 7.68 | 12.21 | 11.21 | 10.37 |
| T14 | BG-65 x RBG | 8.12 | 8.36 | 7.56 | 8.01 |
| T15 | PN x NJ | 8.25 | 11.26 | 10.56 | 10.02 |
| T16 | PN x BG-23 | 9.12 | 9.31 | 8.10 | 8.84 |
| T17 | PN x BG-65 | 8.21 | 10.89 | 9.76 | 9.62 |
| T18 | PN x BG-21-2 | 7.64 | 11.21 | 10.65 | 9.83 |
| T19 | PN x RBG | 8.28 | 9.78 | 8.57 | 8.88 |
| T20 | BG-21-2 x NJ | 9.31 | 11.34 | 10.23 | 10.29 |
| T21 | BG-21-2 x BG-23 | 7.45 | 9.36 | 8.34 | 8.38 |
| T22 | BG-21-2 x BG-65 | 8.12 | 11.34 | 10.62 | 10.03 |
| T23 | BG -21-2 x PN | 7.65 | 7.78 | 7.45 | 7.63 |
| T24 | BG-21-2 x RBG | 8.12 | 8.55 | 10.00 | 8.89 |
| T25 | RBG x NJ | 7.67 | 11.26 | 10.67 | 9.87 |
| T26 | RBG x BG-23 | 8.21 | 10.00 | 7.45 | 8.55 |
| T27 | RBG x BG-65 | 9.05 | 10.21 | 10.00 | 9.75 |
| T28 | RBG x PN | 7.34 | 11.34 | 10.32 | 9.67 |
| T29 | RBG x BG21-2 | 9.97 | 9.01 | 7.65 | 8.88 |
| T30 | **Cross mean** | 8.34 | 12.21 | 11.00 | 10.52 |
|  | NJ | **8.44** | **10.25** | **9.35** | **9.35** |
| T31 | BG-23 | 9.01 | 12.60 | 10.32 | 10.64 |
| T32 | BG-65 | 10.25 | 10.30 | 9.00 | 9.85 |
| T33 | PN | 10.95 | 13.24 | 12.00 | 12.06 |
| T34 | BG-21-2 | 9.36 | 11.32 | 10.10 | 10.26 |
| T35 | RBG | 8.91 | 12.34 | 11.23 | 10.83 |
| T36 | **Parent mean** | 10.23 | 12.04 | 10.23 | 10.83 |
|  | Kashi Ganga | **9.79** | **11.97** | **10.48** | **10.75** |
| T37 | Common Mean | 7.98 | 9.52 | 8.85 | 8.78 |
|  | C.V. (%) | 8.65 | 10.51 | 9.52 | 9.56 |
|  | S.E. (±) | 6.33 | 7.21 | 6.03 | 9.73 |
|  | C.D. 5% | 0.32 | 0.44 | 0.33 | 0.31 |
|  | C.D. 1% | 0.89 | 1.23 | 0.93 | 0.86 |
|  | NJ x BG-23 | 1.18 | 1.64 | 1.24 | 1.14 |

**Table 5. Mean performance of hybrid and parents and check in pooled over environments for peduncle length (cm) and number of primary branches.**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | Peduncle length (cm) | | | | Number of primary branches | | | |
|  |  | E1 | E2 | E3 | Pooled | E1 | E2 | E3 | Pooled |
| T1 | NJ x BG-23 | 12.67 | 14.11 | 13.89 | 13.56 | 6.54 | 5.56 | 5.43 | 5.84 |
| T2 | NJ x BG-65 | 13.67 | 12.89 | 12.77 | 13.11 | 5.56 | 4.69 | 5.21 | 5.15 |
| T3 | NJ x PN | 13.33 | 14.63 | 16.04 | 14.67 | 8.32 | 7.34 | 6.34 | 7.33 |
| T4 | NJ x BG-21-2 | 16.00 | 11.67 | 13.06 | 13.58 | 6.53 | 6.12 | 5.65 | 6.10 |
| T5 | NJ x RBG | 15.00 | 10.09 | 11.94 | 12.34 | 5.34 | 5.21 | 5.00 | 5.18 |
| T6 | BG-23 x NJ | 15.00 | 13.83 | 14.92 | 14.58 | 7.82 | 6.10 | 5.67 | 6.53 |
| T7 | BG -23 x BG-65 | 11.67 | 14.38 | 15.90 | 13.98 | 5.73 | 5.21 | 6.21 | 5.72 |
| T8 | BG-23 x PN | 12.00 | 15.99 | 16.72 | 14.90 | 8.10 | 7.12 | 6.12 | 7.11 |
| T9 | BG-23 x BG-21-2 | 14.00 | 14.29 | 15.79 | 14.69 | 7.78 | 6.12 | 5.67 | 6.52 |
| T10 | BG-23 x RBG | 14.00 | 14.75 | 14.78 | 14.51 | 8.35 | 7.37 | 6.21 | 7.31 |
| T11 | BG-65 x NJ | 11.67 | 14.46 | 12.90 | 13.01 | 5.97 | 6.21 | 5.87 | 6.02 |
| T12 | BG-65 x BG-23 | 11.67 | 16.98 | 15.35 | 14.66 | 5.74 | 5.23 | 5.78 | 5.58 |
| T13 | BG-65 x PN | 10.00 | 16.13 | 15.35 | 13.83 | 7.32 | 6.34 | 5.32 | 6.33 |
| T14 | BG-65 x BG-21-2 | 10.18 | 16.53 | 15.86 | 14.19 | 7.96 | 6.80 | 4.98 | 6.58 |
| T15 | BG-65 x RBG | 9.67 | 17.26 | 16.37 | 14.43 | 6.21 | 6.25 | 6.23 | 6.23 |
| T16 | PN x NJ | 13.00 | 13.83 | 13.03 | 13.29 | 8.12 | 7.14 | 5.89 | 7.05 |
| T17 | PN x BG-23 | 11.67 | 15.26 | 13.26 | 13.40 | 5.67 | 5.34 | 5.12 | 5.38 |
| T18 | PN x BG-65 | 11.00 | 14.55 | 12.09 | 12.55 | 6.45 | 6.23 | 6.32 | 6.33 |
| T19 | PN x BG-21-2 | 13.33 | 12.60 | 11.86 | 12.60 | 7.34 | 7.13 | 6.89 | 7.12 |
| T20 | PN x RBG | 10.33 | 13.11 | 12.53 | 11.99 | 5.56 | 6.21 | 5.67 | 5.81 |
| T21 | BG-21-2 x NJ | 9.33 | 11.19 | 10.40 | 10.31 | 6.67 | 6.14 | 6.00 | 6.27 |
| T22 | BG-21-2 x BG-23 | 10.00 | 12.16 | 11.35 | 11.17 | 7.76 | 6.47 | 6.34 | 6.86 |
| T23 | BG-21-2 x BG-65 | 12.00 | 12.78 | 14.13 | 12.97 | 6.78 | 5.80 | 5.23 | 5.94 |
| T24 | BG -21-2 x PN | 10.33 | 11.29 | 12.63 | 11.42 | 6.34 | 5.67 | 4.78 | 5.60 |
| T25 | BG-21-2 x RBG | 9.67 | 12.24 | 11.72 | 11.21 | 6.85 | 5.87 | 5.67 | 6.13 |
| T26 | RBG x NJ | 17.00 | 14.44 | 13.31 | 14.92 | 7.45 | 6.47 | 5.32 | 6.41 |
| T27 | RBG x BG-23 | 14.00 | 15.23 | 14.89 | 14.71 | 5.89 | 5.23 | 5.54 | 5.55 |
| T28 | RBG x BG-65 | 13.67 | 15.86 | 15.18 | 14.90 | 7.82 | 6.34 | 6.32 | 6.83 |
| T29 | RBG x PN | 12.67 | 14.45 | 16.15 | 14.42 | 7.34 | 6.21 | 4.45 | 6.00 |
| T30 | RBG x BG21-2 | 14.00 | 15.48 | 15.63 | 15.04 | 6.10 | 5.74 | 4.34 | 5.39 |
|  | **Cross mean** | **12.42** | **14.08** | **13.99** | **13.50** | **6.85** | **6.12** | **5.65** | **6.21** |
| T31 | NJ | 13.23 | 12.39 | 13.00 | 12.87 | 7.23 | 6.25 | 5.04 | 6.17 |
| T32 | BG-23 | 13.11 | 13.15 | 13.20 | 13.15 | 6.21 | 5.05 | 5.12 | 5.46 |
| T33 | BG-65 | 12.33 | 15.32 | 14.03 | 13.89 | 6.34 | 5.18 | 4.90 | 5.47 |
| T34 | PN | 9.32 | 12.48 | 12.20 | 11.33 | 6.58 | 5.22 | 5.00 | 5.60 |
| T35 | BG-21-2 | 11.83 | 13.73 | 12.30 | 12.62 | 5.67 | 5.41 | 5.46 | 5.51 |
| T36 | RBG | 15.04 | 12.51 | 14.55 | 14.03 | 6.54 | 5.80 | 5.01 | 5.78 |
|  | **Parent mean** | **12.48** | **13.26** | **13.21** | **12.98** | **6.43** | **5.49** | **5.09** | **5.67** |
| T37 | Kashi Ganga | 9.78 | 12.15 | 12.23 | 11.39 | 6.66 | 5.22 | 5.12 | 5.67 |
|  | Common Mean | 12.36 | 13.90 | 13.82 | 13.36 | 6.77 | 5.99 | 5.55 | 6.11 |
|  | C.V. (%) | 6.05 | 7.05 | 6.36 | 11.38 | 6.40 | 7.22 | 8.04 | 9.40 |
|  | S.E. (±) | 0.43 | 0.57 | 0.51 | 0.51 | 0.25 | 0.25 | 0.26 | 0.19 |
|  | C.D. 5% | 1.22 | 1.59 | 1.43 | 1.41 | 0.71 | 0.70 | 0.73 | 0.53 |
|  | C.D. 1% | 1.62 | 2.12 | 1.90 | 1.86 | 0.94 | 0.94 | 0.96 | 0.70 |

**COMPETING INTERESTS DISCLAIMER:**

Authors have declared that they have no known competing financial interests OR non-financial interests OR personal relationships that could have appeared to influence the work reported in this paper.

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