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

**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 were developed by six parents using 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 Randomized Block Design (RBD) design. Among parents RBG exhibited 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, 2001). Currently, in India, the per capita daily availability of vegetables is 175 grams, falling short of the recommended 280 grams per capita per day (Swarup V, 2022). The pulp possesses antioxidant activity, laxative, cardio-protective, 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, have 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 significantly lower compared to other tropical countries and the national average. Nowadays, there is a need to developed early-maturing and high-yielding varieties. The lack of high-yielding, early-maturing, and stable varieties could be one of the likely causes of low productivity, offering a good scope for research in bottle gourd. Important characteristics like days to first male and female flower opening and harvest, number of nodes to first male and female flower appearance, vine length, internodal length, number of primary branches, and peduncle length are important in varietal improvement.

**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 across three different seasons: Summer (February 2022) as Environment-1 (E1), Rainy (May 2022) as Environment-2 (E2), and Winter (September 2022) as Environment-3 (E3). The study aimed to evaluate the mean performance of genotypes using the 6 x 6 full diallel mating design. Geographically, the experimental site falls under a humid subtropical climate and is located between 82.12° and 83.98° E longitude and 24.47° and 26.56° N latitude, at an altitude of 75 meters above 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 30 F1 hybrids obtained through full diallel mating design. The experiment was evaluated using a Randomized Block Design (RBD) with 37 treatments, including six parents, 30 F₁ hybrids, and one check variety (Kashi Ganga) for the assessment of hybrid performance based on traits such as days to first male and female flower opening and harvest, number of nodes to first male and female flower appearance, vine length, internodal length, number of primary branches, and peduncle length. The plot size was 4 m × 3 m, with each plot consisting of eight plants. The statistical analysis of the experimental design was conducted following the methodology of Panse and Sukhatme (1967).

**RESULTS AND DISCUSSION**

**A. For earliness traits**

In pooled analysis, among the parents, RBG (46.44) and BG-23 (51.00) exhibited the minimum days to first male flower opening. Similarly, the parents RBG (51.44), BG-23 (53.67), and NJ (54.78) required the least number of days for the first female flower opening. For the first harvest, the minimum number of days was recorded in RBG (61.44), BG-23 (63.22), and BG-21-2 (64.00). Additionally, RBG (7.89) showed the minimum number of nodes to first male flower appearance, while RBG (13.44), NJ (13.67), and BG-23 (14.11) required the least number of nodes for first female flower appearance. These traits are desirable for crop improvement. Similar findings were reported by Sohi et al. (2021), Singh et al. (2023), and Paratpararao et al. (2023), as presented in Table 1 to Table 3.

In pooled analysis, among the 30 F₁ hybrids, the hybrids NJ × PN (39.67), PN × NJ (39.67), NJ × BG-23 (40.56), RBG × NJ (41.44), and RBG × PN (41.56) were found superior to the check variety (Kashi Ganga, 47.89) as they recorded the minimum days to first male flower opening. Similarly, the hybrids PN × NJ (42.78), BG-23 × RBG (43.89), RBG × NJ (44.44), NJ × BG-23 (46.44), and NJ × PN (44.56) were superior to the check (Kashi Ganga, 52.89) in terms of minimum days to first female flower opening. For the trait "days to first harvest," the hybrids PN × NJ (50.87), BG-23 × RBG (52.00), RBG × NJ (53.44), and NJ × PN (52.89) were superior to the check (Kashi Ganga, 62.56) as they required fewer days for the first harvest. Regarding the number of nodes to first male flower appearance, the hybrids BG-65 × BG-21-2 (6.27), NJ × PN (6.56), RBG × PN (6.67), BG-23 × BG-65 (6.37), PN × BG-23 (6.67), and PN × BG-21-2 (6.67) recorded the lowest values. Additionally, the hybrids NJ × BG-23 (11.11), PN × BG-21-2 (10.56), PN × RBG (10.89), and BG-23 × BG-65 (11.00) outperformed the check (Kashi Ganga, 7.89 for male and 13.33 for female) in terms of the minimum number of nodes to first female flower appearance. These findings align with the results reported by Gaonkar et al. (2023), Gaddam et al. (2022), and Harika et al. (2012), as presented in Table 1 to Table 3.

**B. For growth traits**

In pooled analysis, among the parents, BG-21-2 (6.21), PN (6.16), and BG-23 (6.15) exhibited the maximum vine length. The parents BG-65 (9.85), RBG (10.83), and BG-21-2 (10.26) recorded the highest internodal length. Similarly, RBG (14.03), BG-65 (13.89), and BG-23 (13.15) had the maximum peduncle length, while NJ (6.17), RBG (5.78), and PN (5.60) showed the highest number of primary branches. These traits are desirable for crop improvement. Similar findings were reported by Sohi et al. (2021), Bhavanasi et al. (2022), and Jamal et al. (2014), as presented in Table 3 to Table 5.

In pooled analysis, among the 30 F₁ hybrids, PN × BG-65 (7.89), BG-65 × PN (7.77), PN × NJ (7.77), BG-21-2 × NJ (7.71), and BG-65 × RBG (7.47) exhibited superior vine length at the time of final harvesting compared to the check variety (Kashi Ganga, 6.34). For the trait internodal length, the hybrids BG-65 × PN (8.91), NJ × BG-23 (10.27), BG-23 × NJ (8.60), RBG × BG-21-2 (8.88), and BG-21-2 × BG-23 (8.38) outperformed the check (Kashi Ganga, 10.75). Regarding peduncle length, the hybrids RBG × NJ (14.92), RBG × BG-65 (14.90), BG-23 × PN (14.90), and RBG × BG-23 (14.00) exhibited maximum peduncle length over the check. For the number of primary branches per plant, the hybrids NJ × PN (7.33), BG-23 × RBG (7.31), PN × BG-21-2 (7.12), PN × NJ (7.05), and BG-23 × PN (7.71) produced more primary branches than the check (Kashi Ganga, 5.67). These findings align with the results reported by Bhavanasi et al. (2022), Paratpararao et al. (2023), and Gaonkar et al. (2023), as presented in Tables 3 to 5.

**CONCLUSION**

Finally, it was concluded that the parent RBG performed well across environments for earliness and growth traits in bottle gourd. Among the F₁ hybrids, NJ × PN and PN × NJ exhibited the minimum days for earliness traits. For growth traits, the hybrid PN × NJ showed a better mean performance than the check variety (Kashi Ganga) for vine length and the number of primary branches, while BG-65 × PN was superior for internodal length, and RBG × NJ had a better mean for peduncle length compared to the 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.**

|  |  |  |  |
| --- | --- | --- | --- |
| Treatment  | F1 and Genotype  | 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 |

Where NJ= (Narendra Joyti), BG-23= (BRBG-23), BG-65= (BRBG-65), PN= (Pusa Naveen), BG-21-2= (BRBG-21-2) and RBG= (Round bottle gourd).

**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.**

|  |  |  |  |
| --- | --- | --- | --- |
| Treatment  | F1 and Genotype  | Days to first 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 |

Where NJ= (Narendra Joyti), BG-23= (BRBG-23), BG-65= (BRBG-65), PN= (Pusa Naveen), BG-21-2= (BRBG-21-2) and RBG= (Round bottle gourd).

**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.**

|  |  |  |  |
| --- | --- | --- | --- |
| Treatment  | F1 and Genotype  | 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 |

Where NJ= (Narendra Joyti), BG-23= (BRBG-23), BG-65= (BRBG-65), PN= (Pusa Naveen), BG-21-2= (BRBG-21-2) and RBG= (Round bottle gourd).

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

|  |  |  |
| --- | --- | --- |
| Treatment  | F1 and Genotype  | Inter-nodal length (cm) |
| E1 | E2 | E3 | Pooled |
| T1 | NJ x BG-23 | 8.72 | 11.21 | 10.87 | 10.27 |
| T2 | NJ x BG-65 | 9.23 | 10.23 | 9.02 | 9.49 |
| T3 | NJ x PN | 9.21 | 9.12 | 8.10 | 8.81 |
| T4 | NJ x BG-21-2 | 7.85 | 11.32 | 10.60 | 9.92 |
| T5 | NJ x RBG | 8.25 | 9.32 | 8.23 | 8.60 |
| T6 | BG-23 x NJ | 9.09 | 11.24 | 10.34 | 10.22 |
| T7 | BG -23 x BG-65 | 9.12 | 10.21 | 9.10 | 9.48 |
| T8 | BG-23 x PN | 8.35 | 9.32 | 8.23 | 8.63 |
| T9 | BG-23 x BG-21-2 | 7.32 | 10.21 | 9.21 | 8.91 |
| T10 | BG-23 x RBG | 8.34 | 8.35 | 7.14 | 7.94 |
| T11 | BG-65 x NJ | 10.20 | 12.21 | 11.34 | 11.25 |
| T12 | BG-65 x BG-23 | 9.10 | 9.32 | 8.32 | 8.91 |
| T13 | BG-65 x PN | 7.68 | 12.21 | 11.21 | 10.37 |
| T14 | BG-65 x BG-21-2 | 8.12 | 8.36 | 7.56 | 8.01 |
| T15 | BG-65 x RBG | 8.25 | 11.26 | 10.56 | 10.02 |
| T16 | PN x NJ | 9.12 | 9.31 | 8.10 | 8.84 |
| T17 | PN x BG-23 | 8.21 | 10.89 | 9.76 | 9.62 |
| T18 | PN x BG-65 | 7.64 | 11.21 | 10.65 | 9.83 |
| T19 | PN x BG-21-2 | 8.28 | 9.78 | 8.57 | 8.88 |
| T20 | PN x RBG | 9.31 | 11.34 | 10.23 | 10.29 |
| T21 | BG-21-2 x NJ | 7.45 | 9.36 | 8.34 | 8.38 |
| T22 | BG-21-2 x BG-23 | 8.12 | 11.34 | 10.62 | 10.03 |
| T23 | BG-21-2 x BG-65 | 7.65 | 7.78 | 7.45 | 7.63 |
| T24 | BG -21-2 x PN | 8.12 | 8.55 | 10.00 | 8.89 |
| T25 | BG-21-2 x RBG | 7.67 | 11.26 | 10.67 | 9.87 |
| T26 | RBG x NJ | 8.21 | 10.00 | 7.45 | 8.55 |
| T27 | RBG x BG-23 | 9.05 | 10.21 | 10.00 | 9.75 |
| T28 | RBG x BG-65 | 7.34 | 11.34 | 10.32 | 9.67 |
| T29 | RBG x PN | 9.97 | 9.01 | 7.65 | 8.88 |
| T30 | RBG x BG21-2 | 8.34 | 12.21 | 11.00 | 10.52 |
|  | **Cross mean** | **8.44** | **10.25** | **9.35** | **9.35** |
| T31 | NJ | 9.01 | 12.60 | 10.32 | 10.64 |
| T32 | BG-23 | 10.25 | 10.30 | 9.00 | 9.85 |
| T33 | BG-65 | 10.95 | 13.24 | 12.00 | 12.06 |
| T34 | PN | 9.36 | 11.32 | 10.10 | 10.26 |
| T35 | BG-21-2 | 8.91 | 12.34 | 11.23 | 10.83 |
| T36 | RBG | 10.23 | 12.04 | 10.23 | 10.83 |
|  | **Parent mean** | **9.79** | **11.97** | **10.48** | **10.75** |
| T37 | Kashi Ganga | 7.98 | 9.52 | 8.85 | 8.78 |
|  | Common Mean | 8.65 | 10.51 | 9.52 | 9.56 |
|  | C.V. (%) | 6.33 | 7.21 | 6.03 | 9.73 |
|  | S.E. (±) | 0.32 | 0.44 | 0.33 | 0.31 |
|  | C.D. 5% | 0.89 | 1.23 | 0.93 | 0.86 |
|  | C.D. 1% | 1.18 | 1.64 | 1.24 | 1.14 |

Where NJ= (Narendra Joyti), BG-23= (BRBG-23), BG-65= (BRBG-65), PN= (Pusa Naveen), BG-21-2= (BRBG-21-2) and RBG= (Round bottle gourd).

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

|  |  |  |  |
| --- | --- | --- | --- |
| Treatment  | F1 and Genotype  | 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 |

Where NJ= (Narendra Joyti), BG-23= (BRBG-23), BG-65= (BRBG-65), PN= (Pusa Naveen), BG-21-2= (BRBG-21-2) and RBG= (Round bottle gourd).

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**REFERENCES**

1. Bhavanasi, S., Bahadur, V., Kerketta, A., & Prasad, V. M. (2022). Performance of bottle gourd (*Lagenaria siceraria* L.) genotypes for growth, yield and quality. *International Journal of Plant & Soil Science*, *34*(23), 239-244.
2. Gaddam, T. A. R., Bahadur, V., & Topno, S. E. (2022). Performance of bottle gourd [*Lagenaria siceraria* L.] Varieties in Prayagraj agro-climatic conditions. *The Pharma Innovation Journal*; 11(6): 456-460.
3. Gaonkar, V. V., Bahadur, V., Topno, S. E., & Kerketta, A. (2023). Performance of bottle gourd (*Lagenaria siceraria* L.) genotypes for growth, yield and quality under Prayagraj agro-climatic condition. *The Pharma Innovation Journal*, *12*(5), 3339-3343.
4. Gaonkar, V. V., Bahadur, V., Topno, S. E., & Kerketta, A. (2023). Performance of Bottle Gourd (*Lagenaria siceraria* L.) Genotypes for Yield and Quality under Climatic Conditions of Prayagraj. *International Journal of Environment and Climate Change*, *13*(8), 1379-1387.
5. Harika, M., Gasti, V. D., Shantappa, T., Mulge, R., Shirol, A. M., Mastiholi, A. B., & Kulkarni, M. S. (2012). Evaluation of bottle gourd genotypes [*Lagenaria siceraria* (Mol.) Standl.] for various horticultural characters. *Karnataka journal of agricultural sciences*, *25*(2).
6. Jain, A., & Singh, S. P. (2016). Evaluation on mean performance in bottle gourd [*Lagenaria siceraria* (Molina) Standl.) genotypes. *J. Global Biosci*, *5*(8), 4515-4519.
7. Jamal Uddin, A. F. M., Tahidul, M. I., Chowdhury, M. S. N., Shiam, I. H., & Mehraj, H. (2014). Evaluation of bottle gourd (*Lagenaria siceraria* (Mol.) Standl.) to growth and yield. *International Journal of Biosciences*, *5*(12), 7-11.
8. Panse, V. G. & Sukhatme, P. V. (1967). Statistical Methods for Agricultural Workers, ICAR, New Delhi, pp. 1-381.
9. Paratpararao, G., & Sekhar, V. (2023). Per se performance of parents and hybrids in bottle gourd (*Lagenaria siceraria* (Mol.) Standl.) for growth, yield and quality attributing characters. *The Pharma Innovation Journal*; 12(8): 1786-1792
10. PIB (Press Information Bureau), government of India under the Ministry of Information and Broadcasting (2021-2022).
11. Singh, H. K., & Adarsh, R. K. A. (2023). Evaluation of bottle gourd genotypes [*Lagenaria siceraria* (Mol.) Standl.] for various horticultural characters. *The Pharma Innovation Journal*, *12*(9), 1801-1805.
12. Sohi, A., Prasad, V. M., Bahadur, V., & Topno, S. E. (2021). Hybrids Evaluation of Bottle Gourd [*Lagenaria siceraria* (Molina) Standl.] for Fruit Growth Yield Quality and Morphological Traits in Prayagraj Agro-Climatic Conditions. In *Biological Forum: An International Journal* (Vol. 13, No. 2, pp. 477-480).
13. Thamburaj, S. (Ed.). (2001). *Vegetables, tubercrops and spices*. Indian Council of Agricultural Research.
14. Swarup V (2022). Vegetable science and technology in India *Kalyani publication ISBN* 97890000187522, 90000187524