The Pharma Innovation Journal 2023; 12(9): 1801-1805

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; 12(9): 1801-1805

www.thepharmajournal.com
Received: 02-06-2023
Accepted: 06-07-2023

HK Singh
Farm Science Center, Kishnagnaj, BAU, Sabour, Bhagalpur, Bihar, India

Randhir Kumar
Agricultural Research Institute, Patna, BAU, Sabour, Bhagalpur, Bihar, India

Anupam Adarsh
Farm Science Center, Saraiya, Muzaffarpur, DRPCAU, Pusa, Bihar, India

Corresponding Author:
Anupam Adarsh
Farm Science Center, Saraiya, Muzaffarpur, DRPCAU, Pusa, Bihar, India

Evaluation of bottle gourd genotypes [*Lagenaria siceraria* (Mol.) Standl.] for various horticultural characters

HK Singh, Randhir Kumar and Anupam Adarsh

Abstract
The study conducted at the vegetable research farm of Bihar Agricultural University, Sabour, India, to identify a suitable bottle gourd genotype for different growing seasons. The experiment was carried out during the early winter season and early summer season of 2013, as well as the summer season of 2014. Forty-five bottle gourd genotypes were assessed based on various quantitative traits. The analysis of variance revealed significant variations attributed to genotypes across all three environments: early winter, early summer, and summer.

The study demonstrated substantial diversity among the nine parent inbreds and their resulting 36 F_1 hybrids, as indicated by the highly significant mean square values associated with 14 distinct characters evaluated within the three environments. Among the 45 genotypes, the hybrid Pusa Santushti × SBBG-31-1 exhibited the highest fruit yield per plant. Furthermore, the research highlighted the potential of specific genotypes for optimal fruit yield and maturity across different environments. Notably, the genotypes Pusa Naveen and HZP-RC-1 displayed early maturity and high yield in all growing conditions, making them promising candidates. In addition to quantitative traits, qualitative traits of bottle gourd were also observed. The general mean values for various qualities were noted, with the highest carbohydrate content in fruit observed at 3.75 g/100 g and the lowest at 3.44 g/100 g. Similarly, calcium content in fruit was comparatively higher at 27.51 mg/100 g during the main growing season, while it was slightly lower at 26.08 mg/100 g during the off-season (early winter). This study provided valuable insights into the variability of bottle gourd genotypes across different growing seasons, offering recommendations for optimal genotypes based on fruit yield, maturity, and qualitative traits.

Keywords: Environment, characters, variance, mean and qualitative

Introduction
Bottle gourd (*Lagenaria siceraria*) is a versatile crop cultivated in tropical and subtropical regions for its diverse applications. Its tender nature makes it highly beneficial for individuals like biliousness, indigestion, and during recovery periods. The cucurbitaceous family, exhibits significant genetic diversity, allowing for adaptation across various climates, including tropical, subtropical, arid, and temperate regions.

A distinctive attribute of bottle gourd resilience in diverse climatic conditions. It stands as the sole cucurbit that can be planted during the rainy season to yield produce in the winter months. It effectively endures the typically chilling weather of December and January in regions like eastern Bihar and Uttar Pradesh, where other cucurbits suffer due to the cold. This trait showed remarkable hardiness against cooler temperatures, indicating its potential for year-round cultivation in natural climates.

Bottle gourd [*Lagenaria siceraria* (Mol.) Standl.] is grown for its wide range of uses and shape (globular, bottle shaped and round) is cultivated in the tropical and subtropical part of country (Adarsh *et al.* 2017) [2, 8]. There is wide range of genetic diversity within the family and the range of adaptation among cucurbitaceous species varies from tropical, subtropical regions, arid deserts, and temperate regions. Bottle gourd is only cucurbit, which is planted during rainy season for winter season produce, can withstand well the natural chilling weather of December and January in eastern part of Bihar and Uttar Pradesh, where other cucurbits such as pumpkin, sponge gourd, bitter gourd to cool etc. are ravaged by low temperature of winter. The current study aimed to identify suitable bottle gourd genotypes and hybrids for different seasons, focusing on various horticultural traits. In the context of India's patent protection regulations, the life sciences industry faces unique considerations due to exclusions on patent protection for specific innovation aspects.

Bottle gourd is a remarkably lucrative crop, capable of generating substantial income for farmers within a short timeframe of just two to three months (Tirumalesh and Mondal, 2018) [12].

Beyond the conventional criteria of novelty, inventive step, and industrial applicability, bottle gourd innovations might also be considered for protection based on their different uses. Overall, this research seeks to unravel the potential of bottle gourd genotypes and hybrids across seasons, recognizing its adaptability and contributions to the agricultural and health sectors.

Materials and Methods

The materials for the present investigation consisted of nine promising and diverse inbred lines/ varieties/ strains of bottle gourd *viz*; Rajendra Chamatkar (P_1), Pusa Santushti (P_2), Pusa Naveen (P_3), Narendra Dharidar (P_4), SBBG-23 (P_5), SBBG-32 (P_6), SBBG-31-1 (P_7), SBBG-11 (P_8) and HZP-RC-1 (P_9), and their 36 F_1 hybrids obtained through diallel mating design excluding reciprocals. The experiments were conducted in complete randomized block design with three, replication to raise bottle gourd crop in three consecutive environmental condition *viz*; early winter (Eew) – from 20th August, 2013 (Autumn winter); early summer (Ees) – from 09th November, 2013 (Spring summer) and summer season (Es) – from 06th February, 2014 (Zaid). The parent P_3 (Pusa Naveen) was used as standard check also for comparative evaluation of hybrids. All the 45 genotypes (09 parents and 36 F_1 hybrids) ware planted in a single row of 4.0 m length with row to row spacing 3.0 m and plant to plant distance of 50 cm. eight plants were maintained in each plot. The distinctive leaf and fruit characteristic and sex form of the present and presented in Table 1. The data were analyzed using the software Statistical Package for Agricultural Research (SPAR).

Results and Discussion

The analysis of variance conducted in this study revealed highly significant mean square values attributed to genotypes across all three environments: early winter (Eew), early summer (Ees), and the summer season (Es). This observation emphasized the presence of considerable variability among both the nine inbred parent genotypes and their resulting 36 F1 hybrids. The significance of the data extended to the parent genotypes as well, indicating substantial differences in all 14 characters across the three aforementioned environments. Similar performance for yield and yield attributing traits was reported by Kandasamy *et al*. 2019 and Bhatt *et al*. 2022 [4].

Furthermore, the analysis indicated a broad spectrum of mean values for each of the 14 characters evaluated among the parent genotypes and F1 hybrids, spanning the three different environments. This wide range of variation underscored the extensive diversity existing within the genotypes, reflecting their adaptability and responsiveness to varying environmental conditions. This observation is in agreement with a previous study conducted by Singh *et al*. in 2017 [8], lending support to the robustness and credibility of the present research findings.

The grand mean of fruit yield as well as number of fruits per plant revealed that highest yield was realized in main season crop of summer (8.16 kg/plant) followed by off season crops of early summer (6.38 kg/plant) and early winter (5.12 kg/plant) season (Table 2). Perusal of grand mean data on days to anthesis of first male and female flower, days to first fruit harvest and node number to first make and female flower in the parents and hybrids over the three environments revealed interesting result (Table 2). November sown early summer crop required highest number of days (113.79) to anthesis of first female flower but produced them at lowest node number (7.98), while august sown winter season crop took minimum number of days to antithesis of first female flower (47.88) and produce them at fairly high node number (14.71) first female flower.

Considering the extent of variation in the node number to first male and female flowers over the three environments, it is inferred that even the node number to anthesis of first female flowers may not be considering a stable criteria of maturity at least in bottle gourd as is the general consideration in cucurbits. Padmakshi (2015) [6] also found the similar result and suggested that the appearance of first female flower particular genotypes (parents/hybrid) of bottle gourd is neither dependent on nor node number but is the function of both.

Highest grand mean values for average length of edible fruit, average weight of edible fruit, number of fruit per plant and fruit yield per plant were observed in summer season followed by early summer and winter (Table 2), which clearly revealed that agro-climatic condition of summer season could be rated as favourable/good for bottle gourd cultivation, whereas, that of early summer, winter and summer season may be rated as adverse poor. Singh (1998) [7] and Sohi *et al*. (2021) [10] also recorded higher fruit yield per plant during summer season than early summer and early winter season.

In the fruit yield per plant in cross Pusa Santushti × SBBG-31-1(9.77 kg) in Es followed by Rajendra Chamtkar × Narendra Dharidar (7.65 kg) in Ees and Pusa Santushti × Pusa Naveen (6.79 kg) in Eew but average fruit weight in cross Pusa Naveen × HZP-RC-1 (1.52 kg and 1.47 kg in Es and Ees, respectively) and Narendra Dharidar × SBBG-11 (1.22 kg) were no single cross found to be mean performance similar pattern it means purely involvement of environments. These observations highlighted the genotype-environments interaction in the expression of these particular traits.

Number of fruit per plant in cross Pusa Naveen × SBBG-32 was noted to be maximum among the all the hybrids in over the environments. The three best cross combinations on the basis of *per se* performance for yield per plant during early winter season Pusa Santushti × Pusa Naveen (6.79 kg) followed by Pusa Naveen × Narendra Dharidar (6.71 kg); for early summer crops the three best hybrids were Pusa Naveen × Narendra Dharidar (6.65 kg) followed by Rajendra Chamatkar × Narendra Dharidar (6.63 kg); for summer season crop the three top ranking hybrids were Pusa Santushti × SBBG-31-1 (9.77 kg) followed by Pusa Naveen × SBBG-31-1 (9.67 kg).

The results obtained are in agreement with Tomar, 2020; in bottle gourd. The fruit shapes of hybrids involving parents Pusa Naveen were perfectly cylindrical, while for the other hybrids the fruit shapes were bottle shaped or near-cylindrical.

The grand mean for this trait showed that summer season was received to harvest the maximum fruit yield per plant *i.e.* 8.16 kg in summer season (Es) followed by pooled the three environments *i.e.* pooled (P) 6.55 kg, early summer (Ees) 6.38 kg, while early winter season gave minimum mean fruit yield per plant 5.12 kg. Perusal of grand mean data on node number to anthesis of first staminate and pistillate flower was lowest in 2nd week of November (7.96 and 10.89) and highest in 3rd week of August (12.62 and 14.71) consequently, day to anthesis of first staminate flower was lowest in 42.90 days to anthesis in 3rd week of August and consists maximum days to

anthesis of first male flower 104.57 days in 2nd week of November, Rajput *et al*., 2020 [1] justified that the genotype is early in days to male and female flowering over other genotypes. Days to anthesis of first pistillate flower was minimum days (47.88) in 2nd week of August and maximum days (113.79) in 3rd week of November, early summer sowing in 2nd week of November took maximum duration for first harvest of the crops (116.07 days) and sowing 1st week of February picking (66.06 days) fruit first harvest, vine length was maximum in 7.25 m in 1st week of February and minimum 5.44 m in 3rd week of November, fruit length was maximum 51.24 cm in summer season and minimum 42.89 cm, fruit circumference was lowest 19.47 cm in early winter mean 3rd week of August and highest 22.01 cm in summer season means 1st week of February, number of fruit was more number produced (6.98) fruits in summer season and minimum number fruits (6.02) produce per plant in early winter season, average fruit was maximum received 1.19 kg in summer season and minimum 0.95 kg in early winter season, for fruit yield per plant was highest in 8.16 kg/plant and minimum 5.12 kg/ plant in 1st week of February and 3rd week of November, respectively. The above finding was an agreement of Singh and Singh 2020 [9] and Iqbal *et al*. 2020 [5].

Also observed qualitative traits of bottle gourd on the basis of general mean *viz;* carbohydrate content in fruit was observed maximum (3.75 g/100 g) and minimum (3.44 g/100 g), for calcium content in fruit also high (27.51 mg/100 g) in main season and low (26.08 mg/100 g) in off season (early winter). According to Yogananda (2020) [13] there was significant amount of variation for ascorbic acid, calcium content, TSS and dry matter content.

Table 1: Visual observation of fruit characteristics of 9 parental lines and their hybrids

Sl. No	Parental Line	Source	Specific traits	General Rating
1	Rajendra Chamatkar	BAU, Sabour	Long fruit, prolific bearing and resistant to powdery mildew and insect	Good
2	Pusa Santushti	IARI, Pusa (N. Delhi)	Pear shape, early fruiting	Very good
3	Pusa Naveen	IARI, Pusa (N. Delhi)	Perfectly cylindrical, blossom end scar pointed.	Good
4	Narendra Dharidar	NDUAT, Faizabad	Perfectly cylindrical, white or green stripes on fruit.	Good
5	SBBG-23	BAU, Sabour	Medium long, symmetrical straight light green, very slim	Good
6	SBBG-31-1	BAU, Sabour	Cylindrical, pointed blossom end scar	Good
7	SBBG-32	BAU, Sabour	Small ellipsoid shape, Late fruiting	Good
8	SBBG-11	BAU, Sabour	Cylindrical and medium BES	Good
9	HZP-RC-1	BAU, Sabour	Long, light green	Very good

Table 2: Range of mean performance of parents and hybrids; mean value over parents and hybrids; and grand mean over parents and hybrids recorded during early winter (Eew), early summer (Ees), summer season (Es) and pooled over Eew, Ees , Es & (P)

Factors/ Components	Environments	Node no. to anthesis of first staminate flower	Node no. to anthesis of first pistillate flower	Days to anthesis of first staminate flower	Days to anthesis of first pistillate flower	Days of first fruit harvest	Vine length (m)	Fruit length (cm)	Fruit circumference (cm)
		1	2	3	4	5	6	7	8
Range of parents	Eew	11.13-14.53	12.07-17.80	39.13-46.47	41.30-50.53	55.67-62.40	4.94-7.05	36.87-54.70	17.67-21.87
	Ees	7.07-9.80	7.97-13.37	97.93-113.37	105.43-123.53	109.20-127.17	5.37-6.77	38.07-59.50	18.53-20.53
	Es	9.33-11.47	10.40-15.27	43.87-51.07	48.40-52.97	62.90-70.27	6.84-7.66	39.07-62.70	20.90-23.83
	P	9.40-11.86	11.07-15.23	60.31-70.30	65.05-75.68	75.93-84.40	5.88-6.75	37.99-58.98	19.05-21.28
Range of crosses	Eew	10.87-15.87	11.27-17.40	39.60-48.00	39.53-55.53	57.87-68.03	4.23-7.29	36.97-55.60	17.07-22.87
	Ees	6.27-10.40	7.00-15.07	93.07-114.70	106.37-122.77	106.17-124.97	5.03-7.43	39.20-54.53	17.37-25.83
	Es	9.47-12.53	10.63-15.60	42.40-50.88	45.57-55.70	61.87-70.83	6.11-8.98	41.03-59.13	20.20-24.93
	P	9.36-12.38	10.83-15.38	58.65-70.00	64.79-76.68	77.46-86.80	5.12-7.90	40.57-54.80	18.66-22.79
Mean over parents	Eew	12.62	15.00	44.37	47.00	60.48	5.63	42.80	19.63
	Ees	7.96	10.85	104.69	112.30	115.06	6.01	46.33	19.67
	Es	10.31	12.85	46.99	49.73	65.13	7.24	49.53	22.01
	P	10.30	12.90	65.35	69.67	80.22	6.29	46.22	20.44

Factors/Components	Environments	Number of fruits per plant	Average fruit weight (kg)	Fruit yield per plant (kg)	Ascorbic acid content in fruit (mg/100 g)	Sodium content in fruit (mg/100 g)	Calcium content in fruit (mg/100 g)
		9	10	11	12	14	15
Range of parents	Eew	3.70-6.37	0.76-1.35	3.18-5.58	7.70-8.33	1.79-1.99	23.13-28.90
	Ees	4.10-6.93	0.94-1.41	4.56-6.51	8.27-8.70	1.86-2.06	24.17-29.83
	Es	5.10-9.06	0.99-1.55	6.48-8.95	8.63-9.10	1.98-2.18	24.33-30.00
	P	4.30-7.45	0.90-1.44	4.82-7.01	8.24-8.67	1.88-2.08	23.88-29.58
Range of crosses	Eew	3.25-7.57	0.69-1.22	3.45-6.79	7.60-8.77	1.76-2.02	23.67-28.47
	Ees	4.45-8.30	0.86-1.47	5.21-7.65	8.07-8.90	1.83-2.09	24.67-29.50
	Es	5.46-9.21	0.91-1.52	6.21-9.77	8.47-9.20	1.95-2.21	25.00-30.00
	P	4.39-8.36	0.83-1.39	5.12-7.90	8.04-8.83	1.84-2.11	24.49-29.21
Mean over parents	Eew	4.62	0.96	4.60	7.97	1.90	25.91
	Ees	5.23	1.07	5.56	8.44	1.97	26.87
	Es	6.38	1.18	7.41	8.81	2.09	27.26
	P	5.41	1.07	5.86	8.41	1.99	26.68

Factors/Components	Environments	Node no. to anthesis of first staminate flower	Node no. to anthesis of first pistillate flower	Days to anthesis of first staminate flower	Days to anthesis of first pistillate flower	Days of first fruit harvest	Vine length (m)	Fruit length (cm)	Fruit circumference (cm)
		1	2	3	4	5	6	7	8
Mean over crosses	Eew	13.20	14.64	42.53	48.10	62.28	5.39	42.92	19.43
	Ees	7.99	10.90	104.54	114.16	116.33	6.16	47.05	19.89
	Es	10.61	12.56	47.10	50.81	66.29	7.25	51.66	22.01
	P	10.60	12.70	64.72	71.02	81.63	6.26	47.21	20.45
Grand mean	Eew	13.08	14.71	42.90	47.88	61.92	5.44	42.89	19.47
	Ees	7.98	10.89	104.57	113.79	116.07	6.13	46.90	19.85
	Es	10.55	12.62	47.08	50.59	66.06	7.25	51.24	22.01
	P	10.54	12.74	64.85	70.75	81.35	6.27	47.01	20.48
S.Em±	Eew	0.48	0.69	1.97	1.96	1.53	0.36	1.52	0.98
	Ees	0.52	0.79	2.45	2.60	3.10	0.28	1.88	1.00
	Es	0.74	0.84	1.09	1.64	2.01	0.48	2.11	1.09
	P	0.72	1.06	7.27	2.17	2.40	0.30	2.01	0.08
CV	Eew	4.48	5.76	5.62	5.01	3.02	8.17	4.33	6.14
	Ees	8.02	8.85	2.87	2.79	3.27	5.55	4.92	6.17
	Es	8.61	8.11	2.82	3.97	3.73	8.10	5.05	6.05
	P	8.38	10.26	13.73	3.76	3.62	5.87	5.24	6.50

Factors/Components	Environments	Number of fruits per plant	Average fruit weight (kg)	Fruit yield per plant (kg)	Carbohydrate content in fruit (g/100 g)	Calcium content in fruit (mg/100 g)
		9	10	11	13	15
Mean over crosses	Eew	5.44	0.95	5.24	3.46	26.12
	Ees	6.22	1.10	6.59	3.83	27.19
	Es	7.14	1.19	8.34	3.99	27.57
	P	6.27	1.08	6.73	3.76	26.96
Grand mean	Eew	5.27	0.95	5.12	3.44	26.08
	Ees	6.02	1.09	6.38	3.82	27.13
	Es	6.98	1.19	8.16	3.98	27.51
	P	6.09	1.08	6.55	3.75	26.90
S.Em±	Eew	0.48	0.09	0.39	0.05	1.08
	Ees	0.49	0.08	0.40	0.05	0.67
	Es	0.52	0.09	0.76	0.08	0.75
	P	0.26	0.06	0.42	0.04	0.17
CV	Eew	11.16	11.21	9.30	1.83	5.08
	Ees	10.00	9.04	7.69	1.46	3.00
	Es	9.11	9.39	11.36	2.33	3.34
	P	5.17	6.46	7.90	1.32	0.80

Conclusion

The current study, which focuses on yield-attributing traits, revealed that the highest yield was achieved during the main season crop of summer, followed by off-season crops of early summer and early winter. The valuable recommendations for optimal bottle gourd genotypes based on fruit yield, maturity, and quality traits across different growing seasons.

Acknowledgements

The authors would like to express their gratitude to the Department of Horticulture at Bihar Agricultural University for providing them with research facilities and bottle gourd genotypes.

References

1. Rajpoot A, Kumar VJ, Saurab T. Evaluation of bottle gourd genotypes (*Lagenaria siceraria*) for various yield and maturity characters. Plant Archives. 2020;20:530-532.
2. Adarsh A, Kumar R, Kumar A, Neetunand, Singh HK. Estimation of Gene Action and Heterosis in Bottle Gourd (*Lagenaria siceraria* Mol. Standl.). Environment & Ecology. 2017;35(2A):936-944.
3. Bhatt R, Raghav M, Singh JP, Verma SK, Srivastava RM, Maurya SK. Studies of genetic variability in bottle gourd [*Lagenaria siceraria* (Mol.) Standl]. 2022;11(9):778-783
4. Kandasamy R, Arivazhagan E, Bharathi SS. Evaluation of growth and yield characters in bottle gourd (*Lagenaria siceraria* (Mol.) Standl.). Journal of Pharmacognosy and Phytochemistry. 2019;8(3):4653-4655.
5. Muhammad Iqbal, Usman K, Arif M, Jatoi SA, Munir M, Khan I. Evaluation of bottle gourd genotypes for yield and quality traits. Sarhad J Agric. 2019;35(1):27-35.
6. Padmakshi T, Dhananjay S, Vaibhav KV, Priyadarsini SD. Evaluation of Bottle Gourd [*Lagenaria Siceraria* (Mol.) Standl.] Genotypes. Plant Archive. 2015;15(2):1037-1040.
7. Singh K. Challenges in vegetable production in twenty first century. Mem. Lec., National Sym. on Emerging Scenario in Vegetable. Research. and Development, P.D.V.R., Varanasi, 12-14 Dec. 1998. p. 1-11.
8. Singh HK, Kumar R, Akhtar S, Adarsh A. Seasonal Variation and Genotypic Variability Studies on Bottle

Gourd for Yield and it's Attributing Traits. Int. J Agr Env Biotechnology. 2017;10(3):357-366.
9. Singh N, Singh H. Evaluation of bottle gourd [*Lagenaria siceraria* (Molina) Standl.] genotypes for various growthand yield characters. The Asian Journal of Horticulture. 2020;15(1):4-6.
10. Sohi A, Prasad VM, Tudu PP, Kumar M. Evaluation of Bottle Gourd [*Lagenaria siceraria* (Molina) Standl.] Hybrids for Fruit Yield and Economics in Prayagraj Agro-Climatic Conditions. Biological Forum – An International Journal. 2021;13(2):248-253.
11. Tomar S. Performance of Cucurbitaceous Demonstrations in Central Plain Zone of Uttar Pradesh, India. Indian Journal of Applied Research. 2020al;10(6):1-3.
12. Tirumalesh M, Mondal J. Evaluation of bottle gourd [*Lagenaria siceraria* (Mol.) Standl.] genotypes during post-rainy season in Red and Laterite Zone of West Bengal. Journal of Crop and Weed. 2018;14(3):185-188.
13. Yogananda M, Refeekher M. Evaluation of bottle gourd (*Lagenaria siceraria* (Mol.) stand) genotypes for growth yield and quality; c2020. http://hdl.handle.net/123456789/10473.