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Performance of parthenocarpic cucumber genotypes under protected cultivation for yield and horticultural traits

Suman Kumar, Paramveer Singh, Ajay Bhardwaj, Deepak kumar Chaudhary, Manisha Kumari, Suman Kumari

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Authors:
S. Kumar, P. Singh ✉, A. Bhardwaj, D. K. Chaudhary, M. Kumari, S. Kumari
Department of Horticulture (Vegetable and Floriculture), Bihar Agricultural University, Sabour, Bihar, India

S. Kumari
Department of Horticulture (Fruit and Fruit Technology), Bihar Agricultural University, Sabour, Bihar, India

✉ shekhawatdeep@rediffmail.com

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Abstract

An investigation was conducted to identify the most desirable genotypes of parthenocarpic cucumber under protected cultivation. Experimental material consists of 23 genotypes of parthenocarpic cucumber including 1 check (KPCH-1) and the experiment was laid out in three replications with support of Randomized Block Design. ANOVA revealed significant differences among the genotypes for 17 traits. Based on the genotypes' mean performance for all traits investigated, m earliest days to first flower (26.80) and minimum inter-nodal length (7.22 cm) was observed in genotype BRPCU-1×BRPCU-8, whereas maximum number of flowers per node (2.20), number fruits per vine (31.47) and yield per vine (3.96 kg) was observed in genotype BRPCU-1×BRPCU-8. The lowest node to the first flower (3.27) was observed in genotype BRPCU-2×BRPCU-7. Earliest days to first picking (39.80 days) whereas highest TSS (3.87 °Brix) and longest span of harvesting (58.67 days) was noted in genotype in BRPCU-2×BRPCU-5. The highest average fruit weight was recorded in genotype BRPCU-2×BRPCU-8 (143.07 g), while the highest fruit length was observed in genotype BRPCU-5 (20.73 cm). Genotype BRPCU-3×BRPCU-8 (3.90 cm) had maximum fruit diameter. Maximum vine length was recorded in BRPCU-6×BRPCU-7 (3.15 m). The best top-performing genotypes identified in the present study were BRPCU-1×BRPCU-8, BRPCU-2×BRPCU-5, and BRPCU-3×BRPCU-8 were superior for most of the fruit yield components and quality traits.

Keywords cucumber, genotypes, gynoecious, parthenocarpic, protected cultivation

Introduction

The Cucumber (*Cucumis sativus* L.) a member of the Cucurbitaceae family, has a diploid chromosome number of 2n = 2X=14 and botanically it is a pepo type of fruit. Cucumber is commonly a monoecious annual having all sex forms such as androecious, gynoecious, hermaphrodite, and andromonoecious. The nature of the plant is a climbing vine, generally, plants have indeterminate growth habits. Cucumber is thermophilic and prefers warm weather for better growth and development, well adopted in tropical and subtropical regions. The optimum temperature for cucumber cultivation ranges between 18°C and 24°C. It is consumed raw as a salad or pickled. It has a cooling effect and is very helpful for people suffering from indigestion and constipation. Protected cultivation is the most efficient way to overcome various biotic and abiotic stresses, useful for off-season vegetable cultivation, cultivation of

parthenocarpic cucumber under protected cultivation has brought revolution. Cucumber can be obtained throughout the year under protected cultivation. Cucumber is a high value, low volume crop, and its commercial exploitation in naturally ventilated polyhouses may boost productivity and create an excellent revenue source for growers. As of today, the majority of the farmers are growing private sector seeds of the parthenocarpic cucumber and the cost of the seed is also very high and beyond the approach of the common farmers. Thus, there is a need to develop public sector cultivars suitable for protected cultivation in different seasons and regions of the country. Thus this investigation was undertaken to assess the performance and horticultural traits of parthenocarpic cucumber genotypes grown under protected environments.

Methodology

The current study, titled "Performance of parthenocarpic cucumber genotypes under protected cultivation for yield and horticultural traits, was carried out at the Polyhouse complex of the Department of Horticulture (Vegetable and Floriculture) Bihar Agricultural College, Bhagalpur, during spring-summer months of 2021. The experimental material consists of 23 genotypes of parthenocarpic cucumber including 1 check (KPCH-1) and the experiment was laid out in three replications with support of Randomized Block Design on raised beds. The seeds were raised in pro trays to get healthy and uniform seedlings and 30 days old healthy seedlings were transplanted in a double row planting (50 cm×50 cm) system in a naturally ventilated polyhouse.

Results and Discussion

ANOVA revealed that the mean sum square of all genotypes exhibited highly significant differences for all the traits taken under the study which indicates that genotypes had sufficient amount of genetic variability. Earlier workers [1-5] have also reported similar findings in their respective experiments.

Mean performance

Floral characters

Earliness is a highly desired characteristic in the cucumber as prevailing prices in the market are invariably higher early in the season. The range for days to the first flower varied from 26.80 days to 32.93 days with an overall mean of 29.87 days. Days to first flowering determine the early maturity of the genotype. BRPCU-1×BRPCU-8(26.80) was recorded superior for earliest flowering whereas, delayed flowering was observed in genotype BRPCU-6×BRPCU-8 (32.93) (Table 1). Among all the genotypes, 13 genotypes were found superior over Check (KPCH-1). The variation in days to first flowering might have been due to inter-nodal length, number of internodes, genetic makeup, and vigor of the crop. A similar finding was reported by different researchers [4-9].

The overall mean for node to first flower was recorded at 4.15 and the range varied from 3.27-4.80. Genotypes BRPCU-2×BRPCU-7(3.27), BRPCU-2×BRPCU-5(3.33), BRPCU-3×BRPCU-7(3.47), BRPCU-1(3.53) and BRPCU-3×BRPCU-5 (3.60) significantly superior to check for a node to first flower, which defines a genotype's earliness (Table 1). Identification of such genotypes would aid in increasing availability. Effectively planting early and late genotypes will aid in the long-term marketing of cucumbers.

The data showed that the range of the number of flowers per node varied from 1.00 to 2.20 with an overall mean of 1.64. Genotypes BRPCU-1×BRPCU-8 (2.20), genotypes BRPCU-7 (2.13), BRPCU-5 (2.07), and BRPCU-2×BRPCU-7 (2.07) were found significantly superior for the highest number of flowers per node over the check (Table 1). Previously, significant. variance in this characteristic was also found by Singh et al., and Mehta and Sharma [5, 7].

Fruiting and yield characters

For the days to first picking the range varied from 39.80 days to 47.40 days with an overall mean of 43.64. The days to first picking were earliest in BRPCU-2×BRPCU-5(39.80) followed by

Table 1. Mean performance for seventeen characters of twenty-three genotypes in parthenocapic cucumber

Genotypes	Days to first flower	Node to first flower	Number of flowers per node	Days to first picking	Average fruit weight (g)	Fruit length (cm)	Fruit diameter (cm)	Thickness of flesh (cm)
BRPCU-1	31.13	3.53	1.60	43.40	123.73	17.00	3.32	1.04
BRPCU-2	30.53	4.73	1.00	47.40	121.87	14.77	3.27	1.05
BRPCU-3	32.87	4.73	1.07	47.00	122.23	16.18	3.57	1.20
BRPCU-5	29.67	4.60	2.07	43.47	127.50	20.73	3.02	1.03
BRPCU-6	31.60	4.27	1.13	44.00	119.73	15.90	3.75	1.24
BRPCU-7	28.87	4.20	2.13	42.47	132.50	17.10	3.38	1.05
BRPCU-8	30.80	4.47	1.20	44.60	120.17	15.87	3.53	1.19
BRPCU-1×BRPCU-2	31.47	4.00	1.47	45.20	120.67	16.07	3.45	1.14
BRPCU-1×BRPCU-7	31.80	3.80	1.33	46.80	125.23	17.43	3.82	1.27
BRPCU-1×BRPCU-8	26.80	3.87	2.20	40.33	131.83	17.27	3.43	1.15
BRPCU-2×BRPCU-3	29.93	4.33	1.93	45.53	121.50	15.65	3.47	1.17
BRPCU-2×BRPCU-5	27.20	3.33	2.00	39.80	129.30	16.75	3.40	1.13
BRPCU-2×BRPCU-7	27.60	3.27	2.07	42.00	138.13	15.55	3.48	1.18
BRPCU-2×BRPCU-8	29.00	4.40	1.73	42.53	143.07	16.37	3.60	1.25
BRPCU-3×BRPCU-5	29.87	3.60	1.73	44.67	133.63	16.30	3.27	1.04
BRPCU-3×BRPCU-6	27.73	4.60	1.87	41.53	121.13	15.35	3.40	1.09
BRPCU-3×BRPCU-7	28.00	3.47	1.60	41.67	123.07	16.63	3.47	1.06
BRPCU-3×BRPCU-8	28.53	4.80	1.53	40.73	140.47	16.40	3.90	1.30
BRPCU-5×BRPCU-7	32.40	4.13	1.53	46.27	126.83	19.27	3.50	1.10
BRPCU-5×BRPCU-8	28.47	4.80	1.67	42.27	127.00	20.20	3.13	1.02
BRPCU-6×BRPCU-7	29.40	3.73	1.80	42.87	134.90	17.58	3.62	1.20
BRPCU-6×BRPCU-8	32.93	4.67	1.40	46.00	135.60	16.85	3.23	1.05
KPCH-1 (Check)	30.40	4.07	1.60	43.27	124.48	15.17	3.67	1.20
S. Em . ±	0.96	0.15	0.06	1.31	3.19	0.48	0.09	0.02
CD (P=o.o5)	2.73	0.44	0.18	3.73	9.08	1.36	0.26	0.05
CV. %	5.54	6.38	6.67	5.19	4.31	4.94	4.62	2.67
RANGE (L -H)	26.80-32.93	3.27-4.80	1.00-2.20	39.80-47.40	119.73-143.07	14.77-20.73	3.02-3.90	1.02-1.30
Overall mean	29.87	4.15	1.64	43.64	128.03	16.80	3.46	1.14

BRPCU-1×BRPCU-8 (40.33), BRPCU-3×BRPCU-8 (40.73) (Table 1). The day to first picking is an important character for all the crops. Earliness is the desired character as market prices are generally high in the early season. Previous similar work was reported by other researchers [7-12].

The overall mean for average fruit weight was recorded at 128.03 g and the range varied from 119.73 g to 143.07 g. The maximum average fruit weight was observed in BRPCU-2×BRPCU-8(143.07 g). The genotypes BRPCU-3×BRPCU-8 (140.47 g), BRPCU-2×BRPCU-7 (138.13 g), BRPCU-6×BRPCU-8 (135.60 g) and BRPCU-6×BRPCU-7 (134.90 g) were statistically at par with superior genotype BRPCU-2×BRPCU-8 (Table 1). Fruits with a greater average fruit weight are advantageous to farmers in terms of production per vine. Fruit diameter has the greatest effect on increased fruit production. A similar discovery was made by different researchers [3, 5, 7, 10-12,].

The range for fruit length varied from 14.77 cm to 20.73 cm with an overall mean of 16.80 cm. Significantly longest fruit was recorded in BRPCU-5 (20.73 cm) genotype and it was found significantly on par with genotype BRPCU-5×BRPCU-8 (20.20 cm) (Table 1). Fruit length has a direct impact on both marketable yield and customer preference. Fruit with a cylindrical form and tenderness are widely liked by customers and bring in great profits for producers. Medium-sized fruits are often recommended for fresh eating. Fruit yield is likewise affected by fruit length; as fruit length increases, so does fruit output. The variation in fruit length might be attributed to the genetic makeup of the genotype and crop vigor. This trait's wide variation has been noted by other research [2-4, 7, 10, 12]. The mean value of fruit diameter ranged from 3.02-3.90 cm with an overall mean of 3.46 cm. The genotype BRPCU-3×BRPCU-8 (3.90 cm) recorded maximum fruit diameter. Farmers often prefer fruits with a bigger diameter to increase

production. When the fruit diameter was high, the fruit yield was equivalently high. The variance in fruit diameter might be driven by genetic factors and crop vigor. A similar discovery was made by Choudhary et al., [6]. The range of thickness of flesh varied from BRPCU-5×BRPCU-8 (1.02 cm) to BRPCU-3×BRPCU-8 (1.30 cm) with an overall mean of 1.14 cm. (Table 1), significantly maximum thickness of flesh was noticed in BRPCU-3×BRPCU-8 (1.30 cm). For salad purposes, maximum thickness of flesh is preferred. Generally, the higher the flesh thickness more will be the shelf life.

The parthenocarpic cucumber bears fruit at almost every node which indicates that it is directly proportional to the yield. The overall mean for the number of nodes per vine was 29.40 and the range varied from 22.20 to 34.40. The maximum number of nodes per vine was recorded in genotype BRPCU-2×BRPCU-5 (34.40) (Table 2). The genotypes BRPCU-3×BRPCU-6 (34.33), BRPCU-5 (34.20), BRPCU-1×BRPCU-8 (33.73), BRPCU-7 (32.87) and BRPCU-3×BRPCU-5 (32.47) was statistically at par with superior genotype BRPCU-2×BRPCU-5 (34.40). Out of 23 genotypes, 10 genotypes were found superior as compared to KPCH-1 (check). The differences in the genetic material concerning the number of nodes have also been reported by Kumar et al., [13] while evaluating the cucumber genotypes.

The mean value for vine length varied from 2.39 to 3.15 m with an overall mean of 2.83 m for this character. The highest vine length was noted in BRPCU-6×BRPCU-7 (3.15 m). Nine genotypes viz. BRPCU-5×BRPCU-7 (3.06 m), BRPCU-2×BRPCU-5 (3.04 m), BRPCU-2×BRPCU-8 (3.04 m), BRPCU-2×BRPCU-3 (2.97 m), BRPCU-5×BRPCU-8 (2.97 m), BRPCU-3×BRPCU-7 (2.95 m) and BRPCU-7 (2.92 m) (Table 2). BRPCI-1 (2.91 m) and BRPCU-3×BRPCU-8 (2.91 m) were statistically at par with superior genotype BRPCU-6×BRPCU-7. The differences in vine length may be linked to the genetic composition of various hybrids, inherent qualities, factors related to the environment, and crop vigor. A similar finding was previously found for vine length [4-7, 11-12,].

Almost every node of the parthenocarpic cucumber bears fruit. Plants with shorter inter-nodal lengths are thus selected for higher production. The range for inter-nodal length varied from 7.22 cm to -11.78 cm with an overall mean of 10.03 cm. The minimum inter-nodal length was recorded in BRPCU-1×BRPCU-8 (7.22 cm) whereas, genotype BRPCU-5 (7.88 cm) was statistically at par with superior genotype BRPCU-1×BRPCU-8 (7.22 cm) were superior for inter-nodal length (Table 2). Earlier workers also reported similar results for internodal length *viz*., [5-7].

The amount of fruits per vine is the most essential yield-determining characteristic that ultimately affects cucumber crop yield. The range for the number of fruits per vine varied from 25.60 to 31.47 with an overall mean of 28.24. Maximum fruits per vine was recorded in genotype BRPCU-1×BRPCU-8 (31.47) whereas, minimum in BRPCU-2 (25.60). Among all the genotypes, BRPCU-1×BRPCU-8, BRPCU-2 × BRPCU-7, BRPCU-7, BRPCU-5, and BRPCU-2 × BRPCU-5 were found promising in respect of number of fruits per vine (Table 2). The differences in the number of fruits per vine might be associated with the genetic composition of various genotypes, lower levels of abscisic acid and higher levels of auxin accumulation in gynoecious cucumber varieties, and more accumulation of photosynthates in leaves and their mobility to developing fruits. This resulted in an increased fruit set. These results were in agreement with the findings of [3-5, 7, 10, 12, 14,] also reported a wide range in their study.

Long-term availability of marketable fruits is a much desired feature of parthenocarpic cucumbers, and genotypes with longer harvest periods are often recommended to be cultivated in polyhouse for superior yields. The range for the span of harvesting varied from 48.47 days to 58.67 days with an overall mean of 53.01 days. Maximum span of harvesting was observed in BRPCU-2×BRPCU-5 (58.67 days), whereas, it was recorded minimum in BRPCU-2 (48.47 days). Significantly maximum span of harvesting was observed in the genotype BRPCU-2×BRPCU-5. The genotypes BRPCU-1×BRPCU-8 (57.20 days), BRPCU-3×BRPCU-6 (57.07 days), BRPCU-5 (56.20 days), BRPCU-3×BRPCU-7 (55.53 days) and BRPCU-2 ×BRPCU-7 (55.40 days) was statistically at par with superior genotype BRPCU-2×BRPCU-5 (58.67 days) (Table 2). The differences in harvesting time might be related to the blooming of the first female flower, as well as genetic and varietal factors. Previously, comparable differences in harvesting duration were documented by other scientists [4-5, 7, 12].

Table 2. Mean performance for seventeen characters of twenty-three genotypes in parthenocapic cucumber

Genotypes	Number of nodes per vine	Vine length (m)	Inter-nodal length (cm)	Number of fruits per vine	Span of harvest (days)	Yield per vine (kg)	TSS (°Brix)	Ascorbic acid (mg/100g)	Shelf life (days)
BRPCU-1	31.33	2.91	9.54	28.53	54.00	3.66	2.77	2.20	5.27
BRPCU-2	24.00	2.70	11.71	25.60	48.47	3.14	3.53	2.26	4.87
BRPCU-3	27.33	2.77	10.67	27.20	49.93	3.45	3.00	2.32	5.93
BRPCU-5	34.20	2.65	7.88	29.47	56.20	3.82	3.47	2.29	5.53
BRPCU-6	24.67	2.70	11.46	25.73	51.00	3.21	3.07	2.22	5.80
BRPCU-7	32.87	2.92	9.12	30.47	53.93	3.87	3.27	2.35	5.07
BRPCU-8	22.20	2.39	11.78	26.00	50.53	3.26	3.30	2.65	6.20
BRPCU-1×BRPCU-2	26.53	2.73	10.89	27.60	52.13	3.40	3.32	2.51	5.80
BRPCU-1×BRPCU-7	26.33	2.81	11.23	26.40	49.47	3.33	2.57	2.89	5.07
BRPCU-1×BRPCU-8	33.73	2.51	7.22	31.47	57.20	3.96	3.00	2.39	6.00
BRPCU-2×BRPCU-3	28.87	2.97	10.56	28.73	52.87	3.66	3.37	2.50	4.73
BRPCU-2×BRPCU-5	34.40	3.04	8.94	29.40	58.67	3.86	3.87	2.25	4.87
BRPCU-2×BRPCU-7	29.13	2.78	10.09	30.60	55.40	3.90	2.97	2.37	5.87
BRPCU-2×BRPCU-8	31.60	3.04	9.83	28.67	52.20	3.74	3.10	2.69	5.20
BRPCU-3×BRPCU-5	32.47	2.67	8.44	28.40	53.20	3.70	3.17	3.26	5.80
BRPCU-3×BRPCU-6	34.33	2.83	8.61	29.40	57.07	3.78	3.40	2.39	6.27
BRPCU-3×BRPCU-7	27.80	2.95	10.83	28.00	55.53	3.60	3.30	1.97	5.53
BRPCU-3×BRPCU-8	28.27	2.91	10.61	27.73	54.47	3.53	3.43	3.04	4.93
BRPCU-5×BRPCU-7	28.80	3.06	10.78	27.87	50.13	3.55	3.58	3.16	4.27
BRPCU-5×BRPCU-8	31.07	2.97	9.72	28.27	51.80	3.57	3.77	2.56	4.87
BRPCU-6×BRPCU-7	32.20	3.15	9.67	29.00	54.93	3.80	2.92	2.11	5.93
BRPCU-6×BRPCU-8	24.80	2.68	11.02	26.87	48.60	3.38	2.90	2.53	6.07
KPCH-1 (Check)	29.27	2.87	10.17	28.20	51.53	3.61	3.02	2.05	5.80
S. Em . ±	0.72	0.08	0.31	0.95	1.25	0.13	0.05	0.04	0.16
CD (P=o.o5)	2.06	0.24	0.87	2.71	3.55	0.38	0.14	0.11	0.47
CV. %	4.25	5.10	5.29	5.45	4.07	6.45	2.55	2.70	5.19
RANGE (L -H)	22.20-34.40	2.39-3.15	7.22-11.78	25.60-31.47	48.47-58.67	3.14-3.96	2.57-3.87	1.97-3.26	4.27-6.27
Overall mean	29.40	2.83	10.03	28.24	53.01	3.59	3.22	2.48	5.46

The mean value for yield per vine range varied from 3.14 to 3.96 kg with an overall mean of 3.60 kg. Maximum yield per vine was observed in BRPCU-1×BRPCU-8 (3.96 kg) followed by BRPCU-2×BRPCU-7, BRPCU-7, BRPCU-2×BRPCU-5 were found promising genotypes (Table 2). Among all the genotypes, 11 genotypes were recorded as significantly superior to KPCH-1 (check). Fruit set %, fruit length, average fruit weight, fruit diameter, the total amount of fruits per vine, and crop vigor might all have contributed to the substantial range in yield per vine. A similar finding was reported by different researchers [3-8, 10, 12].

Biochemical assessment

Significant differences were observed among all the genotypes for TSS. The values ranged from 2.57 to 3.87 °Brix with an overall mean of 3.22 °Brix. Maximum TSS was observed in BRPCU-2×BRPCU-5 (3.87 °Brix). The genotype BRPCU-5×BRPCU-8 (3.77 °Brix) was statistically at par with the superior genotype BRPCU-2×BRPCU-5 (3.87 °Brix) (Table 2). Earlier, variation for this trait was also reported by different researchers [4-5, 7, 12, 14]. In general, high ascorbic acid levels enhance the nutritious value of cucumbers, which aids in color and flavor retention. The ascorbic acid levels of several genotypes of parthenocarpic cucumber differed significantly. The mean value of ascorbic acid ranged from 1.97-3.26 mg/100 g, overall mean for the character was 2.48 mg/100 g. The highest ascorbic acid was recorded in BRPCU-3×BRPCU-5 (3.26 mg/100 g) (Table 2). The genotype BRPCU-5×BRPCU-7 (3.16 mg/100 g) was statistically at par with the superior genotype BRPCU-3×BRPCU-5. It might be due to the genetic makeup of the genotype. These findings conform to the results of [5, 15] in parthenocarpic cucumber.

Fruit shelf life

The vegetable crops are perishable thus longer shelf life is highly desirable. The genotypes differed significantly in terms of shelf life/fresh appearance of fruits for consumption. The shelf-life value varied from 4.27 to 6.27 days with an overall mean of 5.46 days. The longest shelf life was recorded in BRPCU-3×BRPCU-6 (6.27 days) (Table 2). The internal and exterior qualities of a cucumber are important factors in influencing its shelf life. Fruit firmness is usually directly propositional to fruit shelf life. Previously, substantial variation in this characteristic was found by Ranjan et al., [14].

Conclusion

The present study exhibited a highly significant difference among the mean performance of 23 genotypes of parthenocarpic cucumber for all the traits studied. Based on the mean performance of the genotypes for all the traits studied, the genotypes BRPCU-1×BRPCU-8 followed by BRPCU-2×BRPCU-5 and BRPCU-3×BRPCU-8 were found to be superior for most of the yield components and fruit quality traits.

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