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Evaluation of Parthenocarpic cucumber genotypes for growth and yield under protected structures

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Abstract

The present investigation entitled “Evaluation of parthenocarpic cucumber genotypes under protected structures” was conducted rabi season during the year 2020-2021 under naturally ventilated polyhouse and shadenet house conditions at College of Horticulture, Anantharajupeta, Dr. Y.S.R Horticultural University, Andhra Pradesh. The experiment was laid out in factorial complete randomized design consisting two factors viz., Factor one: nine parthenocarpic cucumber genotypes like PPC-2, PPC-3, PPC-6, DpaCH-4, DpaCH-7, KPCH-1, Punjab Kheera-1, Multistar and Sania; Factor two: P₁: Naturally ventilated polyhouse and P₂: 50% Shade net house with replicated thrice. The result indicated that among the protected structures the maximum vine length (251.32 cm), internodal length (11.61 cm) and fruit length (12.12cm), diameter (4.26 cm), weight (223.51 g), number of fruits per vine (19.91), yield per plant (4.31kg) was recorded in polyhouse conditions than that of shade net house. Among the genotypes Sania significantly recorded superior performance with respect to vine length (263.60 cm), fruit length (22.25 cm), fruit weight (302.55 g), yield per plant (5.2 kg). Among the interaction effect the treatment combination G₉P₁ (cv. Sania grown under polyhouse condition) shown maximum plant growth and yield attributes than other treatment combinations.

Keywords: Protected structures, cucumber, genotypes, growth, Fruit yield

Introduction

Cucumber (*Cucumis sativus* L.) is an economically important member of the family cucurbitaceae and its grown commercially as a summer vegetable crop throughout the world for its immature and tender fruits, which are mainly consumed as a salad. It is believed to be originated in India (De Candolle, 1882; Bisht *et al.*, 2004; Sebastian *et al.*, 2010) [4, 1, 20] and has been cultivated for more than 3000 years. From India is spread to China, Asia minor, North Africa and Europe. The country that ranks first in production of cucumbers is China followed by Russian federation and Turkey (FAO, 2019).

In India it is cultivated in an area of about 109 thousand hectares with annual production of about 1696 thousand MT and a productivity of 15.27 tonnes per hectare (NHB, 2019) [13]. The important cucumber growing states are Haryana, Madhya Pradesh, Karnataka, Andhra Pradesh, Assam, Punjab, Bihar and Tamil Nadu.

In India, cucumber is popular primarily consumed as a salad. Cucumbers are rich in vitamins A, B₁, B₆, C, and D and are a good source of minerals like magnesium, calcium and potassium. Cucumbers also contain silica, which strengthens connective tissue and promotes healthy joints. Cucumbers contain three lignans viz: larciresinol, pinoresinol, and secoisolariciresinol, all of which are anticarcinogenic. Cucumber derived ingredients are used in cosmetic formulations owing to their anti-inflammatory properties. Cucumbers are considered useful for people suffering from renal problems, constipation, jaundice and indigestion. Oil extracted from its seeds is considered good for brain and body (Murad *et al.* 2016) [27].

The advent of parthenocarpic cucumber hybrids/varieties in increasing the production and productivity of poly/net house grown cucumber is well recognized in the world. The yield potential of parthenocarpic cucumber is often higher than that of conventional seeded varieties due to its association with gynocious trait and also due to the fact that pollination is not a pre-requisite for fruit set as it is in seeded cucumber. Moreover, the energy required to produce seeds in conventional seeded cultivars is not needed in parthenocarpic hybrids as these hybrids are seedless and the conserved energy will be utilized to produce more fruits in parthenocarpic hybrids.

However, cultivation of cucumber under protected conditions in India is restricted due to non-availability of suitable parthenocarpic gynoecious varieties/hybrids from public sector and high cost of the hybrid seeds developed by the private sector (Kumar *et al.* 2016)^[9].

Hence, the present study was planned to focus on identification of the suitable genotypes for sustainable production of cucumber under protected conditions at southern agro climatic region of Andhra Pradesh.

Material and Method

The present investigation entitled "Evaluation of parthenocarpic cucumber genotypes under protected structures" was undertaken during *rabi* 2020-2021 under Naturally ventilated polyhouse (NVP) and 50% shade net. The experiment was laid out at College of Horticulture, Anantharajupeta Dr. Y.S.R Horticultural university, Andhra Pradesh, which is located in southern agro climatic region of Andhra Pradesh. The experimental site is at an elevation of 162 m (531 feet) above mean sea level lying between the 3° 59.465' North latitude and 79° 19.886' East longitude.

The experiment was laid out in Factorial complete randomised design (FCRD) with three replication and nine parthenocarpic genotypes *rabi* 2020. Seedling raised in portraits were transplanted carefully into grow bags of size 100 x 15x 10 cm kept in both polyhouse and shadenet. Planting of each genotype was done in a single row plot of 10m length accommodating 12 plants in a row spacing of 60 cm and 60 cm respectively. The recommended package of practices and plant protection measures were followed to raise a successful crop. Observation were recorded on five randomly selected plants in each plot on eleven different traits *viz.*, the vine length (cm) at the 30, 45, 60 DAT, and at last harvest, fruit length(cm), fruit diameter(cm), fruit volume (cc), fruit weight (g) number of fruits per plant and yield (g) per plant,

Result and Discussion

Growth parameters

The maximum vine length (119.90, 171.80, 212.50 and 251.32 cm) was observed under polyhouse condition at 30, 45, 60 days after transplanting and at final harvest in comparison with shade net house conditions (Table 1). Among the cucumber genotypes maximum vine length was observed in the cultivar Sania (137.30 cm) at 30 DAP, whereas at 45 DAP cultivar DpaCH-4 recorded maximum vine length (182.65 cm) and minimum vine length was recorded in KPCH-1 (93.10 and 136.74cm) at 30 and 45 DAP respectively. At 60DAP and final harvest cultivar Sania recorded maximum vine length (226.80 and 263.60 cm) it was at par with DpaCH-4 (225.13 and 263.53 cm) and minimum was recorded in the cultivar Multistar than other genotypes under both the conditions. The interaction was also significant among the genotypes and environment. Among the treatment combinations cultivar Sania grown under polyhouse (G₉P₁) recorded the maximum vine length (142.40, 192.20 and 238.40 cm) at 30, 45, 60 DAP, however, at final harvest cultivar DpaCH-4 recorded the maximum vine length (279.25 cm) and the minimum was recorded in the cultivar KPCH-1 (87.00 and 125.00 cm) at 30 and 45 DAP, where as 60 DAP and final harvest minimum vine length (165.80 and 201.20 cm) was observed in the cultivar Multistar and PCC-6 grown under shadenet conditions.

The vine length is maximum in polyhouse condition compare

to shade net house which might be due to presence of high relative humidity, soil moisture and carbon dioxide concentration throughout the growing season and it facilitates maximum plant photosynthetic capacity and finally results higher vine length than that of shade net conditions (Ummyiah *et al.* 2017)^[24]. The results are in close conformity with the findings of Pal *et al.* (2017)^[14] and Kumar *et al.* (2018)^[7] in cucumber. The variation in vine length amongst the genotypes might have been due to specific genetic makeup of different hybrids, interaction response of microclimate prevailing under the poly house condition, hormonal factors and vigour of the crop and other biotic and abiotic factors. Similar results have been reported by Rani (2014)^[19] and Prathyusha *et al.* (2020)^[18] in cucumber.

Internodal length significantly varied both in protected structures and among the genotypes studied. The minimum internodal length (11.09 cm) was observed under shadenet house (P₂) than the polyhouse condition (P₁- 11.61 cm). Among the genotypes, the minimum internodal length was observed in *cv.* Punjab Kheera-1 (9.28 cm) which was on par with the cultivar Multistar (9.61 cm) and maximum internodal length was recorded in the cultivar Sania (13.31cm). The interaction effect on also recorded significant results (Table 1). Among the genotypes and growing conditions, the cultivar Punjab Kheera -1 grown under shadenet house condition (G₇P₂) recorded lowest internodal length (9.2 cm) and the highest was recorded in the treatment combination G₅P₁ *i.e.*, cultivar DpaCH-4 grown under polyhouse conditions. (13.31 cm). The differences in the internode length directly impact the plant yield per plant in the protected structures it might be due to favourable environmental factors prevailing in the structures, that provides higher dry matter production and ultimately leads to higher yields (Xiong *et al.*, 2002)^[25]. Similar observations also made by Patil and Moe (2009)^[16] and Cowan and Reekie (2008)^[3] in cucumber under protected cultivation.

Yield parameters

The maximum fruit length (17.12 cm), fruit diameter (4.26 cm), fruit volume (195.81cm³), fruit weight (223.51 g), number of fruits per vine (19.91) and yield per vine (4.32 kg) was recorded where cucumber grown under polyhouse conditions than the shade net house conditions (Table 2).

Among the genotypes the cultivar Sania recorded the maximum fruit length (22.25 cm) and fruit weight (302.55g), and minimum was recorded in the cultivar Multistar (13.08 cm and 165.6 g). The same trend was observed in the interaction also the treatment combinations such as Sania cultivar grown under polyhouse conditions recorded the highest fruit length and fruit weight (G₉P₁- 22.70 cm and 310.00 g) whereas, the minimum fruit length and fruit weight (12.96 cm and 161.20 g) was recorded by Multistar grown under shadenet conditions. The significant variations in fruit length was observed it might be due to the genetic variation, vigour of the plant and favourable environmental conditions in protected structures like polyhouse, which would have influenced availability of all essential elements and plant growth hormones like auxins, it facilitates better fruit growth (Yogesh *et al.* 2009; Sujatha, 2017)^[26]. These results are in accordance with the findings of Soleimani *et al.* (2009)^[22], Pragathi (2014)^[17] Parashar (2016)^[15] and Kumar *et al.*, (2017)^[8] in cucumber.

The maximum fruit diameter (5.00 cm) was record in the cultivar DpaCH-4, while *cultivar* PPC-6 (3.50 cm) recorded

the minimum fruit diameter. The treatment combination also recorded same results such as the cultivar DpaCH-4 grown under polyhouse conditions (G₅P₁ -5.1 cm) recorded the maximum fruit diameter and minimum were recorded by the cv. PPC-6 (G₃P₂ -3.3 cm) under the shade net house. A significant variation with respect to fruit diameter might be due to genetic nature of the cultivars. Similar findings were reported by Yogesh *et al.* (2009) [26], Soleimani *et al.*, (2009) [22], Golabadi *et al.* (2012) [5], Pal *et al.* (2017) [14] and Kumar *et al.*, (2017) [8] in cucumber.

Highest fruit volume was recorded in cv. Sania (G₉-277.5 cm³) which was significantly higher than all the genotypes followed by DpaCH-7 (215 cm³) and lowest were recorded in the cv. Punjab Kheera-1 (129.00 cm³). Among the interaction G₉P₁ *ie.*, cv. Sania grown under polyhouse condition (280.00 cm³) recorded the maximum fruit volume in the polyhouse and the lowest were recorded by G₈P₂, Multistar in shadenet house (162.00 cm³). Fruit volume is correlated with fruit weight and fruit length. This is similar to the findings of Kurubetta *et al.* (2009) [10], Swamy *et al.* (2014) [23] in capsicum and Khan *et al.* (2017) [6] in cucumber.

Among the genotypes cv. Multistar documented the maximum number of fruits per vine (27.00) which was on par with Punjab Kheera-1 (25.20) and lowest were recorded in PPC-6 (14.5). Interaction amongst the treatment combinations

showed that maximum number of fruits per vine were recorded in G₈P₁, cv. Multistar grown under polyhouse (28.00) and minimum were recorded in G₃P₂, cv. PPC-6 grown under shade net house (14.10). The variation in number of fruits per vine might have been due to variation in sex ratio, fruit set percentage, genetic nature and their response to varying environmental conditions as reported by Nag *et al.* (2012) [21] in ivy gourd.

Among the genotypes, cv. Sania (G₉) recorded the maximum yield per plant (4.84 kg) which was on par with Multistar (4.48 kg) followed by Punjab Kheera-1 (4.36 kg), PPC-3 (4.13 kg) and DpaCH-4 (4.07 Kg) and minimum yield (2.54 kg) was recorded in the cv. PPC-6. Among the interactions cv. Sania grown under polyhouse condition (G₉P₁) recorded the maximum yield per plant (5.2 kg) and the minimum yield (2.4 kg) per plant was recorded by the cv. PPC-6 (G₃P₂) grown in shade net house. Variation in the yield per plant among the growing conditions was attributed to the variation in fruit set percentage, number of fruits obtained from a vine, average fruit weight, fruit length, fruit diameter, environmental factors and vigour of the crop. Variation in yield was likely due to genotypic make up of a particular cultivar as opined by Sharma and Bhattarai (2006) [21], Chaudhary *et al.*, 2016 and Patel *et al.*, 2017 in cucumber.

Table 1: Performance of different cucumber hybrids on vine length (cm) and Internodal length

Genotypes	30 DAT			45 DAT			60 DAT			At last harvest			Internodal length of vine(cm)		
	P ₁	P ₂	Mean	P ₁	P ₂	Mean	P ₁	P ₂	Mean	P ₁	P ₂	Mean	P ₁	P ₂	Mean
PPC 2	120.20	102.50	111.35	180.66	155.91	168.285	220.00	191.25	205.62	265.00	240.00	252.50	11.23	10.9	11.07
PPC 3	125.20	108.20	116.70	185.25	162.00	173.62	225.00	205.00	215.00	270.20	245.00	257.60	10.98	10.85	10.92
PPC-6	110.00	95.00	102.50	160.00	135.00	147.50	195.00	175.00	185.00	220.00	201.20	210.60	12.50	12.20	12.35
DpaCH-7	135.00	115.00	125.00	190.00	165.00	177.50	235.20	203.00	219.10	275.00	242.50	258.75	11.47	10.90	11.19
DpaCH-4	145.00	125.00	135.00	195.20	171.10	183.15	240.00	210.25	225.12	279.25	247.80	263.52	13.72	12.20	12.96
KPCH-1	99.20	87.00	93.10	148.48	125.00	136.74	188.54	168.25	178.39	228.86	210.15	219.50	11.84	11.12	11.48
Punjab Kheera-1	105.00	91.00	98.00	153.10	131.20	142.15	195.20	178.20	186.70	235.13	222.1	228.61	9.36	9.2	9.28
Multistar	97.60	90.00	93.80	141.46	135.20	138.33	175.20	165.80	170.50	210.20	205.20	207.70	9.65	9.56	9.61
Sania	142.40	132.20	137.30	192.20	173.10	182.65	238.40	215.20	226.80	278.20	249.00	263.60	13.71	12.9	13.31
Mean	119.96	105.10		171.80	150.39		212.50	190.22		251.32	229.22		11.61	11.09	
		C.D at 5%	S. Em±		C.D at 5%	S. Em±		C.D at 5%	S. Em±		C.D at 5%	S. Em±		C.D at 5%	S. Em±
Genotypes (G)		8.37	2.91		12.95	4.51		11.68	4.06		17.4	6.05		0.82	0.29
Protected Structure (P)		3.95	1.37		6.11	2.12		5.50	1.92		8.2	2.85		0.39	0.14
G X P		11.84	4.12		18.32	6.37		16.51	5.75		24.6	8.56		1.16	0.41

Table 2: Performance of different cucumber hybrids on yield parameters

Genotypes	Fruit length (cm)			Fruit diameter (cm)			Fruit volume (cm ³)			Fruit weight (g)			Number of fruits /vines			yield / plant (kg)		
	P ₁	P ₂	Mean	P ₁	P ₂	Mean	P ₁	P ₂	Mean	P ₁	P ₂	Mean	P ₁	P ₂	Mean	P ₁	P ₂	Mean
PPC 2	16.67	16.16	16.42	4.40	4.10	4.25	200	198	199	244.0	210.0	227.0	18.00	16.00	17.00	4.40	3.36	3.88
PPC 3	22.01	21.02	21.52	3.90	4.10	4.00	202	200	201	230.0	215.0	222.5	20.00	17.00	18.50	4.60	3.65	4.13
PPC-6	16.05	15.94	16.00	3.70	3.30	3.50	170	165	167.5	180.0	170.0	175.0	14.90	14.10	14.50	2.60	2.40	2.54
DpaCH-7	16.92	16.47	16.70	4.70	4.50	4.60	220	210	215	260.0	245.0	252.5	16.00	14.00	15.00	4.16	3.43	3.80
DpaCH-4	16.75	15.60	16.18	5.10	4.90	5.00	218	208	213	252.6	239.0	245.8	17.10	16.00	16.55	4.30	3.80	4.07
KPCH-1	15.90	15.70	15.80	4.50	4.30	4.40	174	170	172	190.0	185.0	187.5	22.20	21.10	21.65	4.21	3.90	4.06
Punjab Kheera-1	13.90	13.50	13.70	3.60	3.70	3.65	130	128	129	175.0	170.0	172.5	26.20	24.20	25.20	4.50	4.14	4.36
Multistar	13.20	12.96	13.08	3.80	4.0	3.90	168	162	165	170.0	161.2	165.6	28.00	26.00	27.00	4.76	4.19	4.48
Sania	22.70	21.8	22.25	4.60	4.7	4.65	280	275	277.5	310	295.1	302.5	16.80	15.0	16.00	5.20	4.48	4.84
Mean	17.12	16.57		4.26	4.18		195.81	190.6		210.00	223.51		18.18	19.91		4.32	3.71	
		C.D at 5%	S. Em±		C.D at 5%	S. Em±		C.D at 5%	S. Em±		C.D at 5%	S. Em±		C.D at 5%	S. Em±		C.D at 5%	S. Em±
Genotypes (G)		1.04	0.36		0.15	0.05		10.61	3.69		13.39	4.66		1	0.35		0.29	0.1
Protected Structure (P)		0.49	0.17		0.07	0.02		5.00	1.74		6.31	2.2		0.47	0.16		0.14	0.05
G X P		1.47	0.51		0.21	0.07		15.00	5.22		18.94	6.59		1.42	0.49		0.41	0.14

P₁: Naturally ventilated polyhouse

P₂: 50% shade net

Conclusion

The present investigation results shown that cucumber grown under naturally ventilated polyhouse recorded better results in terms of plant growth and yield attributes. Among the different genotypes concern the cultivar Sania recorded maximum fruit yield than other cultivars. Treatment

combinations cultivar Sania grown under polyhouse conditions recorded maximum fruit length, fruit weight, yield per plant than other treatments.

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