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The Growth Characteristic of Cucumber (*Cucumis sativus* L.) Genotypes and Varieties Grown under Prayagraj Agro-climatic Conditions

Sanket Raja Choubey [a*], Vijay Bahadur [a], Samir E. Topno [a] and Anita kerketta [a]

[a] Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture Technology and Science, Prayagraj, Uttar Pradesh-211007, (U.P), India.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The experiment was carried out at Horticulture Research Field, Department of Horticulture, during the year 2022. This experiment was conducted to find out the best performing genotypes in relation of growth, yield and quality of cucumber. Seven cucumber genotypes such as IET, 2021/CUCUVAR-1,2,3,4,5,6,7 and three check variety namely NAZIA,LHC-1395 and MALINI were studied at SHUATS, Prayagraj in randomized block design with three replications in 4.5 x 3.0 m plot during summer season 2022 to find out the best performing genotype in related to growth, yield and fruit quality traits. NAZIA was found with the maximum fruit weight (247.67g), Fruit length (18.37cm), Fruit yield per plot (43.64 kg), Fruit yield (326.40 q/ha). NAZIA was found superior based on overall performance in term of growth, yield and quality and highest net return (3,33,718 Rs/ha). The highest cost benefit ratio (3.14) was found in cucumber NAZIA variety.

**Corresponding author: E-mail: sanketraja09@gmail.com;*

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1. INTRODUCTION

"Vegetables play an important role to keep human beings healthy. Vegetables have a great significance in providing food and nutritional security and as well as provides regular income to vegetable grower. Vegetables are important constituents of Indian diets as they are rich source of carbohydrates, proteins, vitamins, minerals, glucosinolates, antioxidants and fibers" [1].

"Cucumber (*Cucumis sativus* L.) is an important vegetable crop of India cultivated throughout the country. It belongs to the family Cucurbitaceous, which has 120 genera and more than 800 species and is distinct from other Cucumis species, as it has seven pairs of chromosomes (2n=2x=14), whereas most of the other Cucumis species have 12 pairs of chromosomes, or multiple of 12 (i.e., 2n=2x=24, 2n=4x=48, etc.)" [2-6]. "Cucumber can grow on a wide range of soil but can do best on deep well drained sandy loam soils with a pH of 5.5-6.7 and high content of organic matter" [7-9].

"Cucumber is warm season vegetable crop and grown in almost all climate ranging from tropical to semi-temperate zone of the world. It contains (96.3g) water, (0.4g) protein, (0.1g) fat, (0.3g) minerals, (0.4g) fibre, (2.5g) carbohydrate, (13Kcal) energy, (10mg) calcium, (25mg) phosphorus, (1.5mg) iron, (0.33mg) thiamine, (0.2mg) niacin, (7mg) vitamin „C" per (100g) edible portion" [10].

"In fiscal year 2019, the total production of vegetables was estimated to be approximately 185 million metric tonnes. As a leading producer of low-cost fruits and vegetables, India had an enormous export market. This quantity is less than the requirement of 200-250g/day for a balanced diet of a person. Production of cucumber in India is 11, 42,000 tones from an area of 78,000 hectares (NHB, 2017-18).The plant requires fertile soil, infertile soil results, bitter taste and misshapen fruits that are rejected by consumers" [11-15].

"The fruit consist of more than 90% of water. It is also considered as an important fruit from the medicinal point of view as it provides cooling effect to human body when consumed. People also use it on skin and face for relaxation when physically stressed. It is also considered as helpful fruit to prevent and cure jaundice and constipation. Seeds of this fruits contains essential oil which is helpful for brain development and body smoothness" [16,17-19].

2. MATERIALS AND METHODS

The present study was carried out during the summer season year 2022 at Horticulture Research Farm, Department of horticulture, Naini Agriculture Institute, Sam Higginbottom Institute of Agriculture Technology and Sciences, Prayagraj (U.P). In this experiment seedlings are grown under ploy house conditions with help of protrays and cocopeat with vermicompost used for seed germination. The experiment was done under the randomized block design with 03 replications start from 26th February 2022. The transplanting was done on ridges with spacing of 50 cm and 150 cm plant to plant and row to row respectively, each plot was have 16 plants. During experiment irrigation applied through the irrigation channel in summer season. Data recorded on basis of growth, yield and quality parameters of cucumber crop.

Table 1. List of cucumber genotypes

Notation	Name of Genotypes	Sources
G1	IET,2021/CUCUVAR-1	IIVR,Varanasi
G2	IET,2021/CUCUVAR-2	IIVR,Varanasi
G3	IET,2021/CUCUVAR-3	IIVR,Varanasi
G4	IET,2021/CUCUVAR-4	IIVR,Varanasi
G5	IET,2021/CUCUVAR-5	IIVR,Varanasi
G6	IET,2021/CUCUVAR-6	IIVR,Varanasi
G7	IET,2021/CUCUVAR-7	IIVR,Varanasi
C1	NAZIA (Check variety)	East-West Seed Private Limited
C2	LHC-1395 (Check variety)	Laxmi Inputs Private limited
C3	MALINI (Check variety)	Seminis Private limited

3. RESULTS AND DISCUSSION

(A) Growth parameters

1. Length of vine (cm)

Significant differences in the length of vines were recorded in the various genotypes. Maximum vine length has been observed in IET,2021/CUCUVAR-03 (201.27 cm) followed by IET,2021/CUCUVAR-01 (191.27cm). The minimum vine length was observed in IET,2021/CUCUVAR-6 (72.87cm). The variation in vine length might have been due to specific genetic makeup of different Genotypes, inherent properties, environmental factor, hormonal factor and vigour of the crop.The variation in vine length in has also been reported by Chandra et al*.* (2012). Similar findings between the hybrids were also reported by Kumar et al*.* (2008) and Rawat et al*.* (2014).

2. Number of Primary branches

Observation shows significant differences among the various genotypes in the number of Primary branches per vine. Maximum was observed in genotypes IET,2021/CUCUVAR-3 (7.07) and followed by NAZIA (6.27). The smallest number of branches per vine was observed in genotype IET,2021/CUCUVAR-6 (2.87). “The variation in number of primary branches per plant might have been due to its own genetic makeup and also due to vine length, internodal length, hormonal factor and environmental factor also” [20] Chandra et al*.* (2012).

(B) Floral Parameters

1. Days to first appearance of male flower

The various genotypes showed non-significant difference in the first appearance of male flowers. Minimum days were recorded for first appearance of male flower was observed in MALINI (45 days) and followed by IET,2021/CUCUVAR-3 (46.53 days). The maximum number of days for first appearance of male flower was observed in IET,2021/CUCUVAR-5 (46.67 days). The variation in first appearance of male flower, might have been due to number of internodes, genetic factor, environmental factor, hormonal factor and vigour of the crop. Similar findings were reported by Badgujar and More [21] and Sharma and Bhattarai (2006).

2. Days to first appearance of female flower

From the results, there was a non-significant difference in the first appearances of female flowers among the various genotypes of cucumber. Minimum days were recorded for first appearance of female flower was observed in cucumber MALINI (45 days) and followed by the genotype IET,2021/CUCUVAR-3 (47.20 days).

Maximum number of days for first appearance of female flower was observed in genotype IET,2021/CUCUVAR-5 (47.72 days). The variation in first appearance of female flower might have been due to first appearance of male flower, inter nodal length, number of internodes, genetic factor, environmental factor, hormonal factor and vigour of crop. Similar findings were reported by Badgujar and More [21] and Sharma and Bhattarai (2006).

3. Node at which the first male flower appears

The node at which the first male flower appears showed a substantial genetic difference. For high yields, the first male's appearance at a specific node is also crucial. Minimum node at which the first male flower appears was recorded in IET,2021/CUCUVAR-2 (2.33), followed by NAZIA (3.93). Maximum node number at which first male flower appears was found in IET,2021/CUCUVAR-3 (4.80). The variation in node number at which first male flower appears might have been due to specific genetic makeup of different Genotypes prevailing environment condition. Similar findings were reported by Bairagi et al*.* [21] and Sharma and Bhattarai (2006) and Patel et al*.* [22].

4. Node number at which the first female flower appears

Among the several genotypes, there was a noticeable variation in the node at which the first female flower appears. For high yielding cultivars, the first female's appearance at a specific node is also crucial. Minimum node at which the first male flower appears was recorded in IET,2021/CUCUVAR-4 (2.87) and followed by MALINI (5.13). Maximum node number at which first female flower appears was found in LHC-1395 (6.27). The variation in node number at which first female flower appears might have been due to specific genetic makeup of different Genotypes and prevailing environmental condition. Similar findings were reported by

Bairagi et al. [20] and Sharma and Bhattarai (2006) and Patel et al. [22].

5. Number of male flowers

The data showed significant differences in the number of male flowers between various genotypes of cucumber. Maximum number of male flowers per vine was observed in NAZIA (54.60) followed by LHC-1395 (53.40). The minimum number of male flowers per vine was observed in IET,2021/CUCUVAR-7 (38.80). The variation in number of male flowers might have been due to their genetic nature. environmental factor, hormonal factor and vigour of crop. Similar results have been shown in Patel et al. [22].

6. Number of female flowers

From the results shown, there was a significant difference among the number of female flowers per vine. Maximum number of female flowers per vine was observed in MALINI (13.87), followed by NAZIA (13.60). The minimum number of male flowers per vine was observed in genotype IET,2021/CUCUVAR-7 (9.53). "The number of female flowers is an important character for earliness or lateness of crop in general. The variation in number of female flowers per vine might have been due to their genetic nature, hormonal factor, environmental factor and vigour of crop" [22].

7. Days to first fruit Picking

From the results, there was a significant difference in the days to first fruit picking among the various genotypes. The genotype IET,2021/CUCUVAR-6 (34.20 days) has taken minimum to first fruit picking followed by genotype IET,2021/CUCUVAR-2 (43.33days). Genotype IET,2021/CUCUVAR-7 (44.93 days) has taken the maximum time to first fruit picking. "The variation in days to first fruit picking might have been due to genetic factor, environmental factor, hormonal factor and vigour of crop". [Chandra et al., (2012) and Kumar et al.,(2013)].

8. Days to first fruit setting

There was a non-significant difference between the genotypes in days to first fruit setting. The cucumber MALINI (16.67 days) has taken minimum days to first fruit setting followed by IET,2021/CUCUVAR-3 (19.20 days). IET, 2021/CUCUVAR-5 (19.87 days) has taken the maximum days to first fruit setting. The variation in days to first fruit setting might have been due to genetic factor, environmental factor, hormonal factor and vigour of crop. Similar results have been reported by Prasad (1985), Paner (1995) and Howalder et al. (1999).

9. Number of Pickings

From the results, there was a significant difference between the genotypes in number of pickings. The maximum number of pickings recorded in IET,2021/CUCUVAR-1 (4.33), followed by NAZIA and MALINI (4.07). IET,2021/CUCUVAR-7 (2.20) was observed minimum number of pickings. The variation in number of pickings per plant might have been due to sex ratio, fruit set percentage, genetic nature and their response to varying environmental conditions. Similar findings between the hybrids were also reported by Kumar et al., (2008) and Rawat et al., (2014).

10. Sex ratio

The sex ratio varied significantly amongst the genotypes. The maximum sex ratio was observed in LHC-1395 (4.21), followed by NAZIA (3.81) and minimum sex ratio was recorded in IET,2021/CUCUVAR-4 (3.16). The variation in fruits per plant might have been due to number of male flower, number of female flower, genetic nature and their response to varying environmental conditions. Similar findings between the hybrids were also reported by Kumar et al., (2008) and Rawat et al., (2014).

(C) Yield Parameters

1. Number of fruits per vine

The data demonstrate that the amount of fruits produced per vine varies significantly across genotypes. It has been observed that the cucumber MALINI (11.33) gives the maximum number of fruits followed by IET,2021/CUCUVAR-1 (11.27). The lowest number of fruits was observed in IET,2021/CUCUVAR-7 (6.13). The variation in fruits per plant might have been due to sex ratio, fruit set percentage, genetic nature and their response to varying environmental conditions. This type of similar results have also been reported in Chandra et al., (2012) and Patel et al. [22].

2. Fruit diameter (cm)

The results demonstrate that the diameter of the fruits differs significantly between the different

genotype types. Maximum fruit diameter was found in LHC-1395 (4.67 cm) followed by NAZIA (4.50 cm). Minimum fruit diameter was observed in IET,2021/CUCUVAR-6 (2.63 cm). The variation in fruit diameter, might have been due to genetic factor, environmental factor, hormonal factor and vigour of the crop Similar result for this trait were also found earlier [23] (Kumar et al. 2017; Khan et al., 2015).

3. Fruit length (cm)

The observations From the results have shown significant difference in the fruit length of various genotypes of cucumber. Maximum fruit length was observed in the cucumber NAZIA (18.37 cm), followed by IET,2021/CUCUVAR-7 (16.03) and Minimum fruit length was observed in the genotype IET,2021/CUCUVAR-6 (9.70 cm). The variation in fruit length, might have been due to genetic nature, environmental hormonal factor and vigour of crop These result are agreed to that obtained by [24] (Khan et al., 2015).

4. Fruit weight (g)

From the results presented below (Table 4), significant difference in fruit weight was recorded. The highest fruit weight was recorded in the cucumber NAZIA (247.67 g) and followed by LHC-1395 (181.33 g). The lowest fruit weight was recorded with IET,2021/CUCUVAR-6 (46.67 g). The highest fruit weight in NAZIA Super may be due to its vigour and adoptability to Allahabad agro-climatic conditions. For this trait, similar result was also reported by [23] (Kumar et al. 2017).

5. Fruit yield per plot (kg)

From the results, there was a significant difference among the genotypes with regard to yield per plot. The maximum fruit yield per plot was found in the cucumber NAZIA (43.64 kg) followed by cucumber LHC-1395 (29.92 kg). The lowest fruit yield per plot was recorded in IET,2021/CUCUVAR-7 (6.67 kg). The significant variation in yield per plot might have been due to fruit set percentage, fruit length, or of fruit per vine, fruit weight and fruit width, genetic nature, environmental factor and vigour of the findings were supported by Srivasvata and Srivastava (1976), Singh et al., (1996) and Hawlader (1991).

6. Fruit Yield (q/ha)

From the results, there was significant difference recorded amongst the genotypes with regard to yield (q/ha). The maximum fruit yield (q/ha) was recorded in NAZIA (326.40 q/ha), followed by LHC-1395 (209.60 q/ha). Lowest yield was recorded in the genotype IET,2021/CUCUVAR-7 (49.60 q/ha). The significant variation in fruit yield might have been due to number of fruits per plant, yield per plant and yield per plot. This investigation was also supported by Sharma and Bhattarai (2006) and Patel et al., [22].

(D) Quality Parameters

1. Total Soluble Solids (°Brix) and Ascorbic acid mg/100g

The data observed showed that there are significant difference among the different genotypes of cucumber. The maximum TSS value was found in IET,2021/CUCUVAR-1 (2.60), followed by NAZIA (2.43) and LHC-1395 (2.43). Minimum value was found in IET,2021/CUCUVAR-7 (2.0).

The significant variation in fruit yield might have been due to number of fruits per plant, yield per plant and yield per plot. Variation results were reported by Patel et al., [22] and Kumar et al., (2013).

The findings demonstrated that the genotypes of cucumber differed significantly. . The maximum ascorbic acid mg/100g recorded in IET,2021/CUCUVAR-1 (1.77) and followed by NAZIA (1.63), MALINI (1.63) and The lowest ascorbic acid mg/100g was found in IET,2021/CUCUVAR-2 (1.37). Generally speaking, a high ascorbic acid level would improve the nutritional value of cucumbers and aid in better color and flavor retention. The variation of ascorbic acid mg/100g cucumber genotypes have also been reported by Patel et al. [22].

3. Hedonic rating for Organoleptic properties.

From the results, it showed that there was significant difference among the genotypes of cucumber. The maximum hedonic rating observed in IET,2021/CUCUVAR-1 (8.0) and followed by IET,2021/CUCUVAR-2, IET,2021/CUCUVAR-3 (7.0) and IET,2021/CUCUVAR-7 (7.0) and The lowest rating was found in LHC-1395 (5.0). The genotype IET,2021/CUCUVAR-1 (8.0) found highest hedonic rating on the basis of color, taste and flavor of cucumber fruits of various genotypes. Similar estimates for this character were recorded in different genotypes in cucumber (Kumar et al. 2016).

Table 2. Cost Benefit Ratio of various genotypes of cucumber

Notation	Genotypes	Fruit Yield (q/ha)	Gross Income (Rs/ha)	Cost of Cultivation (Rs/ha)	Net Income (Rs/ha)	Benefit : cost Ratio
G1	IET,2021/CUCUVAR-1	169.60	2,54,400	1,48,882	105518	1.70
G2	IET,2021/CUCUVAR-2	126.80	1,90,200	1,48,882	41318	1.27
G3	IET,2021/CUCUVAR-3	130.40	1,95,600	1,48,882	46718	1.31
G4	IET,2021/CUCUVAR-4	119.60	1,79,400	1,48,882	30518	1.20
G5	IET,2021/CUCUVAR-5	194.40	2,91,600	1,49,882	141718	1.94
G6	IET,2021/CUCUVAR-6	52.40	78,600	1,48,882	70282	0.52
G7	IET,2021/CUCUVAR-7	49.60	74,400	1,48,882	74482	0.49
C1	NAZIA (Check variety)	326.40	4,89,600	1,55,882	333718	3.14
C2	LHC-1395 (Check variety)	209.60	3,14,400	1,53,882	160518	2.04
C3	MALINI (Check variety)	109.60	1,64,400	1,52,882	11518	1.07

Table 3. Mean Performance of Cucumber Genotypes and varieties on Growth and Floral parameter

Notation	Genotypes	Vine length (cm)	Number of primary branches	Days to 1st emergence Male flower	Days to 1st emergence Female flower	Node number at which 1st Male flower	Node number at which 1st Female flower	Number of Male flower	Number of Female flower	Sex Ratio	Days to 1st fruit setting	Days to 1st fruit picking	No. of picking
G1	IET,2021/CUCUVAR-1	191.27	5.80	45.73	46.13	3.47	4.53	50.27	13.13	3.76	17.80	37.47	4.33
G2	IET,2021/CUCUVAR-2	148.53	4.67	45.60	47.07	2.33	4.00	45.20	12.00	3.49	18.73	43.33	2.73
G3	IET,2021/CUCUVAR-3	201.27	7.07	46.53	47.20	4.80	4.93	43.13	11.07	3.50	19.20	39.67	3.93
G4	IET,2021/CUCUVAR-4	137.53	3.93	45.87	46.67	3.13	2.87	40.80	12.20	3.16	18.60	39.67	3.27
G5	IET,2021/CUCUVAR-5	179.27	3.53	46.67	47.72	3.87	4.22	47.20	12.13	3.80	19.87	43.20	3.20
G6	IET,2021/CUCUVAR-6	72.87	2.87	45.87	46.60	2.93	4.40	41.13	11.80	3.44	18.60	34.20	3.33
G7	IET,2021/CUCUVAR-7	152.80	3.93	45.93	45.93	3.27	4.27	38.80	9.53	3.69	18.20	44.93	2.20
C1	NAZIA (Check variety)	128.20	6.27	46.13	46.27	3.93	3.67	54.60	13.60	3.81	17.80	34.93	4.07
C2	LHC-1395 (Check variety)	174.00	4.20	45.20	45.60	2.93	6.27	53.40	12.80	4.21	17.53	37.27	3.87
C3	MALINI (Check variety)	152.27	5.33	45.00	45.00	2.47	5.13	51.13	13.87	3.70	16.67	35.73	4.07
	F-Test	S	S	NS	NS	S	S	S	S	S	NS	S	S
	S. Ed. (±)	9.30	0.33	0.50	0.85	0.44	0.80	1.49	1.38	0.11	0.86	2.95	0.49
	CD at @5%	19.53	0.69	1.06	1.79	0.93	1.68	3.14	2.89	0.23	1.82	6.20	1.03
	CV	7.40	8.42	1.34	2.24	16.39	22.11	3.93	13.80	3.71	5.79	9.25	17.19

Table 4. Mean Performance of Cucumber Genotypes and varieties on Yield and Quality parameter

Notation	Genotypes	Number of fruits/ plant	Fruit weight (g)	Fruit length (cm)	Fruit diameter (cm)	Fruit yield/ Plot (kg)	Yield (q/ha)	TSS (^{o}Brix)	Vitamine C (mg/100g)	Organoleptic property
G1	IET,2021/CUCUVAR-1	11.27	124.00	13.23	3.53	22.71	169.60	2.60	1.77	8.00
G2	IET,2021/CUCUVAR-2	9.93	106.67	12.37	3.27	17.00	126.80	2.10	1.37	7.00
G3	IET,2021/CUCUVAR-3	8.53	125.00	14.23	3.73	17.47	130.40	2.10	1.47	7.00
G4	IET,2021/CUCUVAR-4	10.20	98.33	12.13	3.30	15.99	119.60	2.40	1.57	6.00
G5	IET,2021/CUCUVAR-5	9.60	170.33	15.53	4.43	26.57	194.40	2.33	1.60	6.00
G6	IET,2021/CUCUVAR-6	9.40	46.67	9.70	2.63	7.06	52.40	2.33	1.40	6.83
G7	IET,2021/CUCUVAR-7	6.13	66.33	16.03	2.70	6.67	49.60	2.00	1.43	7.00
C1	NAZIA (Check variety)	11.00	247.67	18.37	4.50	43.64	326.40	2.43	1.63	6.00
C2	LHC-1395 (Check variety)	10.33	181.33	15.13	4.67	29.92	209.60	2.43	1.60	5.00
C3	MALINI (Check variety)	11.33	83.67	13.50	3.33	15.05	109.60	2.40	1.63	5.33
	F-Test	S	S	S	S	S	S	S	S	S
	S. Ed. (±)	1.21	1.90	0.25	0.14	2.12	18.41	0.12	0.09	0.16
	CD at @5%	2.55	4.00	0.53	0.29	4.46	38.67	0.25	0.19	0.34
	CV	15.22	1.87	2.19	4.75	12.87	15.15	6.33	7.12	3.11

(E) Economic Analysis

Maximum gross income was found in the cucumber NAZIA (Rs.4,89,000/ha) followed by cucumber LHC-1395 (Rs.3,14,400/ha) and the minimum was found in IET,2021/CUCUVAR-7 (Rs.74,400/ha). Maximum net return was found in the cucumber NAZIA (Rs.3,33,718/ha) followed by cucumber LHC-1395 (Rs.16,0518/ha) and the minimum was found in IET,2021/CUCUVAR-7 (Rs.74,482/ha). Maximum Benefit: Cost Ratio was found in the cucumber NAZIA (3.14) followed by cucumber LHC-1395 (2.04) and the minimum was found in genotype IET,2021/CUCUVAR-7 (0.49).

4. CONCLUSION

The study concluded that cucumber NAZIA was found best performing variety from the other genotypes in relation of growth, yield and quality traits of cucumber. The NAZIA was found with the maximum results in fruit weight (247.67g), Fruit length (18.37cm), Fruit yield per plot (43.64 kg), Fruit yield (326.40 q/ha) and In the economics analysis NAZIA was also found highest in terms of the gross return (Rs.4,89,600/ha) and net return (Rs.3,33,718/ha). The highest benefit cost ratio was also seen in the cucumber NAZIA (3.14).

Therefore, from the results of research, the cucumber NAZIA was found superior from other genotypes used in the research and therefore it can be recommended for the cultivation for high fruit yield with good fruit quality.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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