Potentiality of greenhouse cucumber cultivars for economic and nutritional realization

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ABSTRACT

An attempt was made to identify horticulturally superior, economically potential and nutritionally rich cultivar (s) of cucumber in naturally ventilated polyhouse (NVPH) from a list of 16 parthenocarpic cultivars at Regional Horticultural Research Station, Navsari Agricultural University, Navsari. It was revealed that RS 03602833 was the earliest in first flowering (28.33 days) as well as picking (37.67 days) attributable to shortest inter-nodal length (8.12 cm) irrespective of the appearance of first pistillate flower in upper node. The vine length of 4.56 m was significantly exhibited by KUK 9 over all other cultivars. JSCU 01 excelled remaining cultivars in sensory parameters like flavour, colour and texture perceived by heterogeneous panel of evaluators which was well supported by instrumental measurement of fruit firmness (4.22 kg/cm^2) in this cultivar. The supremacy in term of dietary fibre, an important quality parameter in cucumber was displayed by KUK 9 (1.63%) with statistically similar content in other cultivars namely JSCU 01, KUK 6 and Kian. The majority of cultivars exhibited very narrow variations for fruit length and diameter except Kafka, KUK 6, Multistar, CBA 910569500, CBA 910569500 and Ronino. The cv Multistar produced highest number of fruits per vine (34.77) with statistically close affinity in Kian and Valleysta whereas JSCU 01 expressed significantly highest fruit weight of 207.82 g. The highest fruit yield per 1000 m^2 was recorded in Oscar (13.34 tons) bearing 27.97 fruits per vine and possessing 162.23 g fruit weight having statistically similar results in RS 03602833, Kian, KUK 9, 52-23, Valleystar and Multistar. The economic analysis also identified Oscar as highly remunerative cv exhibiting BCR of 0.94 which was followed by KUK 9, RS 03602833 and Valleystar thereby expressing the potentiality of growing fibre rich parthenocarpic cucumber under protected conditions to improve the socio-economic and nutritional status of farmers in shorter cropping period and as of the consumers.

Keywords: Parthenocarpic cucumber; protected cultivation; comparison; economy

INTRODUCTION

Cucumber (*Cucumis sativus* L) is one of the most important vegetables belonging to family Cucurbitaceae. It is an edible cucurbit popular throughout the world grown for its crisp texture and taste. Cucumber is truly a versatile vegetable because of wide range of uses from salads to pickles and digestive aids to beauty products. It is a primary source of vitamins and minerals for human body but its caloric and nutritional value is very low (Keopraparl 1997). Its edible portion contains 95.23 per cent water, 3.63 per cent carbohydrates, 0.65 per cent protein, 0.1 per cent fat and 0.4 per cent mineral matter (Anon 2014). It is good source of vitamins B and C. The fruit is also used as an astringent and antipyretic. Fruits are good for people suffering from constipation, jaundice, allied diseases and indigestion.

With the advent of modern technologies scenario of vegetable industry in India is changing at a faster rate. Due to erratic behaviour of weather the crops grown in open field are often exposed to fluctuating levels of temperature, humidity, wind flow etc which ultimately affect the crop productivity adversely. Therefore protected cultivation being the most efficient means to overcome climatic diversity has the potential of fulfilling the requirements of small growers as it can increase the yield manifolds and at the same time improve the quality of the produce

significantly as per the demand of the market (Akabari and Chauhan 2013). The greenhouse is best option for off-season vegetable production. Compared to open field very high yields of cucumber have been reported even under naturally ventilated polyhouse (Srivastava and Singh 1997).

Parthenocarpy has long been known to occur within the species of *C sativus* L (Sturtevant 1890). The term was propounded by Noll (1902) and he was the first to trace it in cucumber. Parthenocarpy is a much desired trait in cucumber production as it minimizes yield irregularity, enhances total yield and makes the production possible under suboptimal environmental conditions.

Availability of parthenocarpic cultivars has really revolutionized greenhouse cucumber cultivation in India. But there is always a dilemma in the minds of farmers to select a particular cultivar from big list of greenhouse cultivars floating in the market therefore identification of potential cultivar for protected cultivation is of vital importance. In India very little efforts have been made for identification of parthenocarpic cultivars suited to different agro-climatic conditions. Thus to yield better returns and achieve a boost in the production and productivity of cucumber the polyhouse cultivation of parthenocarpic cucumber cultivars during main and off-season seems indispensable. Moreover this frontier of identification of suitable parthenocarpic cultivars for protected cultivation is still unexplored and very meager information exists in this regard. Considering the above the present investigation was made to evaluate different parthenocarpic cultivars of cucumber available in the market.

MATERIAL and METHODS

The experiment was conducted under naturally ventilated polyhouse (NVPH) of 2000 m^2 at Regional Horticultural Research Station, Navsari Agricultural University, Navsari, Gujarat during the month of July 2014. The location is situated at a latitude 20°57' N and longitude 72°54' E with an altitude of 12 m amsl characterized by high humid climate with high annual rainfall of 1600 to 2400 mm mainly concentrated during monsoon from 2nd fortnight of June to September.

The experiment comprised 16 different parthenocarpic cultivars of cucumber namely Kafka, Dinamik, Fantasy, RS 03602833, Kian, KUK 6, Oscar, Valleystar, KUK 9, 52-23, Multistar, Y-225, JSCU 01, CBA 910569500, Ronino and Pruva from various private firms seeds of which were sown on 25 July 2014 in raised beds having dimensions of 100 x 40 x 50 cm (width, height and path) and at the spacing of 60 x 45 cm. Each cultivar was assigned a plot size of 3.0 x 6.3 m with three replications and laid out in a randomized block design. The crop was fertigated with NPK at the rate of 90:75:75 kg per hectare along with micronutrients (Grade-5) and farmyard manure. Each cultivar was trained to single stem system by disallowing all the laterals emerging from axials of leaves. The data on various parameters viz days to first flowering, days to first picking, node of first pistillate flower, vine length at final harvest, fruit length (cm), fruit diameter (cm), number of fruits per vine, average fruit weight (g) and fruit yield were collected. The data on sensory characters like fruit colour, texture and flavour were recorded on the basis of nine point Hedonic scale. The fruit firmness was ascertained by taking reading from proximal, middle and distal portions of the fruit with the help of penetrometer and average was worked out. The dietary fibre was determined by the method as suggested by Chopra and Kanwar (1999). The mean values were subjected to statistical analysis through WASP-Web Agri Stat Package 2.0 developed by Ashok Kumar Jangam and Pranjali Thali at ICAR Research Complex for Goa, Ela, Old Goa, Goa, India (Anon 2015).

The produce was marketed at Shree Navsari Jalalpore Taluka Horticulture Cooperative Society Ltd, Navsari, Gujarat and average selling rate was worked out for the given season. The data of single season have been considered to work out the annual account. To work out and simplify calculations the data generated through accounting method were subjected to analysis as suggested by Gittinger (1982). The actual values on fixed investment were subjected to amortized accounting by adopting certain assumptions. The prevailing market value at that point of time was accounted into analysis first for single season in each year and then converted into expected value per annum for calculation of variable components.

RESULTS and DISCUSSION

Reproductive and vegetative parameters

It is evident from Table 1 that parthenocarpic cultivars expressed significant variations for days to first flowering and picking. Amongst these RS 03602833 took minimum number of days to appearance

Table 1. Comparative performance of greenhouse cucumber cultivars for various reproductive and vegetative parameters

Cultivar	Days to first flowering	Days to first picking	Node of first pistillate flower	Internodal length (cm)	Vine length at final harvest (m)
Kafka	31.33	41.33	6.07	11.59	3.66
Dinamik	34.00	44.00	8.80	10.49	3.84
Fantasy	34.33	44.33	8.33	10.17	3.87
RS 03602833	28.33	37.67	9.53	8.12	3.69
Kian	29.00	38.33	6.67	11.45	3.48
KUK 9	29.00	39.00	6.93	11.72	4.56
Oscar	31.67	41.67	7.47	10.59	3.49
Valleystar	31.33	41.33	6.93	11.02	3.61
KUK 6	33.33	43.33	4.60	15.28	3.45
52-23	33.33	43.33	7.67	10.83	3.99
Multistar	33.33	43.33	6.40	12.77	3.85
Y-225	33.33	43.33	7.53	10.63	3.84
JSCU 01	36.33	47.00	9.87	12.31	3.51
CBA 910569500	32.67	42.67	7.00	10.71	3.87
Ronino	30.67	40.67	6.00	11.81	3.29
Pruva	31.33	41.33	6.13	11.79	3.34

of first flower (28.33) and harvest (37.67). However seven other cultivars namely Kafka, Kian, KUK 9, Oscar, Valleystar, Ronino and Pruva had statistically close affinity in relation to number of days taken to first flowering with the earliest in cv RS 03602833. The cv RS 03602833 also being the first in harvest was closely associated with most of the cultivars except Dinamik, Fantasy and JSCU 01. There was a critical observation in JSCU 01 for its late first harvest as the appearance of male flowers in early nodes made the expression of phenomenon of parthenocarpy late.

Although KUK-6 exhibited its first pistillate flower at the earliest node having statistically similar results with Kafka and Ronino but it was not reflected in its earliest harvesting. This could be due to the fact that these cultivars expressed high inter-nodal length. The lowest inter-nodal length of 8.12 cm was displayed in RS 03602833 which was statistically at par with cv Fantasy whereas KUK-6 showed maximum inter-nodal length of 15.28 cm over all other cultivars under investigation. It is clear from the data that node of first pistillate flower does not always reflect earliness in cucumber cultivars but it is also dependent greatly on inter-nodal length. That is how RS 03602833 became earliest in its first harvest because of its lowest inter-nodal length though it was having its first pistillate flower on upper node. Nikulenkova (1986), Yurina et al (1986), Hussain et al (1990) and Bisht et al (2011) also observed such variations among various cucumber varieties for time taken to first flowering and picking. The variation for vine length was not much wider however KUK-9 recorded significantly highest vine length compared to all other cultivars under investigation. Bisht et al (2011), Prasad and Singh (1992) and Rastogi and Deep (1990) also substantiated similar trends in character expression by different varieties during their period of study.

Quality parameters

The observations on various sensory characters based on Hedonic scale reflected that JSCU 01 excelled all other cultivars for fruit colour, flavour and texture. However the cultivars Kafka, KUK 9, Valleystar, KUK 6, 52-23, Multistar and Y-225 had statistically similar sensitivity for fruit colour with top ranking cultivar. Likewise KUK 9, 52-23, Multistar and only KUK 9 were at par with JSCU 01 for fruit flavour and texture. The fruit firmness in cucumber is always an important criterion to adjudge its quality for texture and crispness that is directly related to commercial value of the produce. It was observed that JSCU 01 displayed the highest value for fruit firmness (4.22 kg/cm^2) which was closely followed by KUK 9, Kian and KUK-6.

This trend of highest values for fruit firmness was well supported by Hedonic scaling carried out by heterogeneous panel of evaluators during the period of investigation (Table 2). Similarly Yoshioka et al (2009) have observed variability for fruit texture in various hybrids generated by them. Jeon et al (1973) and Thompson et al (1982) have also demonstrated close relationship between results of instrumental measurements and sensory evaluation by human thereby showing equal importance of sensory evaluation for prompt applicability.

Likewise dietary fibre in cucumber is an important quality parameter highlighting its presence in daily dose of diet for better health. Because of the presence of good amount of dietary fibre and negligible amount of fats cucumber is also known as a super food. The chemical analysis of different parthenocarpic cultivars for dietary fibre showed significant differences for this trait. It is evident from Table 2 that KUK 9 possessed higher amount of dietary fibre (1.63%) having statistically similar values in other cultivars like JSCU 01, KUK 6 and Kian.

Yield attributes

The fruit length ranged from 12.20 cm in KUK 6 to 18.08 cm in JSCU 01 exhibiting narrow variations among various cultivars for this trait. Most of the cultivars had statistically similar fruit length with JSCU 01 except Kafka, KUK 6, Multistar and CB A 910569500. Similarly the differences among various cultivars for fruit diameter were also very narrow ranging from 2.95 cm in CBA 910569500 to 3.43 cm in Kian. The majority of cultivars showed statistically similar fruit diameter except CBA 910569500 and Ronino (Table 3). The occurrence of such narrow differences among various parthenocarpic cultivars highlights very little scope of consumer selection on the basis of length and diameter of fruits.

The cv Multistar produced highest number of fruits per vine (34.77) with statistical similarity in Kian and Valleystar for this trait. However average fruit weight expressed wide variations ranging from 115.26 g in KUK 6 to 207.82 g in JSCU 01. Such variations in different cultivars are attributed to the peculiar character of a particular variety in attaining a size better for consumer preference.

The highest fruit yield of 4.51 kg per vine was obtained in Valleystar which was statistically at par with RS 03602833, Kian, KUK 9, Oscar, 52-23 and Multistar. The highest yield per 1000 square metre (13.34 tons) was expressed by Oscar which was statistically shared by RS 03602833, Kian, KUK 9, 52-

Table 2. Comparative performance of greenhouse cucumber cultivars for various quality parameters

Cultivar	Sensory parameter			Fruit firmness (kg/cm^2)	Dietary fibre (%)
	Fruit colour	Fruit flavour	Fruit texture		
Kafka	7.29	6.83	7.18	3.20	1.22
Dinamik	6.88	6.59	6.49	2.60	1.05
Fantasy	6.79	6.38	6.55	3.02	1.18
RS 03602833	6.08	6.13	6.85	3.29	1.28
Kian	6.58	6.46	7.25	3.92	1.54
KUK 9	7.33	7.21	7.63	4.08	1.63
Oscar	6.63	6.29	6.82	3.22	1.26
Valleystar	7.75	6.58	6.92	2.65	1.08
KUK 6	7.67	6.92	7.29	3.82	1.55
52-23	7.38	7.00	7.31	3.72	1.43
Multistar	7.88	7.38	7.43	3.64	1.44
Y-225	7.17	6.50	6.61	2.81	1.12
JSCU 01	8.13	7.83	8.42	4.22	1.62
CBA 910569500	6.88	6.54	6.50	2.78	1.10
Ronino	6.67	6.38	6.58	2.92	1.12
Pruva	6.88	6.33	6.56	3.02	1.16
$CD_{0.05}$	0.99	0.86	0.80	0.45	0.18

Table 3. Comparative performance of greenhouse cucumber cultivars for yield and yield attributes

Cultivar	Fruit length (cm)	Fruit diameter (cm)	# fruits/ vine	Fruit weight (g)	Fruit yield (kg/vine)	Fruit yield (tons/1000 m^2)
Kafka	14.50	3.14	29.47	128.24	3.76	10.73
Dinamik	15.30	3.25	26.11	132.97	3.43	10.17
Fantasy	15.30	3.18	26.84	133.66	3.57	10.59
RS 03602833	17.00	3.33	29.92	143.76	4.33	12.79
Kian	14.90	3.43	31.69	138.14	4.40	13.09
KUK 9	16.40	3.40	27.70	151.94	4.18	12.38
Oscar	16.40	3.34	27.97	162.23	4.50	13.34
Valleystar	15.30	3.25	31.84	142.32	4.51	13.33
KUK 6	12.20	3.22	23.74	115.26	2.72	8.07
52-23	16.00	3.05	25.20	163.36	4.05	12.01
Multistar	14.40	3.15	34.77	129.08	4.46	13.22
Y-225	15.06	3.21	24.51	143.74	3.50	10.36
JSCU 01	18.08	3.35	13.17	207.82	2.71	8.04
CBA 910569500	14.72	2.95	24.60	136.72	3.34	9.88
Ronino	14.90	3.01	25.62	127.28	3.24	9.61
Pruva	16.04	3.20	24.50	139.40	3.39	10.04
$CD_{0.05}$	3.26	0.39	4.52	18.32	0.49	1.73

23, Valleystar and Multistar. This can be attributed mostly due to number of fruits obtained from a vine and average fruit weight (Table 3). These results are in close agreement with the findings of earlier researchers like Rasmussen (1985), Gordii et al (1986), Bulatova (1987) and Hochmuth et al (1996). But it was also envisaged by the earlier workers that value for number of fruits per vine provides most stable measure for yield assessment rather than fruit weight (Elk and McSay 1981). Therefore selecting a particular cultivar with highest number of fruits per vine in the first step and with average fruit weight in second step can help in successful cucumber cultivation under protected conditions.

The economic analysis of different parthenocarpic cultivars of cucumber grown under naturally ventilated polyhouse (Table 4) revealed highest BCR of 0.94 in Oscar followed by KUK 9, RS 03602833 (0.86), Valleystar (0.85) and Multistar (0.84). This analysis clearly presented the dependency of net returns on cost of seed, yield of individual cultivar in particular and prevailing market price. Pozderec et al (2010) were also of the similar view that protected cultivation of cucumber presents a lot of opportunity in terms of better economic gain in shorter span of cropping period.

CONCLUSION

The comparative analysis of different parthenocarpic cultivars of cucumber under NVPH displayed good amount of variability for majority of vegetative, reproductive, quality and yield parameters except days to first picking, fruit length and diameter. Thus it offers a lot of scope to exploit their horticultural potential for protected cultivation. The presence of first pistillate flower at early node does not necessarily reflect earliness of a cultivar but it is also governed by inter-nodal length. The stability in the expression of the phenomenon of parthenocarpy is very important criterion to analyse earliness and overall performance of a parthenocarpic cultivar as some may express it very late in the season thereby affecting yielding ability. The close trends observed for sensory analysis between heterogeneous panel of evaluators and instrumental measurement highlighted the field applicability of sensory evaluation for quick and prompt results. The selection of high yielding cultivar should first be critically observed for fruits per vine and secondly for

Table 4. Economic feasibility of greenhouse cucumber cultivars under NVPH

Amortized cost (Rs)										
Cost of NVPH		Red soil		Rice husk		Plant support system			Total	
93500		7200		1333		2000			104033 (A)	
Variable cost										
Cultivar	Seed	Packing	V_1 to V_9	Total expenditure (Rs) (B)	Total A+B (Rs)	Yield (kg/1000 m²)	Selling rate (Rs/kg)	Gross (Rs)	Net (Rs)	BCR
Kafka	36000	6962	142224	185186	289219	32490	14.5	471105	181886	0.63
Dinamik	45000	6538	142224	193762	297795	30510	14.5	442395	144600	0.49
Fantasy	45000	6808	142224	194032	298065	31770	14.5	460665	162600	0.55
RS 03602833	45000	8222	142224	195446	299479	38370	14.5	556365	256886	0.86
Kian	58500	8415	142224	209139	313172	39270	14.5	569415	256243	0.82
KUK 9	36000	7959	142224	186183	290216	37140	14.5	538530	248314	0.86
Oscar	45000	8576	142224	195800	299833	40020	14.5	580290	280457	0.94
Valley Star	58500	8569	142224	209293	313326	39990	14.5	579855	266529	0.85
KUK 6	45000	5188	142224	192412	296445	24210	14.5	351045	54600	0.18
52-23	45000	7721	142224	194945	298978	36030	14.5	522435	223457	0.75
Multi star	58500	8499	142224	209223	313256	39660	14.5	575070	261814	0.84
Y-225	45000	6660	142224	193884	297917	31080	14.5	450660	152743	0.51
JSCU 01	35100	5169	142224	182493	286526	24120	14.5	349740	63214	0.22
CBA 910569500	54000	6351	142224	202575	306608	29640	14.5	429780	123172	0.40
Ronino	63000	6178	142224	211402	315435	28830	14.5	418035	102600	0.33
Pruva	63000	6454	142224	211678	315711	30120	14.5	436740	121029	0.38

V_1= FYM (Rs 2820)
V_2= Formalin (Rs 3375)
V_3= Application of formalin (Rs 1500)
V_4= Micronutrients (Rs 2700)
V_5= Bed preparation (Rs 3000)
V_6= Labour (Rs 108000)
V_7= Pesticides (Rs 3000)
V_8= Fertilizer (Rs 13329)
V_9= Miscellaneous (Rs 4500)

average fruit weight as consumer preference is generally targeted at medium-sized fruits.

Simultaneously economic component must be given enough weightage as it is the cost of seed along with selling rate which makes huge difference in the economy of cucumber cultivation under protected conditions. Going through above enumeration it can be viewed that growing fibre rich parthenocarpic cucumber under protected conditions can improve the socio-economic and nutritional status of farmers in shorter cropping period and as of the consumers though comprehensive trials over the years may be required to carry out yield and economic analysis to identify highly stable and quality acclaimed cultivar suited to a particular region.

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