Evaluation of Gherkin (*Cucumis anguria* L.) Genotypes for Yield and Quality Traits

Abstract

Genetic variability in a crop population is essential for successful plant breeding. The morphological characterization of gherkin studies has received relatively little attention. This investigation was conducted during the *Rabi* season, 2022, at the University of Horticulture Sciences, Bagalkot aims to study morphological variation among seven gherkin genotypes. Davangere Local was superior with in terms of vine length at 30, 60 and final harvest (0.66 m, 1.57 m, and 2.37 m, respectively), primary branches per vine (6.13), nodes per vine (24.00) and intermodal length (8.45 cm). It also excelled in the appearance of first female flower (15.10 days), days to first harvest (23.00 days), number of fruits per vine (125.29) and fruit yield per vine (0.61 kg). In terms of quality parameters, Chandini exhibited highest total soluble solids (5.50 °B). While Kadur Local showcased highest ascorbic acid (26.60 mg/100 g). Davangere Local shows the highest crude fiber content (19.56%). In conclusion, Davangere Local demonstrated overall superiority.

Keywords: Gherkin, Genetic variability, Morphological Characterization, Yield and Quality Parameters

1. Introduction

Gherkin (*Cucumis anguria* L.,) popularly known as bur cucumber, bur gherkin, cackery, gooseberry gourd, maroon cucumber, West Indian gherkin and west Indian gourd, belongs to the Cucurbitaceae family. It has a chromosome number of 2n = 24 and may well be found in tropical and subtropical regions, including tropical Africa, Brazil and the Caribbean (Venturin *et al*., 2020, Shanmugapriya (2017) and Madeira *et al*., 2008).This plant is characterized by its slender, trailing growth habit and is a monoecious annual herb. The plant and stem of the gherkin are covered with stiff hairs, and the stem has distinct angles with small, simple tendrils for support. The fruits typically 4-5 cm long and, are covered with long, sharp, glistening hairs and warty pimples. The seeds are smooth and white, measuring about 3-5 mm in length (Perseglove, 1968). The gherkin is also known for traditional importance in medicinal uses, including the treatment

of stomach ache, jaundice, and hemorrhoids and preventing of kidney stone formation (Baird and Thierest, 1988 and Patil and Narayana, 2018).Gherkin is primarily cultivated for its edible fruit, which are used in pickling, a cooked vegetables or eaten raw (Rana *et al.*, 2017). It was introduced in India in the late 1980s, for export-oriented production (Shanmugapriya, 2017). In India, its cultivation has gained significant importance over the last 20 years and Production of gherkin in India is mainly concentrated in the southern states like Karnataka, Andra Pradesh and Telangana of this country (Kumar and Rajkumar, 2021).

India provides around 15% of the global demand for gherkins through production. In addition to having export potential, the gherkin sector is crucial in generating employment in rural areas. In India around 90,000 small and marginal farmers cultivated gherkin in an area of 65,000 acres, under contract farming. India is currently the world's top exporter of gherkins. Indian exports of pickled cucumbers, often known as gherkins or cornichons around the world, have surpassed the USD 200 million in the most recent fiscal year. India exports gherkins to more than 20 countries, among them North America, Europe and Oceania serving as the primary markets. Important destinations for Indian gherkin exports include the United States, France, Germany, Australia, Spain, South Korea, Canada, Japan, Belgium, Russia, China, Sri Lanka and Israel (Anon, 2022).

Gherkin cultivation has gained popularity due to its fair returns to farmers. Given the crucial role for this crop plays in supporting agriculture livelihoods, so the evaluation of gherkin genotypes is of paramount importance for several compelling reasons. Evaluating of different genotypes constitutes a fundamental stage in breeding programs. Such assessments enable the identification of growth and yield disparities among various genotypes directly in the field.

Morphological characterization is the first most important step in describing and classifying the genetic resources (Smith and Smith, 1989) and genetic diversity in crop plants (Cartea et al., 2002, Balkaya and Ergun, 2008 and Zhang et al., 2012). Genetic diversity can be measured using morphological, biochemical characterization and evaluation. The morphological characterisation does not require expensive technology and these characters allow for the assessment of diversity in the presence of environmental variation (Mondini *et al.*, 2009). Morphological markers have been employed successfully as tools for germplasm

characterization. They have been used to assess genetic variation, monitor changes in population structure and manage variation through concerted conservation strategies (Millar and Westfall, 1992, Bretting and Widrlechner, 1995 and Meglic *et al*., 1996).

In the realm of gherkin research, there's been notably minimal focus on morphological characterization. Due to the gherkin being a barely exploited crop, studies related to this species are rare, and papers with an emphasis on seedling production are even less evident (Oliveira *et al*., 2017 and Neta *et al*., 2018). However, this aspect constitutes fundamental groundwork for future improvement endeavors in the gherkin industry. Establishing a comprehensive understanding of gherkin morphology serves as a cornerstone for advancing research in this field.

This foundational research not only fills crucial knowledge gaps but also provides a reference point for subsequent advanced studies in gherkin cultivation and breeding. By documenting and characterizing the morphological traits of gherkin varieties, researchers pave the way for more targeted and effective breeding programs, ultimately leading to improved gherkin varieties with desirable characteristics.

Therefore, investing in basic research on the morphological characterization in gherkin lays the groundwork for future advancements and serves as a valuable resource for researchers undertaking more specialized studies in this field. Given this importance, there is apressing need to evaluate the current genotypes available for cultivation. Keeping this view, the present study is designed to evaluate seven available gherkin genotypes.

2. Material and methods

The following study was conducted in the *Rabi* season of 2022 at the College of Horticulture Bagalkot. The experimental site was situated in the Northern dry zone of Karnataka, at an altitude of 533 meters above mean sea level (MSL), positioned at 16°18' N latitude and 75° 07' E longitude in Zone-3. We collected seven genotypes namely Chandini, Keerthi, Secure, Sira Local, Arsikere Local, Davangere Local and Kadur Local from different geographical areas of Karnataka and are grown by farmers based on contract farming with private companies. The experiment was laid out in randomized complete block design with three replications and a

spacing of 120 cm x 45 cm. The subsequent observations on traits, vine length (m) at 30, 60 days after planting and at final harvest, primary branches per vine, nodes per vine, inter nodal length of vine (cm), days to first female flower, node at first female flower appears, days to first harvest of the fruit, fruit length (cm), fruit diameter (cm), average fruit weight (g), number of fruits per vine, fruit yield per vine (kg), fruit yield per hectare (t).

Quality parameters like total soluble solids (%), titratable acidity (%), ascorbic acid (mg/100mg), crude fibre (%),tenderness (N) and colour values (*L**, *a** and *b**) values are recorded.

2.1. Total soluble solids (%)

Total soluble solids (%) were determined by using atago merapal refractometer.

2.2. Titratable acidity (%)

Titratable acidity was determined as per the procedure by Ranganna (1986). Acidity was evaluated by titration method with 0.10N sodium hydroxide. The final amount of extract was estimated using 5.00 g gherkin juice diluted in 50 ml distilled water.

$$\text{Titratable acidity (\%)} = \frac{\text{Burette reading} \times \text{volume made} \times \text{normality of NaOH} \times \text{equivalent wt. of citric acid}}{\text{Weight of the sample} \times \text{volume of sample taken for estimation}} \times 100$$

2.3. Ascorbic acid (mg/100mg)

The ascorbic acid content of gherkin fruits was determined using the 2, 6-dichlorophenol volumetric technique (Sadasivam and Manickam, 1992). The green fruits were sliced into two to three-millimeter pieces, and a 0.5-5 g sample was blended with 4% oxalic acid before being filtered through muslin fabric. 5 mL of working standard solution was pipetted into a 100 mL conical flask, followed by 10 mL of 4% oxalic acid and titration against the dye (V_1). The end point was the appearance of a pink colour which persisted for a few minutes. The amount of dye consumed is equivalent to the amount of ascorbic acid. The sample crushed using 4% oxalic acid, was extracted and made up to a known volume (100 ml) and centrifuge. 5ml of supernatant was poured into a conical flask and 10 ml of 4% oxalic acid was added and titrated against the dye (V_2). The ascorbic acid concentration of samples was determined three times, and the

average value was used to calculate the ascorbic acid content. The ascorbic acid concentration was determined and represented in mg/100 g of fruit using the following formula.

$$\text{Ascorbic acid (mg/100g)} = \frac{0.5}{V1} \times \frac{V2}{5ml} \times \frac{100ml}{\text{wt.of the sample}} \times 100$$

2.4. Crude fibre (%)

To calculate crude fiber, the Fibra plus-FES-6 gadget was employed. Before adding 100ml of 1.25% H_2SO_4 to each sample, a gram of the sample was weighed in the crucibles, which were then fastened to the Fibraplus apparatus. The sample was left for 40 minutes at a temperature of 370 □. The temperature was lowered to 200 □ after 40 minutes, and the knobs were then opened to suction, drain out all the H_2SO_4 and wash it with distilled water. The same procedure was followed, except this time each sample also received 100 ml of 1.25 % NaOH. The crucibles were then cooled in a desiccator and weighed after spending 3 hours in an oven at 100 °C.

$$\text{Crude fibre (\%)} = \frac{W_1\,(g) - W_2\,(g)}{\text{Weight of the sample (g)}} \times 100$$

Where: W_1 = Weight of crucibles after drying in an oven

W_2 = Weight of crucibles after ashing in muffle furnace

2.5. Tenderness (N)

The TAXT Pl Texture Analyzer (Make: stable microsystem, Model: Texture Export Version 1.22) was used to determine the texture of the fresh fruits. The force with which the fruits were cut was graphed and the peak force value in the graph was used to calculate the texture value in Newton's (N) force.

2.6. Colour values (*L**, *a** and *b**)

Using a Hunter colorimeter, the surface color of the gherkin fruits were assessed at two specific locations on the opposite sides of the equatorial region. The intensity of red, yellow, green and blue colors are each assigned + *a**, + *b**, - *a** and - *b** number in the color system

respectively. In addition, L^* = 0 represents the deepest darkness and L^* =100 represents lightness.

2.7. Statistical Analysis

The data of all quantitative and qualitative characteristics factors obtained from five randomly chosen plants that had been tagged within each treatment and replication was subjected to basic analysis and the following statistical parameters were calculated. The experimental data was statistically analyzed using Fisher's "Analysis of variance" approach. The F- test employed a 0.05 probability threshold of significance. The data was interpreted using crucial difference (CD) values obtained at 0.05 percent probability (Panse and Sukathame 1985).

3. Result and Discussion

Analysis of variance (has shown in the table 1 and 2) revealed significant differences for the entire trait under study except for the average fruit weight trait.

Mean performance of genotypes for growth and yield parameters:

Genetic variability is the basic need for a plant breeder to initiate any breeding program. Among the horticultural traits, a comparatively wide range was observed for vine length at 30 days after planting, 60 days after planting (DAP) and at final harvest. The value varies from 0.42 to 0.66 meters, 0.83 to 1.57 meters and 1.82 to 1.57 meters (Table 1.) respectively. At different growing stages genotype Davangere Local had the longest vine length of 0.66 m, 1.57 m and 2.37 m at 30, 60 DAP and at final harvest respectively. At 30 DAP Kadur Local had the shortest vine length of 0.42 m. At 60 DAP Arsikere Local the had shortest vine length of 0.83 m and at final the harvest Kadur Local had the shortest vine length of 1.65 m. The wide variation observed for the number of primary branches per vine and node per vine is shown in Table .1. For node number bearing the first female flower varies from 2.20 to 3.00 which determine the earliness of a genotype. It has been observed that Davangere Local was found to be earliest for the first female flower at 2.20 nodes and Chandini was found late for first female flower it bears flower at the 3rd node.

There was quite a good variation observed for days to first fruit harvest (23.00 to 28.13). Less variation as observed for fruit length (4.17 to 6.11 cm), fruit diameter (1.34 to 1.60 cm) and

average fruit weight (5.12 to 5.60 g) because rhythmic picking *i.e.* every alternate days we carried out the harvesting. So less variation observed for these traits. The number fruit per vine varies from 81.95 to 125.29 as shown in Table 1. The highest number of fruit per vine was found in Davangere Local (125.29) while the lowest number of fruit per vine was found in Kadur Local (81.95). Fruit yield per vine ranged from 0.45 to 0.61 kg and fruit yield per hectare varies from 6.73 to 9.09 t. In general, wide variation observed for yield and yield attributing traits mainly depends on genetic factors, environmental influences, hormonal aspects and the overall vigor of the crop. Similar outcomes have been reported by Cardoso and Silva (2003), Shah *et al*., 2017 in cucumber. The vine length, number of primary branches per vine, intermodal length, node at first female flower appears, days to first flower appearance, number of nodes per vine and fruit number per vine are have a positive correlation with the quantity of gherkins they produce. Similar correlation and projections were previously repoted in cucumber by Sharma *et al.* (2000) and Yadav *et al.* (2012) Kumar *et al*., 2017, Pal *et al*., 2017, Shah *et al*., 2017, Karthick *et al*., 2019, Lalnunkimi *et al*., 2022.

All the genotypes under study showed good variation was observed with respect to quality parameters TSS, titratable acidity, ascorbic acid and crude fibre as mentioned in figure 1. The highest TSS content was recorded in Chandini (5.50 °B) and the lowest TSS content was noticed in Davangere Local (4.13 °B).The highest titratable acid content was observed in Arsikere Local (1.39 %) and lowest titratable acid content was recorded by Kadur Local (0.65 %). The highest ascorbic acid content was found in Kadur Local (26.60 mg/100 g).Whereas, low ascorbic content was noticed in the genotype Davangere Local (15.54 mg/100 g). The highest crude fibre content was found in Davangere Local (19.56 %). While, less crude fibre content was noticed in the genotype Arsikere Local (11.63 %).

Quite a good variation observed with respect to tenderness and colour (*L**, *a** and *b**) parameters across the studied genotypes were represented in table 2. Tenderness is determined by the force required to cut the fruits, measured in Newton's (N) force. With respect to colour, intensity of red, yellow, green and blue colors are each assigned + *a**, + *b**, - *a** and - *b** number in the colour system respectively. In addition, *L** = 0 represents the deepest darkness and *L** =100 represents lightness.

Significantly the highest tenderness was observed in the Arsikere Local (35.29 N) and the lowest firmness was recorded in Secure (18.92 N).With respect to colour values *L**, *a** and *b** values variation was also observed within studied gherkin genotypes. *L** was value ranged from 22.42 to 35.06, *a** value ranged from -3.80 to -2.15 and *b** value ranged from 8.80 to 12.53. Numerically high colour value *L** was recorded for genotype Sira Local (35.06) and low colour value *L** noticed in Arsikere Local (22.41). Numerically high colour value *a** was observed for the genotype Chandini (-2.15) and a low colour value *a** was recorded for genotype Keerthi (-3.80). Genotype Keerthi showed a numerically high colour value of *b** (12.53) and a low colour value of *b** recorded for the genotype Davangere Local (8.80). The variation in quality parameters might have been due different harvesting stages, genetic, environmental and hormonal factor of the crop. Similar results were found by Verma *et al*. (2003), Kumar (2006), Rajawat *et al*., 2017 and Shah *et al*., 2017.These distinct qualities make these genotypes suitable for specific purposes, including utilization in processing industries, exportation and various other applications.

4. Conclusion

Based on the discussion presented earlier, it is evident that among the seven gherkin genotypes evaluated for their performance, the Davangere Local genotype outperformed the others in terms of both vegetative and fruit characteristics, as well as overall yield.

Through this understanding, we can identify gherkin varieties that exhibit desirable traits such as disease resistance, yield potential, and adaptability to different growing conditions. With this knowledge, we can streamline breeding efforts, develop targeted cultivation practices, and optimize production techniques to fully realize the crop's potential. Ultimately, this research not only contributes to expanding our understanding of gherkin but also sets the stage for its sustainable cultivation and increased utilization, potentially benefiting farmers, consumers and the agricultural industry as a whole.

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Table 1. Performance of gherkin genotypes for yield and yield attributing traits

Genotype	Vl			Pbpv	Npv	Inlv (cm)	Dfff	Dfr	Fl (cm)	Fd (cm)	Afw (g)	Nfv	Fypv (kg)	Fyph (t)
	30 DAP	60 DAP	Fh											
Chandini	0.49	1.34	2.01	4.53	18.11	11.25	18.90	28.13	5.02	1.49	5.30	83.61	0.44	6.56
Keerthi	0.50	1.36	1.82	4.40	16.11	11.25	18.60	27.66	5.14	1.60	5.48	86.86	0.47	7.05
Secure	0.48	1.29	1.94	4.53	17.55	10.50	18.90	28.09	4.72	1.50	5.21	90.61	0.47	6.99
Sira Local	0.60 b	1.36	1.87	5.26	20.00	10.45	18.40	27.60	4.78	1.45	5.60	87.29	0.48	7.24
Arsikere Local	0.48	0.83	1.83	5.46	20.66	10.59	18.90	27.80	4.74	1.51	5.15	95.78	0.49	7.30
Davangere Local	0.66 a	1.57	2.37	6.13	24.00	08.45	15.10	23.00	6.11	1.34	5.12	125.29	0.61	9.09
Kadur Local	0.42	0.99	1.65	4.86	16.44	12.38	18.10	26.80	5.82	1.43	5.55	81.95	0.45	6.73
S. Em. ±	0.02	0.05	0.07	0.21	0.86	0.42	0.83	1.37	0.16	0.08	0.26	2.89	0.02	0.40
CD at 5%	0.05	0.15	0.20	0.62	2.56	1.26	2.46	4.22	0.46	0.24	NS	8.59	0.05	1.19

Vl: Vine length, DAP: days after planting, Fh : final harvest, Pbpv: Primary branches per vine, Npv: Node per vine, Inlv (cm): Inter-nodal length of vine (cm), Dfff: Days to first female flower, Nfff: Node at first female flower, Dfr: Days to first harvest of the fruit, Fl: Fruit length (cm), Fd: Fruit diameter (cm)**,** Afw: Average fruit weight (g), Nfv: Number of fruits per vine, Fypv: Fruit yield per vine (kg) and Fyph: Fruit yield per hectare (t).

Table 2. Tenderness and Colour of gherkin genotypes

Genotypes	Tenderness (N)	Colour		
		*L**	*a**	*b**
Chandini	30.78	26.49	-2.15	9.475
Keerthi	25.21	33.66	-3.80	12.53
Secure	18.92	26.07	-3.44	10.02
Sira Local	23.04	35.06	-2.46	11.47
Arsikere Local	35.29	22.42	-2.76	8.85
Davangere Local	31.56	31.97	-2.93	8.80
Kadur Local	24.48	28.46	-2.83	9.22
S. Em. ±	0.90	1.07	0.09	0.42
CD at 5%	2.68	3.17	0.27	1.24

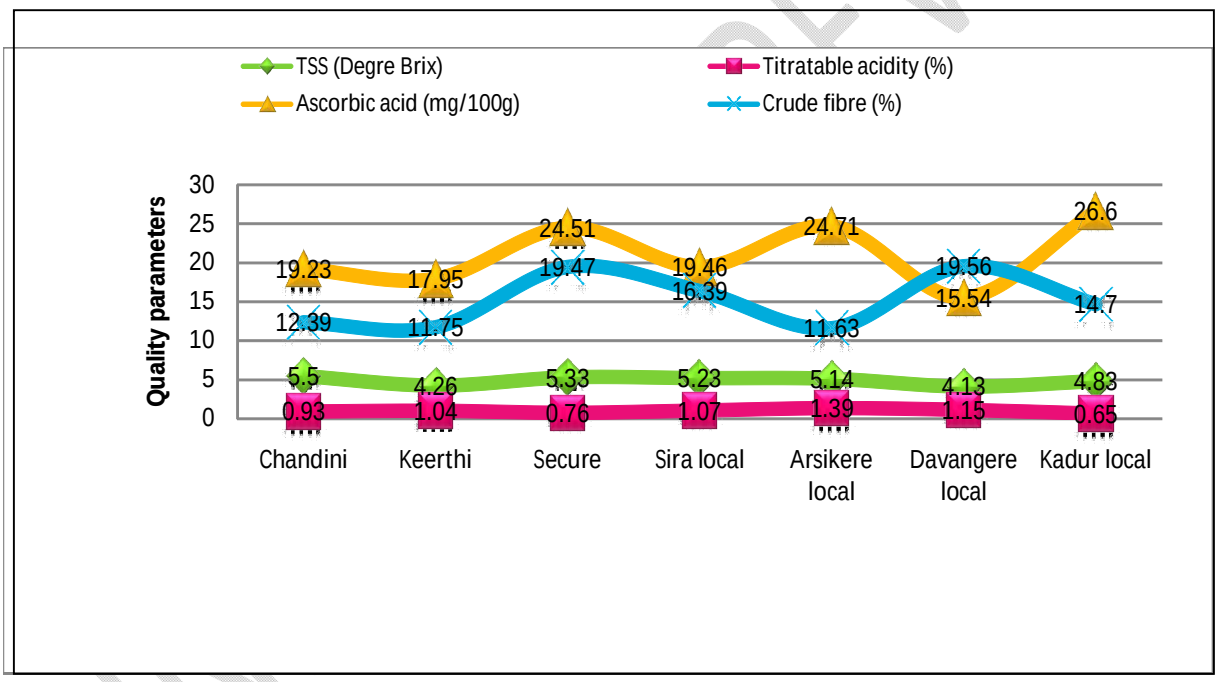

Fig. 1. Performance of gherkin genotypes for quality characteristics