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Evaluation of gerbera (*Gerbera jamesonii*) cultivars for growth and yield under polytunnel in upper Palani hills of Kodaikanal

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Abstract
The gerbera daisy is a favorite flower amongst the masses due to its striking appearance. These flowers are generally used as a decorative cut flower for bouquets but are also in flower beds. These daisies come in many vibrant colors including red, orange, yellow, pink, white and cream. Evaluation of gerbera (*Gerbera jamesonii*) cultivars for growth and yield under polytunnel in upper Palani hills of Kodaikanal was carried out during the year 2022–2023 at the Horticulture and Forestry Research Station, TNAU in Kodaikanal. Significant variations existed among the cultivars in terms of growth, flowering, and floral traits. Haimi has recorded maximum length among the cultivars at 42.93 cm, the more number of leaves at 20.66, and the recorded maximum length of leaves at 46.53 cm. Then the cultivar Breakdance measured maximum plant spread (75.06 cm NS and 71.06 cm EW) and maximum leaf breadth (18.40 cm). Deepti took the shortest time to flower bud initiation (50.66 days), flower bud opening (59.33 days), and flowering (70.67 days). Maximum flower and disc diameters (15.07 and 2.6 cm respectively) were measured in the cultivar Haimi.
Haimi has the maximum yield (4.08/plant) and vase life (19.00days) in terms of yield and quality metrics. The results suggest that cultivar Haimi exhibits the best performance in terms of growth and floral qualities for producing quality blooms of commercial standards, followed by Breakdance, Srividya, Livia, and Deepti.

Keywords: Gerbera, polytunnel, cultivars, growth, yield and cost of cultivation

1. Introduction
Gerbera, a significant commercial flowering crop, belongs to the Asteraceae family and is native to South Africa and Asia. It is an herbaceous perennial or annual plant with unique flower colors and is now being researched for cut flowers, pot plants, and garden accents. People prefer this flower due to its diverse colors, beautiful shape, and long post-harvest life. Farmers can harvest flowers in three to four years, and tissue culture plants are becoming more popular. It is gaining importance in domestic and international markets as cut flowers and potted plants. Farmers benefit from high profit margins and long post-harvest life, and people are increasingly interested in using this flower in daily life and celebrating festivals.

Hi-tech Gerbera cultivation faces challenges such as high initial investment, restricted technology, and fluctuating market conditions. Despite those advancements in polyhouse production, users must upgrade knowledge for that evaluation of gerbera cultivars for growth and yield is needed. Hence in the present study low cost polytunnel was taken as a cost effective solution for recommending to farmers that can help overcome these challenges.

2. Materials and Methods
The experiment was conducted in a 15 m × 4.1 m polytunnel at the Horticultural & Forestry Research Station, TNAU in Kodaikanal in 2022–2023. During the trial period, the mean maximum temperature varied from 31.7 to 39.2 °C, while the mean minimum temperature varied from 11.4 to 15.8 °C. A mean relative humidity of 47.2 to 93.9% was present. The experiment was layed out in Randomized Block Design along with replicated three times. The five commercial gerbera cultivars undertaken in this study are Deepti (Red), Haimi (Orange), Breakdance (White), Srividya (Pink), and Livia (Yellow). Uniform tissue cultured plants were planted on raised beds that were 1 ft tall and 1 m wide, with a 30 cm space between each row.

3. Results and Discussion

3.1. Growth characteristics

The investigation's findings on the various growth and flowering traits of gerbera cultivars showed that there are notable variations among them in terms of growth traits (Table 1). The highest plant height among the cultivars was recorded by Haimi (42.93 cm), followed by Srividya (38.47 cm), and the lowest by Livia (30.10 cm). Vijalaxmi *et al*.'s (2021) [1] report on varietal traits may be the cause of the plant height's noticeable difference. The results from Baghele *et al*. (2022) [2] are similar in that the number of leaves per plant ranged from 14.33 (cv. Deepti) to 20.66 (cv. Haimi). Plant spread NS was highest for the cultivar Breakdance (75.06 cm), followed by Srividya (66.17 cm), and lowest for Deepti (40.93 cm). Plant spread EW was highest in the cultivar Breakdance (71.06 cm), followed by Srividya (61.55 cm), and lowest in Deepti (36.26 cm). According to Sarmah *et al*. (2014) [3], each varieties' distinctive traits may have reflected their genetic characteristics, explaining the noticeable variety in vegetative properties.

3.2. Flowering, Flower and yield characteristics

As demonstrated in Table 2, cut flower metrics such as flower diameter, stalk length, and stalk diameter showed significant variance among the cultivars. Haimi produced with a maximum diameter of 15.0 cm, followed by Breakdance with 14.43 cm, and Deepti with a minimum diameter of 13.13 cm. The disc's diameter was highest in Deepti (2.8 cm), followed by Haimi (2.66 cm), and lowest in Livia (1.93 cm). According to Mathala (2012) [10], the average hourly temperature and humidity of the poly tunnel are significantly different from those of the shade net house and double span poly house. Because of this, the flowers cultivated in polytunnels have a great variation in bloom diameter and disc diameter.

The number of ray florets as well as their size was noted. Among the cultivars, Haimi displayed the longest ray florets (2.49 cm), Breakdance was second (2.23 cm), and Livia was the shortest (2.00 cm). Then, Breakdance (1.53 cm) and Haimi (1.40 cm) had the widest ray florets, while Livia (1.03 cm) had the narrowest. Breakdance (72.33) had the most ray florets, followed by Haimi (64.67), Srividya (60.00), Livia (58.00), and Deepti (53.33). These standards establish a flower's size morally; without them, a bloom cannot lure customers. This agrees with the judgement made by Thomas *et al*. (2004) [9]. For gerbera cut flowers, the stalk length is an important factor. It confirms the standard for cut flowers. According to Paramveer Singh *et al*. (2017) [4], when the length of the stalk expands, more food that was previously reserved will be stored there and later made available to the flower for a longer period of time. For a longer vase life, the flower's stalk is a necessary component in gerberas. Haimi recorded the longest stalk at 82.17 cm, followed by Breakdance at 80.30 cm, Livia at 76.47 cm, Srividya at 74.33 cm, and Deepti at 71.93 cm. Additionally, stalk girth is crucial, much as stalk length. Haimi recorded the largest stalk girth (24 mm), followed by Breakdance (23.33 mm), while Deepti (18.67 mm) recorded the smallest. Along with that, Haimi recorded the highest weight (46.00 g), followed by Breakdance (45.57 g), while Deepti recorded the lowest weight (38.00 g). The days required for bud initiation, bud opening, and full blooming were significant, as shown in table 3 of the data. For flowers, the length of time between bud initiation, bud opening, and full bloom is crucial to flower harvesting and overall crop yield. Deepti was the first cultivar to show signs of bud initiation, bud opening, and full blossoming (50.66 days, 59.33 days, and 70.67 days, respectively). Breakdance (52.00 days, 59.67 days and 71.67 days), Srividya, Haimi, and Livia (58.67, 66.33 and 78.67 days) were next in order. Similar results were found by Biswal *et al*. (2017) [5] and Satish Kumar *et al*. (2012) [8].

According to Meeramanjusha *et al*. (2003) [6], a particular variety's yield potential may be a result of its inherent genetic potential as well as its improved vegetative growth, which enables the plant to convert its stockpile of photosynthesis into reproductive sinks. Yield varies significantly among varieties. This establishes the crop cultivation's financial gain. Among these cultivars, Haimi recorded the highest production of 4.08 flowers per plant, followed by Breakdance (3.92 flowers per plant), Deepti (3.75 flowers per plant), Srividya (3.50 flowers per plant), and Livia (3.08 flowers per plant). Haimi recorded the highest yield/plot (49 flowers/plot), followed by Breakdance (47 flowers/plot), Deepti (45 flowers/plot), Srividya (42 flowers/plot), and Livia (37 flowers/plot). Results were similar to Sangma *et al*. (2017).

4. Cost economics

For 2008 sq. m., as shown in table 4, it will take two years to break even with a production of high-quality cut gerbera flowers. With a benefit cost ratio of 2.26, the net returns are greater than the cost of cultivation. This demonstrates the excellent economic level of profit generated

Table 1: Plant growth characters of gerbera cultivars grown under Polytunnel

Varieties	Plant height (cm)	No of Leaves	Leaf length (cm)	Leaf breadth (cm)	Plant spread - NS (cm)	Plant spread - EW (cm)
Deepti	39.93	14.33	35.20	14.33	40.93	36.26
Haimi	42.93	20.66	46.53	16.26	54.68	50.46
Breakdance	36.30	20.00	41.63	18.40	75.06	71.06
Srividya	38.47	19.33	39.40	14.36	66.17	61.55
Livia	30.10	16.00	40.53	12.33	63.55	57.22
SEM	1.634**	0.557**	1.324**	0.580**	2.154**	3.101**
CD 5%	5.331**	1.819**	4.318**	1.894**	7.024**	10.11**
CD 1%	7.757**	2.646**	6.284**	2.756**	10.22**	14.71**
CV	7.541**	5.347**	5.641**	6.645**	6.209**	9.711**

Table 2: Floral characters of gerbera cultivars grown under Polytunnel

Varieties	Flower diameter (cm)	Disc diameter (cm)	Ray florets			Stalk length (cm)	Flower stalk girth (mm)	Weight of flower (g)
			length (cm)	width (cm)	No. of. Ray florets			
Deepti	13.13	2.8	2.10	1.20	53.33	71.93	18.67	38.00
Haimi	15.07	2.6	2.49	1.40	64.67	82.17	24.00	46.00
Breakdance	14.43	2.33	2.23	1.53	72.33	80.30	23.33	45.67
Srividya	13.97	2.03	2.07	1.37	60.00	74.33	15.33	32.67
Livia	13.90	1.93	2.00	1.03	58.00	76.47	20.67	38.33
SEM	0.238**	0.098**	0.071**	0.055**	1.895**	1.516**	1.282**	1.145**
CD 5%	0.777**	0.320**	0.231**	0.181**	6.182**	4.944**	4.182**	3.734**
CD 1%	1.130**	0.466**	0.335**	0.264**	8.996**	7.194**	6.085**	5.433**
CV	2.927**	7.277**	5.616**	7.393**	5.325**	3.408**	10.88**	4.941**

Table 3: Flowering, yield and quality characters of gerbera cultivars grown under Polytunnel

Varieties	Days to visibility of flower bud.	Days to flower bud opening	Days to full bloom	Flower yield /plant (no)	Flower yield / plot (no)	Vase life (days)
Deepti	50.66	59.33	70.67	3.75	15.00	14.67
Haimi	55.00	63.67	75.00	4.08	16.33	19.00
Breakdance	52.00	59.67	71.67	3.92	15.67	17.67
Srividya	52.33	60.67	71.33	3.50	14.00	14.67
Livia	58.67	66.33	78.67	3.08	12.33	15.67
SEM	0.760**	0.741**	0.699**	0.119**	0.477**	0.596**
CD 5%	2.478**	2.418**	2.280**	0.389**	1.556**	1.944**
CD 1%	3.606**	3.519**	3.317**	0.566**	2.264**	2.829**
CV	2.450**	2.074**	1.648**	5.636**	5.636**	6.323**

Table 4: Cost economics of Polytunnel cultivation of gerbera.

Particulars	Contents & cost	Amount
Area of Polytunnel	2000 square/meter	
Polytunnel Construction	Polytunnel, as per NHB norms, GI pipe structure & imported plastic @ Rs. 600 / per Sq. meter.	₹12,00,000
Irrigation System	Drip Irrigation system for plants, Fertigation unit, Water Filtration unit	₹1,88,000
Bed Preparation	Red Soil, Rice Husk,FYM, Sand, etc	₹2,20,000
Plants	Plant Density: 6 plants / sq. Mtr. Total Plants: 12,000 Nos. Cost of one Plant: Rs. 35 / plant	₹4,20,000
Subtotal		₹20,28,000
	Working Capital	
Electricity	3.0 unit/day	₹50,000
Water requirement	Approximate per year	₹50,000
Fertilizers	Water Soluble Fertilizers	₹60,000
Labour	3- 4 labours per day	₹250000
Crop Protection	Spraying	₹60000
Packing Material, Transport, Sales commission	Packing material, and transport	₹162000
Miscellaneous	Maintenance, Depreciation	₹226800
Subtotal		₹8,58,800
	Returns Per Year	
Yield / Plant / Year	54	₹648000
Price per Flower in Rs.	₹3	₹3
Total Returns	Per Year	₹1944000
Cost of Cultivation	Per Year	₹8,58,800
Net Return	Per Year	₹10,85,200
	Benefit Cost Ratio	2.263623661
	Break-even point	2 years

Fig 1: Gerbera cultivated in Polytunnel at H&FRS, Kodaikanal

Fig 2: 1. Deepti, 2. Haimi, 3. Breakdance, 4. Srividya, 5. Livia

5. Conclusions

The results of the trial made it abundantly evident that the cultivar Haimi produced the greatest number of blooms with superior cut flower quality, closely followed by the cultivars Breakdance, Srividya, Livia, and Deepti. According to the results of the study, all gerbera cultivars exhibit the floral characteristics needed to produce A-grade cut flowers in a polytunnel, which also costs less than a polyhouse. Therefore, the commercial production of cut gerbera flowers in a polytunnel can be advised to farmers.

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