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Performance of Carnation (*Dianthus caryophyllus L*) Varieties under Protected Condition

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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 present investigation was undertaken to elevate different carnation varieties for the performance of Growth, yield and post-harvest quality under protected condition. The experiment was conducted in Horticultural Research Station, Tamil Nadu Agricultural University, The Nilgiris, India . The experiment was laid out in a Randomized Block Design (RBD) with Eleven varieties of Carnation *viz.*, Big one, Turbo, Solex, Hunza, Easy Golem, Express Golem, Red King, Golem, Gioele, Big mama and Happy Golem. observation were recorded for plant height (cm), days to first flower, flowering duration, length of flower stem (cm), diameter of flower (cm), Number of flowers per plant and Calyx splitting (High : 60% and above, Medium: 30 – 50%, Low : less than 30%), Strength of flower stem, vase life solutions *viz.,* AOA (25ppm), AOA (50ppm), $CoCl_2$ (10ppm) ,$CoCl_2$ (20ppm) and plain water for 30 minutes. The cultivar Happy Golem recorded maximum plant height of 100.50cm and the minimum plant height of 77.0 cm was noticed in Golem. Maximum number of shoots per plant was recorded in the cultivar Gioele (7.98) followed by Hunza (7.50) and minimum number of shoots per plant was observed in the entry Golem (5.30).Maximum number of leaves (195.20) and Leaf length (13.55 cm) was recorded in the entry Gioele. The Days to first flower ranged between 130.01 to 139.20 days from planting. The cultivar Turbo (130.01) recorded early to initiate the flower bud followed by Golem (130.10) .The cultivar Red king recorded

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maximum flowering duration of 13.50 days followed by big mama (13.20 days)) and minimum flowering duration was observed in Happy Golem (10.47 days).The Cultivar Gioele recorded the highest stalk length of 93.00 cm and the lowest stalk length of 68.50cm was observed by Golem. With respect to yield parameters maximum number of flowers per plant was recorded in Gioele (7.50 nos) followed by Red king (7.17 nos) and Hunza (6.97 nos) and Minimum number of flowers per plant was recorded in Golem (5.11 nos). Maximum number of A and B grade flower stems are produced in the Variety Gioele. Among the cultivar for prolonging the vase life of Carnation, treatment comprising of AOA @50ppm recorded maximum vaselife of 19 days by cultivar, minimum flower diameter (5.3cm) and maximum total water absorbed (45.0 ml) and found to be the best to increase the shelf life of carnation.

Keywords: Carnation; Dianthus caryophyllus L; post harvest; shelf life.

1. INTRODUCTION

Carnation is one of the leading cut a flower of international market trade belongs to the family Caryophyllaceae. Carnation plants are half-hardy herbaceous perennials with 1.0 to 1.5 meters height. Carnation is another important cut flower among the countries of the world and is grown in poly houses. Carnation flowers are excellent cut flowers and are also used for pot cultivation, bedding and borders in landscapes. The major Carnation growing countries are Italy, Spain, Columbia, Kenya, Srilanka, Canary Islands, France, Holland, USA and Germany. While the major importers of carnation are France, United Kingdom, Holland, Israel, Italy, Spain, Peru, Greece, Mexico and Equador. In India the major production regions are located around The Nilgiris, Hosur, Bengaluru, Kolkata, Pune, Delhi, Solan, Shimla, Ludhiana and Hyderabad.

In recent years, the demand for cut flower is being gaining momentum with increasing aesthetic sense and higher socio-economic standard of the people. Indian floriculture market worth INR 130 billion in 2017 and in further the floriculture will reach upto INR 349 Billion by 2023, at a CAGR of 20% during 2018- 2023 https://www.Research and markets.com). The area under carnation cultivation in India is around 210 ha. with production of 590 MT of loose flowers and 6000 MT of cut flowers.

In West Ghats of Tamil Nadu, there is a wide fluctuation in temperature, light intensity and humidity which not only affect the yield, quality of flowers and also affects the shelf life of flowers. Hence, the performance of the varieties in poly condition varies from region to region to obtain the good quality of the cut flowers [1]. To produce quality flowers, carnation need to be grown under cover, that is, in greenhouse which provides the plants with the optimum condition of light, temperature, humidity and carbon dioxide etc for proper growth and to achieve maximum yield of best quality flowers [2].In worldwide more than 100 varieties are available for protected Cultivation. Among them, Eleven varieties of Carnation *viz.*, Big one, Turbo, Solex, Hunza, Easy Golem, Express golem, Red King, Golem, Gioele, Big mama and Happy golem were evaluated under The Nilgiris condition.

2. MATERIALS AND METHODS

The present investigation was carried out for two years (2017 -2018) to study the evaluation of carnation (*Dianthus caryophyllus* L.) varieties under protected condition of The Nilgiris. The experiment was conducted in Horticultural Research Station, Tamil Nadu Agricultural University, The Nilgiris, India which is located at 11.4025'N Latitude, 76.735' E Longitude and at an Altitude of 2635 m above Mean Sea Level. The mean annual rainfall of The Nilgiris is 1632 mm. The average maximum and minimum temperature is 26.0^{o}C and 2^{o}C respectively. The average relative humidity is 75 %. The experiment was laid out in a Randomized Block Design (RBD) with Eleven varieties of Carnation *viz.*, Big one, Turbo, Solex, Hunza, Easy Golem, Express Golem, Red King, Golem, Gioele, Big mama and Happy Golem replicated thrice. The Healthy, rooted plants of standard carnation were collected from M/s. Florance Flora, Bangalore and Department of Horticulture and Plantations crops, The Nilgiris were planted with a spacing of 20 cm between the rows and 15 cm apart. The plots were irrigated with drip irrigation system by providing two laterals per bed. The important operation to get quality flowers with long, firm and straight stalks is by netting. First layer of GI net having 7.5 x 7.5 cm mesh was laid out at 15 cm height from ground level and second layer with mesh size of 12.5 x 12.5 cm and third and fourth layers of 15 x 15 cm mesh size were laid

out. Five plants from each cultivar in each replication were selected for recording observation on plant height (cm), days to first flower, flowering duration, length of flower stem (cm), diameter of flower (cm), Number of flowers per plant and Calyx splitting (High : 60% and above, Medium: 30 – 50%, Low : less than 30%), Strength of flower stem is determined by holding the stem horizontally at a point 25cm above the base and noting the deviation of the flower head below horizontal line. A grade: less than 15^0, B grade : 50 – 30^o, C grade : more than 30^o, No. of flowers produced with stem length A grade : 55 cm & above, B grade : 45cm – 54cm,C grade : 30cm – 44cm [3].

To prolong the keeping quality of cut carnation flowers, the stems should be treated with different vaselife solutions. In this experiment, vase life was studied in best performing variety under protected condition of Nilgiris with different vase life solutions *viz.,* AOA (25ppm), AOA (50ppm), $CoCl_2$ (10ppm) ,$CoCl_2$ (20ppm) and plain water for 30 minutes. The stems was harvested at paint brush stage and immediately put in water. The leaves from the lower1/3rd portion of the stem was removed and the stems were pre-cooled at 2-3 C in cool chamber for 6 hours. , The Thereafter, the stems were treated with AOA (25ppm), AOA (50ppm), $CoCl_2$ (10ppm) and $CoCl_2$ (20ppm) and plain water of the mentioned solutions for 30 minutes. In the post harvest studies, the characters like vase life (days), maximum flower diameter attained in vase, total water (ml) and any phytotoxic affect of the chemical on the foliage or flower bud were recorded. The data generated during the course of study was subjected to statistical analysis as prescribed by Panse and Sukhatme [4].

3. RESULTS AND DISCUSSION

The present investigation is undertaken with eleven elite varieties of carnation were evaluated for the performance of Growth, development, productivity and post-harvest quality under protected condition. The findings of the investigation are discussed under the following headings with the supporting data are presented Table 1. The cultivar Happy golem recorded the maximum plant height (100.50cm) followed by Turbo (99.35cm), Solex (97.60cm) and Hunza (96.90cm). While, the least plant height was noticed in Golem (77.00cm). Similar range of variability with respect to plant height among the varieties is mainly due to genetic nature and environmental conditions. This was in accordance with the reports of Verma et al*.,* [5] evaluated ten cultivars, the maximum plant height at bud emergence was noted for variety Sissagree (67.5cm) followed by Cherry Solar (65.0cm). The similar variation is also due to fact that removal of apical portion by pinching which neutralizes the effect of apical dominance were reported by Ajay Kumar Singh et al., [1].

Maximum number of shoots per plant was recorded in the cultivar Gioele (7.98) followed by Hunza (7.50) and minimum number of shoots per plant was observed in the entry Golem (5.30). Maitra and Roychowdhury [6] noticed that, Decio produced the highest number of side shoots (2.61) and Pink and Orange Isac produced the lowest number of side-shoots (1.08/plant) per plant in carnation. This may be due to fact that removal of apical portion by pinching which neutralizes the effect of apical dominance. Maximum number of leaves was recorded in the entry Gioele (195.20) and minimum number of leaves was recorded in the entry Golem (101.10). The variety Gioele recorded the maximum leaf length of 13.55cm followed by Red king 13.01cm and Turbo 12.50cm. This was in conformity with the findings of Mukund et al. [7].

The Days to first flower ranged between 130.01 to 139.20 days from planting. The cv Turbo (130.01) recorded early to initiate the flower bud followed by Golem (130.10) and big one (132.10) there by earlier to reach the peak flowering. The longest number of days for flower bud initiations was taken by Red king (139.20 days). These variations for flower bud initiation may be attributed to genetical factors by reported by Reddy et al. [8] in carnation. The variations in bud initiation may also be due to influence of solar radiation and temperature as reported by Harris and Scott [9]. Flowering duration ranged from 10.47 to 13.50 days. The cultivar Red king recorded the maximum Flowering duration(13.50 days) followed by big mama (13.20 days) and minimum flowering duration Happy Golem (10.47 days).

The different flower quality parameter were evaluated for eleven varieties of carnation recorded were stalk length (cm), Stem girth (mm),flower diameter (cm), number of flowers per plant, calyx splitting, strength of flower stem and No. of flowers produced with stem length (A,B,C Grade) are presented in Table 2.

Table 1. Evaluation of carnation *(Dianthus caryophyllus L)* varieties for vegetative characters under protected condition

S. No.	Particulars	Plant height (cm)	No of the shoots	No of the Leaves	Leaf Length (cm)	Days to first flower	Flowering duration in days
1	Big One	94.40	6.10	131.30	12.31	132.10	11.50
2	Turbo	99.35	6.80	169.35	12.50	130.01	12.10
3	Solex	97.60	5.95	123.56	11.10	134.00	11.50
4	Hunza	96.90	7.50	170.68	12.08	135.18	11.60
5	Easy golem	85.20	6.53	159.56	10.51	134.20	12.10
6	Express Golem	95.10	6.14	154.30	11.10	138.18	12.30
7	Red king	96.36	7.30	189.30	13.01	139.20	13.50
8	Golem	77.00	5.30	101.10	8.50	130.10	12.90
9	Gioele	81.89	7.98	195.20	13.55	132.00	11.00
10	Big mama	93.12	6.75	162.50	9.85	134.50	13.20
11	Happy Golem	100.50	6.50	164.50	10.23	133.70	10.47
	Mean	92.15	6.62	156.49	11.34	134.06	11.96
	SE.d	5.71	0.91	11.59	0.71	2.28	0.59
	CD(P=0.05%)	11.99	0.43	24.34	1.48	4.80	1.24
	CV	7.59	7.89	9.01	7.56	2.09	6.08

Table 2. Evaluation of carnation *(Dianthus caryophyllus L)* varieties for floral characters under protected condition

Sr.No.	Particulars	Stalk stem (cm)	Stem girth (mm)	Diameter of flower (cm)	No. of flowers per plant	Calyx spliting	Strength of flower stem	No. of flowers produced with stem length		
								A	B	C
1	Big One	82.30	4.01	5.20	6.03	Low	A	2.80	2.50	1.30
2	Turbo	85.10	6.45	5.20	6.78	Low	A	2.60	2.50	1.60
3	Solex	72.00	3.25	5.70	5.50	Low	A	2.50	1.50	1.50
4	Hunza	83.20	6.32	5.30	6.97	Low	B	2.50	2.30	2.10
5	Easy golem	78.10	5.79	4.00	6.23	Low	A	2.80	1.40	2.00
6	Express Golem	80.20	3.98	5.20	6.00	Low	B	2.50	2.20	1.40
7	Red king	86.50	6.20	5.60	7.17	Low	A	2.90	2.70	1.60
8	Golem	68.50	3.01	5.40	5.11	Low	B	2.10	1.70	1.30
9	Gioele	93.00	6.98	6.10	7.50	Low	A	3.50	2.80	1.20
10	Big mama	83.00	4.35	5.30	6.50	Low	A	2.80	2.30	1.40
11	Happy Golem	85.40	4.28	5.00	6.30	Low	A	2.50	2.10	1.70
	Mean	81.23	4.97	5.26	6.40	-	-	1.48	2.40	1.67
	SE.d	4.15	0.47	0.38	0.40	-	-	0.18	0.17	0.13
	CD(P=0.05%)	8.72	1.00	079	0.84	-	-	0.39	0.35	0.28
	CV	6.22	11.58	8.67	7.684			15.20	8.39	9.86

Table 3. Post harvest studies on keeping quality of Cut carnation flowers

Treatments	Vase life (days)	Maximum flower diameter attained in vase (cm)	Total water absorbed (ml)	Any phytotoxic affect of the chemical on the foliage or flower bud
1.Control	7.0	7.3	20.0	Nil
2.AOA (25ppm)	18.0	5.8	40.0	Nil
3.AOA (50ppm)	19.0	5.3	45.0	Nil
4.CoCl2 (10ppm)	11.0	6.5	25.0	Nil
5.CoCl2 (20ppm)	12.0	6.8	30.0	Nil
SED	0.87	0.51	1.77	-
CD(0.05)	2.05	1.19	4.15	-
CV	8.02	9.86	6.79	

In carnation very important quality parameters is stalk length which is considered for the grading of flowers which in turn increases the shelf life of the flowers. Cultivar Gioele recorded the highest stalk length of 93.00cm followed by Red king (86.50cm), Happy Golem (85.40cm) respectively. Lowest stalk length was observed by Golem (68.50cm). Increased number of internodes with increased internodal length resulted in increased stalk length Poonam and Sharma, [10]. The variation in stem length among varieties was mainly due to the interaction between genetic and environmental factors also reported Verma et al., [5] in Carnation. The drastic increase in stem girth was observed in the cultivar Gioele (6.98mm) followed by Turbo (6.45mm), Hunza (6.32mm). This may be attributed to genetic characters or physiological differences among the genotypes reported by Dona Ann Jose et al., [11].

The maximum flower diameter ranged from 4.00 to 6.10 cm .Among the different cultivars studied cv. Gioele recorded the maximum diameter of flower (6.10cm) followed by Solex (5.70 cm) and Minimum flower diameter was recorded in the entry Easy golem (4.00 cm). One of the components of the flower that contributes for the increase in diameter is the flower length. Increase in flower length directly contributed for the higher flower diameter and varied among the different varieties evaluated and result was confirmed by Sarkar & Sharma [12] in Carnation.

With respect to yield parameters maximum number of flowers per plant was recorded in Gioele (7.50 nos) followed by Red king (7.17 nos) and Hunza (6.97 nos) and Minimum number of flowers per plant was recorded in Golem (5.11 nos).The increased flower yield might be attributed due to the production and accumulation of maximum photosynthetic material which ultimately resulted in production of more number of flowers. Similar variation in was also observed by Ryagi [13]. All cultivars recorded the low calyx splitting It might be attributed to extra growth and inability of calyx to contain these extra petals and petaloids according to Whealy [14]. Strength of the flower stem was recorded for eleven carnation varieties among them Big one, Turbo, Solex, Easy golem, Red king ,Gioele, Big mama and Happy Golem recorded the A grade. Three varieties Hunza, Express Golem and Golem recorded B grade. Maximum number of A grade flower stems are produced in the Variety Gioele (3.50) followed by Red king (2.90) ,Big mama, Easy golem and Big one (2.80).Maximum number of B grade flowers was recorded in the entry Goiele (2.80) Minimum number of B grade flowers were recorded in the variety Easy golem (1.40). The entry Easy golem recorded the maximum number of C grade flowers and Minimum number of C grade flowers were recorded in the variety Goiele (1.20).

4. CONCLUSION

The results of the experiment is presented in Table.3. Maximum vase life of 19 days was recorded in treatment AOA @ 50ppm.whereas control recorded minimum vase life of 7 days. Minimum water absorption (20.0 ml) was recorded in control. In contrary, treatment comprising of AOA @ 50 ppm absorbed maximum amount of water absorbed (45.0ml). Inaddition, minimum flower diameter in vase was recorded in the same treatment (5.3cm) and maximum in control (7.3cm). Variation in vase life could also be attributed to fact that, the variation in ability to produce ethylene and sensitivity to it among the different varieties. Similar variation for vase life of varieties was also reported previously in carnation by Gharge et al.,[15]. It could be concluded from the present investigation that out of Eleven Varieties evaluated Gioele were found to be superior in vegetative and yield parameters for carnation under The Nilgiri condition.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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