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Growth, Yield and Quality of Carnation (*Dianthus caryophyllus* L.) Cultivars under Lath House Conditions

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Abstract

Five carnation cultivars ('Grand Salam', 'Nelson', 'Kaly', 'Cinderella' and 'Tempo') were evaluated with respect to growth, yield and quality characteristics under lath house conditions at Kala Shah Kaku Research Station, Directorate of Floriculture, Lahore during 2011. Among the cultivars studied, maximum plant height was recorded in carnation cultivar 'Grand Salam' (78.66 cm) closely followed by 'Kaly' (78.23 cm) and 'Cinderella' (77.96 cm). Number of shoots was highest in cultivars 'Tempo' (6.3) and 'Nelson' (6.2). Maximum stem thickness was observed in 'Nelson' (6.21 mm) and minimum in 'Grand Salam' (3.63 mm). Maximum number of internodes per stem were found in 'Nelson' (12.66) followed by 'Kely' (11.33) and 'Grand Salam" (11.00). Highest flower yield per plant was recorded in cultivars 'Tempo' (6.4) and 'Nelson' (6.33). Maximum number of flowers per square meter were recorded in cultivar 'Nelson' (198.3) followed by 'Tempo' (189.6). Hence it can be concluded that cultivars 'Nelson' and 'Tempo' were found superior with respect to growth and flower yield characteristics under lath house conditions.

Keywords: Carnation, Cultivars, Lath house, Vase-life, Yield.

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INTRODUCTION

Carnation (*Dianthus caryophyllus* L.) a native to Mediterranean region (Salehi, 2006) is an important flower crop having great commercial value as a cut flower due to its excellent keeping quality, wide array of colours and forms (Pralhad, 2009). Carnation, apart from producing cut flowers has also become useful in gardening for bedding, edging, borders, pots, and rock gardens (Biondo and Noland, 2000; Dole and Wilkins, 2005). From medicinal point of view, the carnation flowers are considered to be cardiotonic, diaphoretic and alexiteric (Shiragur *et al*., 2004).

Carnation flowers are sold as cut flowers round the year throughout the world and it is on the top three cut flowers traded in the international market. The flower quality is maintained in the long distance transport as they have ability to rehydrate after transportation (Pralhad, 2009). The demand for carnation as cut flower is gaining momentum with increasing socio-economic standard of the people.

In Pakistan, the floriculture crops are grown in open fields. Planting after April has to pass through a great stress due to prevailing high temperature. Though low temperature conditions exist during winter months but the shortage of light during winter months is the main barrier for its reduced and delayed flower production. In addition this, other operations are also known to affect its flowering but so far, there is no systematic report on its growth and flower behavior to different climatic conditions.

The performance of carnation varies with region, season, genotypes and growing environment. In Pakistan, there is a wide fluctuation in temperature, light intensity and humidity which not only affect the yield and quality of flowers but also limit their availability during particular period of a year. It is necessary to grow carnation under lath house condition for obtaining good quality flowers. Testing of the available varieties for suitability and adaptability with respect to flowering, flower quality and yield parameters are of prime importance. There is need of suitable varieties to our climatic conditions. Selection of proper variety for producing the desired quantity and quality of flowers for domestic as well as export market is of greater importance.

At present, sparse information is available about the suitability of potential carnation varieties for cultivation in central Punjab. Hence, the objective of this study was to evaluate suitability of different carnation cultivars by analyzing their vegetative and reproductive characteristics under the agro climactic conditions of Lahore, Pakistan.

MATERIALS AND METHODS

The present investigation was carried out to study the performance of carnation cultivars under lath house conditions during 2010-2011. The experiment was carried out at Kala Shah Kaku Research Station, Directorate of Floriculture, Lahore (31°62'N; 74°9'E). The experiment was laid out in a complete randomized design (CRD) with three replications. The soil was sterilized with four 3 % formalin and covered with black polyethylene for 72 hours. The plots were incorporated with fully decomposed farmyard manure and sand in the ratio of 2:1. Following five cultivars of standard carnation were used during the study; 'Grand Salam', 'Nelson', 'Kaly', 'Cinderella' and 'Tempo'. The rooted cuttings of five carnation cultivars were procured and were transplanted in field experimental units of 3.3m x 2.5m, keeping row to row and plant to plant distance 45 and 30 cm, respectively. All the cultural practices such as fertilizers, irrigation, weeding and hoeing were done uniformly for each treatment. The beds were irrigated regularly to keep the soil moderately moist. The experiment was carried out under poly-carbonated (6 mm thickness) lath house with misting and cooling facility.

The physiological characteristics of soil were also determined. The pH value of soil was 7.5 with electrical conductivity 2.0 dS m^{-1}. The organic matter of the soil was 0.9%. Available phosphorus, calcium and potassium contents of the soil were 55, 220 and 120 mg $kg^{-1}$of dry soil, respectively. The soil was mixed with NPK as recommended doses to increase production (Dufault

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et al., 1990).

The data on plant height (cm), number of shoots per plant, stem thickness (mm); number of internodes per stem, yield per plant, number of flowers per square meter and vase life were recorded. Plant height was measured from the plant crown up to point just below the flower head and the average plant height was worked out and expressed in centimeter (cm). Carnation flowers for vase life evaluation were harvested when the outer petals unfold nearly perpendicular to the stem. The flowers were harvested early in the morning and were immediately placed in fresh water. Later these flower stalks were cut to have uniform stalk length. After that flowers were kept individually in flask containing tap water at 22 oC and 60 % humidity. Each flask had five flower stems replicated three times. Flowers were observed daily till they were found unfit for containing in vase. The vase life was expressed in terms of days from the date of harvesting to final observation (50 % petals wilting).

The climatic data consisting of daily observations of average temperature and relative humidity was recorded during the whole study period (Fig. 1).

The data were subjected to analysis of variance (ANOVA) using Genstat (release 31.1; Lawes Agricultural Trust, Rothamsted Experimental Station, Rothamsted, UK). The effects of various treatments were assessed within ANOVA and Fisher's least significant differences were calculated following a significant ($p \leq 0.05$) F test. All the assumptions of analysis were checked to ensure validity of statistical analysis.

RESULTS AND DISCUSSION

Plant height (cm)

The plant height among the different cultivars of carnation differed significantly. The range was from 64.96 cm to 78.66 cm. Cultivar 'Grand Salam' (78.66 cm) recorded highest plant height closely followed by 'Kaly' (78.23 cm) and 'Tempo' was shortest (64.96 cm) (Table 1).

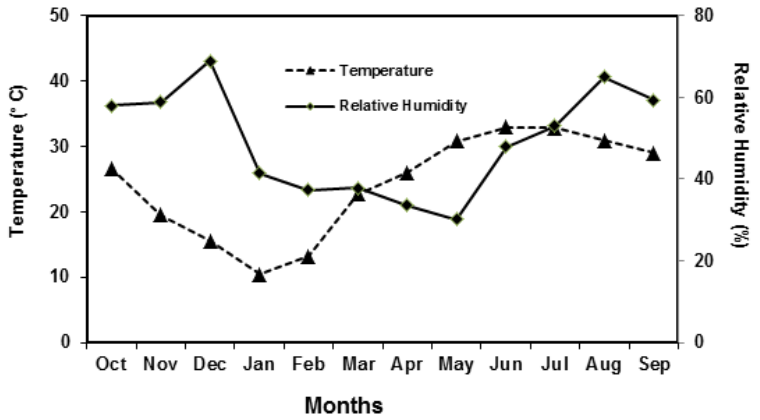

Fig. 1. The average temperature and relative humidity of Kala Shah Kaku from October 2010 to September 2011.

Table 1. Growth characteristics of different carnation cultivars under lath house.

Varieties	Plant height (cm)	Number of shoots. plant^{-1}	Stem diameter (mm)	Number of internodes. stem^{-1}
Grand Salam	78.66 a	4.6 c	3.63 d	11.00 b
Nelson	74.40 b	6.2 a	6.21 a	12.66 a
Kaly	78.23 a	3.7 d	5.44 b	11.33 ab
Cinderella	77.96 a	5.4 b	4.48 c	10.00 b
Tempo	64.96 c	6.3 a	5.61 b	7.33 c
LSD (0.05)	3.23	0.65	0.14	1.62

Means with different letters in a column differ significantly at p≤0.05.

This variability in plant height among the carnation varieties is mainly due to genetic nature, growing environmental conditions, production technology and cultural practices. Patil (2001) also observed same plant height in carnation cultivars 'Alma', 'Sugar Baby' and 'Leon' under low cost polyhouse. Our results are also in accordance with the results of Sathisha (1997) and Shiragur *et al.* (2004) who have also recorded vigorous growth in terms of plant height in different carnation cultivars.

Number of shoots per plant

Cultivars 'Tempo' (6.3) and 'Nelson' (6.2) recorded more number of shoots as compared to 'Cinderella' (5.4) and 'Grand Salam' (4.6). Least number of shoots was counted in cultivars 'Kaly' (Table 1). Similar differences with respect to number of shoots per plant were also noticed by Shiragur (2002). These results are also similar to that of Shahakar *et al.*, (2004).

Stem diameter

Stem thickness may vary from cultivar to cultivar. It gives strength to the plant. Cultivar 'Nelson' (6.21 mm) had thicker and stronger stems, while 'Tempo' (3.63 mm) had weaker stems. On the other hand 'Grand Salam', 'Kaly' and 'Cinderella' had stems of moderate thickness (Table 1). Similar variations in stem thickness in different carnation cultivars had been recorded earlier by Mahesh (1996). Thicker stems indicated higher capacity of strong reserve food material.

Number of internodes per stem

Carnation cultivar 'Nelson' possessed the maximum number of internodes per stem (12.66), followed by 'Kaly' (11.33) and 'Grand Salam' (11.00) (Table 1). 'Tempo' produced minimum number of internodes per stem (7.33). Variations in number of internodes per stem had been recorded earlier among different carnation varieties by Hanzel *et al.*, (1954). These differences in number of internodes per stem may be due to varietals characters.

Yield per plant

There was a significant difference among the cultivars for flower yield per plant. The highest number of flowers was recorded in 'Tempo' (6.4) followed by 'Nelson' (6.3). Cultivar 'Kaly' (2.66) produced minimum number of flowers per plant (Fig. 2).

Yield. Meter $^{-2}$

Maximum number of flowers per square meter was recorded in carnation cultivar 'Nelson' (198.3). The next superior variety was 'Tempo' (189.6), whereas cultivar 'Kaly' recorded minimum number of flowers per square meter (135.6) (Fig. 2). The increased flower yield might be attributed

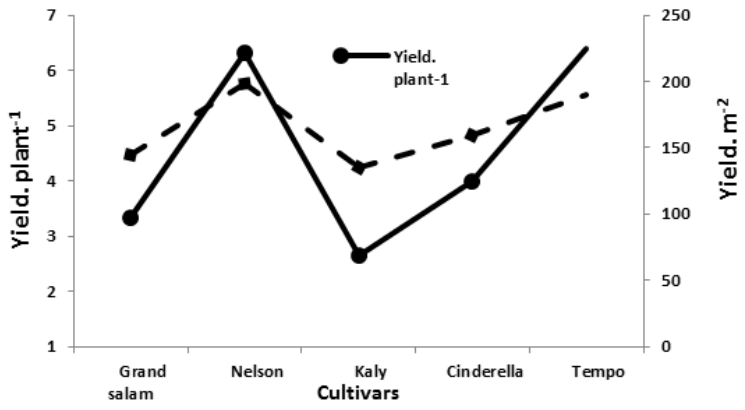

Fig. 2. Yield and yield component data of five carnation cultivars under lath house conditions.

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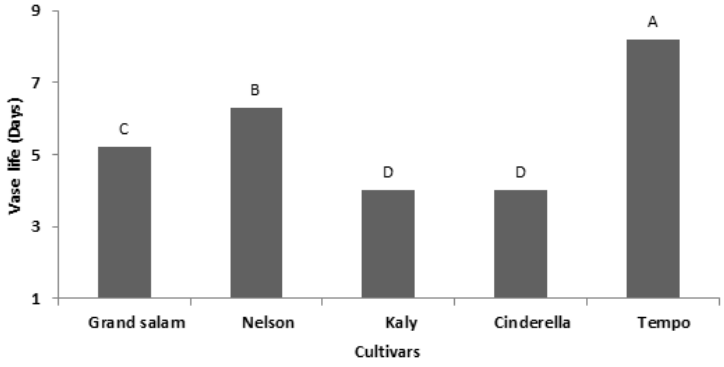

Fig. 3. Vase life of five carnation cultivars grown under lath house conditions.

to more number of leaves resulted in production and accumulation of maximum photosynthetic material which ultimately resulted in production of more number of flowers with bigger sized flowers. Similar variation in carnation with respect to flower yield was also observed by Ryagi (2007) and Shahakar *et al*. (2004).

Vase life

Carnation cultivars differ in the length of the vase life of cut flowers which is one of the characteristics determining the commercial value of the ornamental flowers. Thus, it is of economic importance to know the vase life of cut carnation flowers of different cultivars. There was significant difference among the carnation cultivars with respect to shelf life. Shelf life was highest in cultivar 'Tempo' (8.2 days). The next superior cultivar was 'Nelson' (6.3 days) and 'Grand Salam' (5.2 days). The cultivar 'Kaly' and 'Cinderella' (4.0 days) were on par to each other (Fig. 3).

The vase life is one of the important traits which decide its economic value. This variation in vase life among the varieties might be attributed to the variations in accumulation of carbohydrates since these varieties could produce more number of leaves and indicated positive and significant correlation between these characters. Variation in vase life could also be attributed to fact that, the variation in ability to produce ethylene among the different cultivars. Similar variation for vase life in different cultivars was also reported previously in carnation by Pathania (2000), Singh *et al.* (2007), Shahakar *et al.* (2004) and Patil (2001). The increased ethylene production promotes the in-rolling of petals resulting in wilting of the flower. The time of onset of ethylene production and the amount of ethylene produced in the flowers vary with the carnation cultivar, and thus influence their vase life (Nukui *et al*., 2004).

CONCLUSIONS

The above mentioned findings indicated that considering the important characteristics, 'Nelson' and 'Tempo' were found superior with respect to growth, yield and vase life characteristics. These cultivars are suitable for commercial cultivation under lath house conditions.

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