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EFFECT OF STORAGE DURATION ON ROOTING OF CARNATION (*Dianthus caryophyllus* L.) CUTTINGS

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ABSTRACT : Studies on the effect of storage on rooting of carnation (*Dianthus caryophyllus* L.) cuttings were carried out during 2011-12 on four commercial carnation cultivars viz. 'White Wedding', 'Farida', 'Niva' and 'Madras'. A basal dose of 20-5-5 g/m^2 of NPK was applied before planting and the plants were fertigated with 200 ppm N + 280 ppm K twice a week. Results revealed that cuttings stored for 7 days resulted in minimum percentage of weight loss (3.48 %) and maximum cost benefit ratio (1:3.55). However, carnation cuttings stored for 7 days and 14 days resulted in 100 per cent rooting. The studies also indicated that carnation cuttings may be stored up to 35 days at 2°C without significant change in quality and quantity of cuttings.

Keywords : *Carnation, storage, duration, rooting, survival.*

In the commercial production of rooted carnation plants and other species, cuttings usually stored for several weeks to match production with demand. Low temperatures are commonly used for postharvest storage of *in vitro* propagules, transplants and rooted cuttings (Zencirkiran, 16). For long term storage, cuttings are placed in polyethylene bags or polyethylene lined boxes to prevent them from dessication. Storage at low temperature is very effective for cuttings of many temperate zone species like carnation, azaleas, chrysanthemums etc. These can be stored at low temperature for a certain period without any deleterious effect on the subsequent root formation and the growth afterwards. However, cuttings can deteriorate with extended storage from excess respiration, light exclusion, exposure to extreme temperatures, moisture loss, pathogen invasion and ethylene accumulation. These abiotic and biotic factors can influence the aesthetic quality (necrotic lesions, senescence, desiccation and chlorophyll degradation) of cuttings and their subsequent performance during production (Rapaka *et al.,* 13). It is also important to store the cuttings which would allow growers to regulate market supply during surplus production or peak demand to accommodate propagation and production schedules. Therefore, it is important to work out techniques for getting quality planting materials and an appropriate storage period which would help the farmer to secure good planting materials of carnation for a longer duration.

MATERIALS AND METHODS

The experiment was carried out at the experimental farm, Department of Floriculture and Landscaping, Dr. Y.S. Parmar University of Horticulture and Forestry, Nauni, Solan during 2011-2012. Four commercial carnation cultivars *viz.;* White Wedding, Farida, Niva and Madras were taken for study. The cuttings of each cultivar having 4-5 nodes and 10-15 cm on length were harvested and stored in cardboard boxes at a temperature of 2°C and relative humidity of 75 per cent. The cuttings were packed by placing a layer of cellophane sheet on all sides of the boxes. The experiment was laid out in factorial completely randomized design with six storage durations viz. 0 days (S_0), 7 days (S_1), 14 days (S_2), 21 days (S_3), 28 days (S_4) and 35 days (S_5). After storing of cuttings for different durations, these were taken out and kept in a bucket of water for 1 hour. Cuttings were prepared for rooting by removing the lower leaves and dipping the basal ends in NAA (500 ppm) solution for 2-3 seconds before planting in pro-trays containing a mixture of river bed sand + coco peat in the ratio of 1:1 (v/v).

RESULTS AND DISCUSSION

Per cent weight loss of un-rooted cuttings in storage

Storage durations affected the weight of the cuttings and differed significantly from the un-stored cuttings (Table 1). All cuttings, regardless of the storage durations, declined in weight as storage duration prolonged. Cuttings stored for 7 days (S_1)

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Table 1 : Per cent change in weight of the cuttings of different carnation cultivars in storage at 2°C for different durations

Cultivars / Storage Durations	White Wedding (V_1)	Farida (V_2)	Niva (V_3)	Madras (V_4)	Mean
S_0 - Control	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
S_1 - 7 days	4.79 (2.13)	2.23 (1.46)	4.58 (2.06)	2.32 (1.52)	3.48 (1.79)
S_2 - 14 days	6.58 (2.54)	6.11 (2.42)	3.65 (1.85)	1.48 (0.99)	4.46 (1.95)
S_3 - 21 days	3.62 (1.90)	4.48 (2.06)	9.22 (3.03)	3.22 (1.78)	5.14 (2.19)
S_4 - 28 days	15.18 (3.88)	13.00 (3.59)	14.89 (3.85)	17.99 (4.18)	15.26 (3.87)
S_5 - 35 days	14.31 (3.73)	15.76 (3.96)	13.45 (3.63)	14.66 (3.82)	14.54 (3.78)
Mean	7.41 (2.36)	6.93(2.25)	7.63 (2.40)	6.61(2.05)	-

* Figures in parenthesis are square root transformed values.

CD (P=0.05) : Cultivars : NS Storage durations : 0.41 Cultivars × Storage durations : NS

showed the minimum per cent weight loss (3.48 %) in storage compared to other storage durations.

As the storage duration increased, the per cent weight loss in storage of the un-rooted cuttings tend to increase and cuttings stored for 28 days (S_4) and 35 days (S_5) had the largest difference in per cent weight of the un-rooted cuttings. The decrease in per cent weight loss of the un-rooted cuttings may be due to the fact that leaves losses excess amounts of water after storage and unless roots are present, this water cannot be fully replenished before desiccation occurs. Though cuttings were maintained at 75 per cent relative humidity in storage condition, temperature differences between pre harvest and storage condition may have resulted increased water loss. These findings are in close conformity with the results that enhanced storage duration and temperature decreased the storage potential and post-storage performance of the Philodendron, Pothos, New Guinea, Impatiens and Poinsettia cuttings, respectively (Poole and Conover, 11; Ropez and Runkle, 14; Faust and Enfield, 7).

Number of roots

The number of roots noted significant differences with storage durations (Table 2). Cultivar Madras recorded highest number of roots (32.87), while cultivar White Wedding showed minimum number of roots (28.08). These differences observed amongst the cultivars might be due to the different endogenous auxin levels in each cultivar which is responsible for rooting process. It has also been observed that low endogenous auxin concentration was present in the fresh cuttings which increased during the cold storage and helped in subsequent rooting. Similar trend was

Table 2 : Effect of storage of different carnation cultivars at 2°C for different durations on number of roots per plant.

Cultivars / Storage Durations	White Wedding (V_1)	Farida (V_2)	Niva (V_3)	Madras (V_4)	Mean
S_0 - Control	32.13	45.80	31.17	32.67	35.44
S_1 - 7 days	28.13	28.60	28.53	30.00	28.82
S_2 - 14 days	28.40	33.67	29.80	36.07	31.98
S_3 - 21 days	31.73	29.67	34.20	50.33	36.48
S_4 - 28 days	27.00	25.73	30.00	27.00	27.43
S_5 - 35 days	21.07	21.00	21.73	21.17	21.24
Mean	28.08	30.74	29.24	32.87	23.23

CD (P=0.05) : Cultivars : 3.19 Storage durations : 2.59 Cultivars × Storage durations : 6.36

observed during storage of carnation cultivars Elsy and Oriana (Garrido *et al.,* 10; Garrido *et al.,* 8). The un-rooted cuttings that were kept for 35 days (S_5) had the least number of roots (21.24 roots) as compared to those stored for 21 days (S_3). Van de Pol and Vogelezang (15) concluded that the storage of carnation cuttings at temperatures above 0°C promoted root initiation without unfavourable effects, provided that storage period in relation to the temperature does not last too long. The significant interaction between cultivars and storage durations on the number of roots have also been reported by several workers (Van de Pol and Vogelezang, 15; Garrido *et al.,* 9; Arteca *et al.,* 2; Ropez and Runkle, 14; and Agullo-Anton *et al.,* 1). The changes in auxin concentration at the rooting zone occurring during and/or after storage might be responsible for the changes observed in the rooting. Zencirkiran (16) also reported that cold storage of un-rooted cuttings of carnation cultivars Dianora and Vittorio at 0 ± 0.5°C for 2-3 months had good rooting rate.

Length of the roots (cm)

The length of the roots varied only with the storage durations (Table 3). Cuttings stored for 14 days (S_2) had the longest roots (3.43 cm), while those stored for 35 days (S_5) had minimum root length (2.59 cm). This might be due to some changes occurred in the cuttings during the storage period which modified the rooting process in the cuttings. The variation in endogenous auxin level could have occurred during the rooting which was capable of nullifying the impact of storage (Garrido *et al.,* 9 and 10).

Percentage of healthy rooted cuttings

The percentage of healthy rooted cuttings showed significant differences on the carnation cultivars examined (Table 4). Cultivars White Wedding and Farida recorded better results as compared to cultivars Niva and Madras. Zencirkiran (16) observed that the survival rates of stored cuttings influenced by the cultivars. In interaction, the percentage of healthy rooted cuttings of all four cultivars decreased with the increase in storage durations. Cuttings may deteriorate with extended storage due to excess respiration, light exclusion, exposure to extreme temperatures, moisture loss and ethylene accumulation. This might be the reasons for the decrease in survival rates of the cuttings. With the increase in storage durations, there is extensive loss in weight of the cuttings which determines the performance of the cuttings after storage. It has also been observed that there was deterioration of the cuttings not taking root after the storage which was characterized by the yellowing and necrosis of the foliage that proved to be a limiting factor (Conover, 3; Eisenberg *et al.,* 6; and De Almeida and Pivetta, 4). However, the survival percentage of the cuttings ranged from 80 to 90 per cent in all the cultivars were noticed even after 35 days of storage. Better performance might be due to use of best fertilizer module or rather with the highest dose of NPK fertilizers that attributed to the sufficient roots visible and maintained the quality of cuttings and its subsequent rooting even after 35 days of storage.

Table 3 : Effect of storage of different carnation cultivars at 2°C for different durations on root length (cm).

Cultivars / Storage Durations	White Wedding (V_1)	Farida (V_2)	Niva (V_3)	Madras (V_4)	Mean
S_0 - Control	2.33	1.88	1.92	2.45	2.14
S_1 - 7 days	3.91	3.01	2.58	3.30	3.20
S_2 - 14 days	3.51	3.44	3.31	3.45	3.43
S_3 - 21 days	2.85	2.03	3.33	3.85	3.01
S_4 - 28 days	2.41	2.85	3.53	2.62	2.86
S_5 - 35 days	3.03	2.62	2.09	2.61	2.59
Mean	3.00	2.64	2.79	3.05	2.87

CD (P=0.05) : Cultivars : NS Storage durations : 0.48 Cultivars × Storage durations : NS

Table 4 : Per cent rooting of cuttings of different cultivars of carnation as influenced by storage at 2°C for different durations.

Cultivars Storage Durations	White Wedding (V_1)	Farida (V_2)	Niva (V_3)	Madras (V_4)	Mean
S_0 - Control	99.33 (9.97)	96.67 (9.83)	93.00 (9.64)	100.00 (10.00)	97.25 (9.86)
S_1 - 7 days	100.00 (10.00)	100.00 (10.00)	84.67 (9.20)	100.00 (10.00)	96.17 (9.80)
S_2 - 14 days	100.00 (10.00)	100.00 (10.00)	90.00 (9.49)	100.00 (10.00)	97.50 (9.87)
S_3 - 21 days	93.33 (9.66)	95.33 (9.76)	90.00 (9.49)	98.00 (9.90)	94.17 (9.70)
S_4 - 28 days	98.64 (9.93)	100.00 (10.00)	95.33 (9.76)	94.00 (9.69)	96.99 (9.85)
S_5 - 35 days	99.31 (9.97)	95.45 (9.77)	97.96 (9.90)	88.65 (9.41)	95.34 (9.77)
Mean	98.44 (9.92)	98.19 (9.89)	91.83 (9.58)	96.78 (9.83)	-

*Figures in parenthesis are square root transformed values

CD (P=0.05) : Cultivars : 0.09 Storage durations : NS Cultivars × Storage durations : 0.22

Sugar analysis

Analysis of sugars content in the cuttings showed non- significant differences with storage durations (Table 5). The present results are in agreement with the findings of Rajapakse and Kelly (12) where the stem starch reserves in chrysanthemum cuttings did not show a clear relationship between the storage potential. Agullo-Anton *et al.* (1) proposed a model of auxin-sugar interactions in adventitious root formation (ARF) in carnation and stated that cold storage brings forward root induction and sink establishment which promoted by the accumulation of auxins and not sugars. A negative relationship exists between nitrogen and soluble carbohydrate concentrations in the cuttings. Similar results were observed in chrysanthemum cuttings (Druege *et al.,* 5).

Table 5: Initial sugar content (%) of un-rooted cuttings of four carnation cultivars prior to storage at 2°C for different durations.

Cultivars	Total sugar (%)	Reducing sugar (%)	Non-reducing sugar (%)
White Wedding (V_1)	1.04	0.02	1.02
Farida (V_2)	0.99	0.02	0.97
Niva (V_3)	1.02	0.02	1.00
Madras (V_4)	1.02	0.02	0.99

Conclusively, un-rooted cuttings of carnation packed in cellophane lined box can be stored at 2°C temperature and 75 % relative humidity for 35 days without significant reduction in the quality and quantity of rooted cuttings.

REFERENCES

1. Agullo-Anton, M. A., Sanchez-Bravo, A. M. and Druege, U. (2011). Auxins or Sugars: What makes the difference in the adventitious rooting of stored carnation cuttings? *J. Plant Growth Regul.* **30** : 100-113.
2. Arteca, R. N., Arteca, J. M., Wei, W. T and Schlagnhaufer, C. D. (1996). Physiological, biochemical, and molecular changes in Pelargonium cuttings subjected to short-term storage conditions. *J. Amer. Soc. Hort. Sci.,* **121** (6) : 1063–1068.
3. Conover C. A. (1976). Postharvest handling of rooted and un-rooted cuttings of tropical ornamentals. *HortSci.,* **11** : 127-128.
4. De Almeida, J. B. S. A. and Pivetta, K. F. L. (2003). Effect of storage of cuttings on the rooting of different cultivars of cut chrysanthemums (*Dendranthema grandiflora* Tzvelev) for two different seasons. *Acta Hort.,* **624** : 379-384.
5. Dreuge, U., Zerche, S., Kadner, R. and Erns, M. (2000). Relationship between nitrogen status, carbohydrate distribution, and subsequent rooting of chrysanthemum cuttings as affected by pre-harvest nitrogen supply and cold storage. *Ann. Bot.,* **85** : 687-701.
6. Eisenberg, B. A., Staby, G. L. and Fretz, A. T. (1978). Low pressure storage and refrigerated storage of rooted and unrooted ornamental cuttings. *J. Amer. Soc. Hort. Sci.,* **103** (6) : 732-737.
7. Faust, J. E. and Enfield, A. L. (2010). Effect of temperature and storage duration on quality and

rooting performance of poinsettia (*Euphorbia pulcherrima* 'Prestige Red') cuttings. *Acta Hort.* **877** : 1799-1807

8. Garrido, G., Arnao, M. B., Acosta, M. and Sanchez-Bravo, J. (2003). Polar transport of indole-3-acetic acid in relation to rooting in carnation cuttings: influence of cold storage duration and cultivar. *Biologia Planta,* **47** (4) : 481-485.
9. Garrido, G., Cano, E. A., Acosta, M. and Sanchez-Bravo, J. (1996). Influence of cold storage period and auxin treatment on the subsequent rooting of carnation cuttings. *Scientia Horti,* **65** : 73-84.
10. Garrido, G., Cano, E. A., Acosta, M. and Sanchez-Bravo, J. (1998). Formation and growth of roots in carnation cuttings: influence of cold storage period and auxin treatment. *Scientia Horti,* **74**: 219-231.
11. Poole, R. T. and Conover, C. A. (1988). Storage of philodendron and pothos cuttings. *Proc. Florida State Hort. Soc.,* **101** : 313- 315.
12. Rajapakse, N. and Kelly, J. W. (1995). Cultivar differences with respect to storage potential and carbohydrate status of rooted chrysanthemum cuttings. *Acta Hort.* **405** : 427-434.
13. Rapaka, V. K., Faust, J. E., Dole, J. M. and Runkle, E. S. (2007). Diurnal carbohydrate dynamics affect post harvest ethylene responsiveness in portulaca (*Portulaca grandiflora* 'Tubi Deep Rose') unrooted cuttings. *Postharvest Biol. Technol.,* **44** : 293-299.
14. Ropez, G. R. and Runkle, E. S. (2008). Low-temperature storage influences morphological and physiological characteristics of non-rooted cuttings of New Guinea impatiens (*Impatiens hawkeri*). *Postharvest Biol. Technol.,* **50** : 95–102.
15. Van de Pol, P. A. and Vogelezang, J. V. M. (1983). Accelerated rooting of carnation 'Red Baron' by temperature treatment. *Scientia Hort.,* **20** : 287-294.
16. Zencirkiran, M. (2010). Cold storage of rooted and non-rooted carnation cuttings. *African J. Biotech.,* **9** (24): 3603-3606.

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