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Effect of Wrapping Materials and Cold Storage Durations on Keeping Quality of Cut Flowers of *Ornithogalum Thyrsoides* Jacq

KEYWORDS: Ornithogalum, wrapping material, spike, storage

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ABSTRACT *The effect of different wrapping material and cold storage durations (3, 6, 9 and 12 days) at 4^{0}C on keeping quality of Ornithogalum was investigated. Among different wrapping materials (polyethylene, newspaper, cellophane, butter paper, low density polyethylene (LDPE) and high density polyethylene (HDPE)), cellophane proved promising in improving the keeping quality of cut spikes. The keeping quality of unpackaged cold stored cut spikes was highly deteriorated and decreased with increase in storage duration. Cut stems wrapped in cellophane and stored recorded maximum water uptake with less number of unopened florets. This material further increased floret size and vase life of cut stems. Cold storage of spikes for 3 days with cellophane wrapping maintained good keeping quality with improved floret opening, floret size and appearance. Thus, ornithogalum spikes can be best stored up to 3 days at 4^{0}C in modified atmosphere packaging with cellophane.*

INTRODUCTION

Chincherinchee (*Ornithogalum thyrsoides* Jacq.) is an ornamental bulbous plant and belongs to the family Hyacinthaceae. It is native to South Africa. Chincherinchee is suitable for cut flower, herbaceous border, naturalizing wild gardens, rockery, pot culture, bouquets and flower arrangements. Scapes even if cut after complete drying on the plant, look beautiful, lasted long and can be used in dry decoration. It possesses relatively longer vase life too than most of the other commercial cut flowers. Appropriate packaging of cut flowers for optimum duration offers potential advantage of extending their vase life and maintaining flower quality. It is immensely important to determine the optimum duration for storage of cut flowers that keeps the quality and potential vase life at its best. Thus the present experiment was conducted to investigate the effect of different wrapping material and storage durations on the quality of ornithogalum cut spikes in order to evolve an optimum storage technique.

MATERIALS AND METHODS

The experiment was conducted at the Department of Floriculture and Landscaping, Dr. Y.S. Parmar University of Horticulture and Forestry, Nauni, Solan. Fresh cut spikes of Ornithogalum were obtained from experimental farm. Cut stems of chincherinchee (more than 20 cm long) were harvested when lower most florets start showing colour. The experiment was laid out in Factorial Completely Randomized Design with 7 wrapping materials and 4 storage durations replicated thrice.

The spikes were grouped into bundles of 10 spikes each and packaged in different wrapping material. The packages were stored in cold storage at 4^{0}C temperature for 3, 6, 9 and 12 days. The bundles of cut spikes without wrapping were also kept in cold storage as control. After the storage bottom 2.5 cm portion of the basal end was re-cut under water to remove surface blockages and the basal ends were dipped in distilled water and kept for taking observations.

The observations were recorded on amount of solution consumed (ml/stem), Percent of unopened florets (number of unopened florets per spike / Total number of florets per spike x 100), Vase life (till 70% of the florets dry), Weight change (%) (Final weight (g) - Initial weight (g) /Initial weight (g) x 100) and Floret size (cm).

RESULTS AND DISCUSSION.

Maximum amount of solution (19.60, 15.73, 12.73 and 10.80 ml, respectively) consumed in cut stems of ornithogalum wrapped in cellophane for 3, 6, 9 and 12 days as compared to un wrapped ones (14.20, 11.93, 9.73 and 8.07 ml, respectively) as presented in Table 1.

Table 1. Effect of wrapping materials and storage durations on amount of solution consumed (ml/stem) and per cent of unopened florets by Ornithogalum cut flowers

Wrapping materials	Solution consumed (ml/stem) Storage durations (Days)					Un opened florets (%) Storage durations (Days)				
	3	6	9	12	Mean	3	6	9	12	Mean
Control(without wrapping)	14.20	11.93	9.73	8.07	10.98	4.08 (2.02)	4.21 (2.05)	4.36 (2.09)	4.46 (2.11)	4.28 (2.07)*
Polyethylene	19.00	15.33	12.60	10.40	14.33	3.62 (1.90)	3.69 (1.92)	3.80 (1.95)	4.89 (2.19)	4.00 (1.99)
News paper	16.07	13.20	10.33	9.40	12.25	3.92 (1.98)	4.03 (2.01)	4.15 (2.04)	4.21 (2.05)	4.08 (2.02)
Cellophane	19.60	15.73	12.73	10.80	14.72	3.53 (1.88)	3.62 (1.90)	3.75 (1.94)	3.87 (1.97)	3.69 (1.92)
Butter paper	18.60	15.20	12.47	10.40	14.17	3.75 (1.94)	3.81 (1.95)	3.89 (1.97)	3.95 (1.99)	3.85 (1.96)
Low density polyethylene (LDPE)	17.53	14.80	12.07	10.00	13.60	3.77 (1.94)	3.89 (1.97)	3.95 (1.99)	4.05 (2.01)	3.92 (1.98)
High density polyethylene (HDPE)	17.20	14.60	12.00	9.80	13.40	3.86 (1.96)	3.90 (1.98)	4.03 (2.01)	4.10 (2.03)	3.97 (1.99)
Mean	17.46	14.40	11.71	9.84	-	3.79 (1.95)	3.88 (1.97)	3.99 (2.00)	4.22 (2.05)	-

C.D. (P=0.05) Treatment = 0.29;
Storage durations= 0.22
Treatment = 0.28;
Storage durations =
Interaction = 0.58
0.21; Interaction = 0.55
*Figures in parentheses are square root transformed values

Wrapping of cut stems in cellophane created optimum conditions that maintain physiological systems healthy and finally led to normal absorption of solution in the vase after storage. Wrapping of cut stems in cellophane resulted in longer vase life that may leads to more vase solution absorbed by cut stems as they stay maximum days in their holding solution. This wrapping material might possesses low air diffusion rate across the film compared to other films. Initially continued metabolic activities specially respiration and transpiration of flowers, might have led to the evolution of beneficial equilibrium of modified atmosphere (EMA) with high CO_2 and low O_2 and high relative humidity within the package. This further might have caused closure of stomata and minimized the respirational loss of carbohydrates as well as transpirational loss of water from cut spikes (Zeltseret al., 2001). This would further contribute towards minimal cell damage during storage and retain normal cell condition after storage, which ultimately resulted into normal water uptake. In case of unwrapped spikes and other wrapping material, undesired gaseous equilibrium appear to have caused higher cell damage resulting in poor water uptake as also earlier observed by van Doorn and Hont (1994).

The cellophane wrapped and dry stored cut spikes for 3, 6, 9 and 12 days exhibited low percentage of unopened florets (3.53, 3.62, 3.75 and 3.87 %). Maximum percentage of unopened florets (4.08, 4.21, 4.36 and 4.46 %) was recorded in cut stems without wrapping as shown in Table 1.

The enhanced bud opening in cut flowers is associated with high cell turgidity (Torre et al., 1999) and up-regulation of optimum metabolic activities with high petal sugar status (Singh et al., 2005). The higher number of floret opening in cellophane wrapped spikes could be attributed to turgidity of the spikes on account of higher water uptake and optimum cell metabolism with sustainable levels of carbohydrates in florets. Similar effects of improved bud opening with modified atmosphere packaging have been reported by Meir et al. (1995), Grover et al. (2005). In case of other wrapping material, the depletion of carbohydrates might have resulted into failure of florets to open.

The cut stems wrapped in cellophane sheet for 3, 6, 9 and 12 days exhibited longest vase life (14.40, 14.20, 13.93 and 13.53) followed by cut stems wrapped in polyethylene and butter paper as compared to unwrapped ones (13.00, 12.93, 12.33 and 12.00) as presented in Table 2.

This might be due to the fact that this wrapping material reduces the rate of respiration by creating a sort of modified atmosphere with limited oxygen and higher carbon dioxide concentrations. The limited oxygen concentration can retard the rate of respiration as oxygen is needed for this process. This condition in turn reduces depletion of stored food and helped to supply adequate energy to the florets for successful opening and to be larger in diameter (Nowak and Rudnicki, 1984). The more stored food in the cut stems the longer the vase life, as vase life is a function of stored food as well. The moisture retentive nature of this wrapping material prevents moisture loss and increase the relative humidity inside the wrapped cut stems. This helps to maintain turgidity of cut stems by retaining the moisture level in the tissue even after harvest. Normally, cut stems deteriorate from the original appearance and reduced the vase life when there is excessive loss of moisture apart from lack of photosynthates. When moisture loss is minimized using these wrapping material, there will be better maintenance of appearance and extended vase life of cut stems (Goszczynska & Rudnicki, 1988). The modified atmosphere created by wrapping material inhibits ethylene synthesis in the stored materials. This helps to delay senescence of flowers that lead to flower fading and shortening of vase life as ethylene causes senescence. The results are in line with the other worker's reports viz., Joti and Balakrishnamoorthy (1999); Singh and Mirza (2004); Jain et al. (2006) in rose; Bhat et al. (1999) in chrysanthemum; Beura and Singh (2003) in gladiolus; Sindhu and Pathania (2003) in Asiatic hybrid lily; Beshir (2008); Sharma et al. (2008) in Asiatic hybrid lily cv. 'Apeldoorn'.

The cut stems wrapped in cellophane sheet for 3, 6, 9 and 12 days exhibited minimum per cent weight loss (1.11, 1.68, 2.07 and 2.72%) as compared to unwrapped ones (4.04, 11.25, 15.06 and 16.65 %) as presented in Table 2.

Table 2. Effect of wrapping materials and storage durations on vase life (days) and weight loss in Ornithogalum cut flowers

Wrapping materials	Vase life (Days) Storage durations (Days)					Weight loss (%) Storage durations (Days)				
	3	6	9	12	Mean	3	6	9	12	Mean
Control(without wrapping)	13.00	12.93	12.33	12.00	12.57	4.04 (2.01)	11.25 (3.35)	11.25 (3.35)	16.65 (4.08)	11.75 (3.33)*
Polyethylene	14.13	13.93	13.67	13.27	13.75	1.92 (1.39)	2.48 (1.57)	2.48 (1.57)	3.44 (1.85)	2.68 (1.63)
News paper	13.80	13.40	12.87	12.47	13.13	3.54 (1.88)	4.30 (2.07)	4.30 (2.07)	7.04 (2.65)	5.05 (2.23)
Cellophane	14.40	14.20	13.93	13.53	14.02	1.11 (1.05)	1.68 (1.30)	1.68 (1.30)	2.72 (1.65)	1.90 (1.36)
Butter paper	14.20	13.87	13.53	13.13	13.68	2.14 (1.46)	2.69 (1.64)	2.69 (1.64)	4.11 (2.03)	3.01 (1.72)
Low density polyethylene (LDPE)	14.00	13.67	13.33	12.87	13.47	2.48 (1.57)	3.18 (1.78)	3.18 (1.78)	4.76 (2.18)	3.57 (1.88)
High density polyethylene (HDPE)	13.67	13.53	13.13	12.67	13.25	2.85 (1.69)	3.64 (1.90)	3.64 (1.90)	5.41 (2.33)	4.06 (2.00)
Mean	13.89	13.65	13.26	12.85	-	2.58 (1.58)	4.17 (1.95)	4.17 (1.95)	6.31 (2.40)	-

C.D. (P=0.05) Treatment = 0.15;
Storage durations= 0.11
Treatment = 0.21;
Storage durations =
Interaction = 0.29
0.16; Interaction = 0.42

*Figures in parentheses are square root transformed values

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Reduction of weight loss in storage might be due to the reason that these wrapping materials prevented the water loss and maintained high relative humidity which helped in reducing weight loss from cut stems (Beura & Singh, 2003). Weight loss may also be associated with the rate of respiration that leads to exhaustion of assimilate already accumulated in the stem tissues. In addition to storage temperature the composition of the atmosphere created by the wrapping materials determines the rate of respiration. Moreover, modified atmosphere condition maintains lower temperature due to restricted air movement (Zeltzeret al., 2001). As a result the optimum modified conditions in the wrapped cut stems minimized weight loss to the minimum. The present finding got the support from the findings of Beshir (2008) and Sharma et al. (2008) while working with Asiatic hybrid lily cv. 'Apeldoorn'.

The cellophane wrapped spikes for 3, 6, 9 and 12 days storage duration exhibited maximum floret size (4.05, 4.02, 3.99 and 3.96 cm) followed by polyethylene and butter paper. Minimum floret size (3.81, 3.79, 3.79 and 3.77cm) was recorded in those cut stems stored without wrapping material as presented in Table 3.

Table 3. Effect of wrapping materials and storage durations on floret size (cm) in Ornithogalum cut flowers

Wrapping materials	Floret size (cm) Storage durations (Days)				
	3	6	9	12	Mean
Control (without wrapping)	3.81	3.79	3.79	3.77	3.79
Polyethylene	4.01	3.98	3.95	3.92	3.97
News paper	3.90	3.87	3.86	3.84	3.87
Cellophane	4.05	4.02	3.99	3.96	4.00
Butter paper	4.02	3.97	3.94	3.92	3.96
Low density polyethylene (LDPE)	3.95	3.93	3.91	3.89	3.92
High density polyethylene (HDPE)	3.94	3.92	3.89	3.88	3.91
Mean	3.95	3.93	3.90	3.88	

C.D. (P=0.05) Treatment = 0.02;
Storage durations= 0.02
Interaction = NS

An enhanced water uptake by the spikes packaged in cellophane might have increased the cell turgidity and cell enlargement in the florets. Further, the maintained levels of sugars in the petals of cellophane packaged spikes (Singh et al., 2007), facilitated higher rate of respiration necessary for cell division, cell enlargement and for providing 'C' skeleton for the tissue structure (Ho & Nichols, 1977) there by contributing to floret expansion. The senescence processes undergo with the expense of stored food of the cut stems. The longer the periods of storage of those cut stems more the depletion of stored food is there. Hence, cut stems stored for longer periods with reduced amount of energy resulted in flowers of smaller diameter and shorter vase life as compared to those stored for short term durations. The present findings got support from the findings of Beshir (2008) and Sharma et al. (2008) who worked with Asiatic hybrid lily cv. 'Apeldoorn'.

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