Journal of Tropical Agriculture 62(2): 165-171 , 2024

Vase life studies in *Dracaena fragrans* cv. 'Massangeana' as influenced by storage conditions and packaging materials

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Received on 17 January 2024; received in revised form 23 August 2024, accepted 23 September 2024.

Abstract
Dracaena fragrans cv. 'Massangeana', belonging to the family Asparagaceae is one of the most exported foliage plants from India. The present study was undertaken with the objective to standardise appropriate storage condition and packaging materials to extend the vase life of *Dracaena fragrans* cv. 'Massangeana'. After harvest, the leaves were subjected to various precooling treatments and the best treatment was subjected to packaging and storage studies *viz.*, using polyethylene and polypropylene as packaging materials and storage in both cold storage and refrigerated conditions. Packaging in polypropylene sleeves with no perforations and storage for one week under cold storage conditions resulted in a better vase life (20.50 days). A minimum percentage loss in weight (18.64%) was observed in leaves stored under cold storage conditions after packing in perforated polyethylene sleeves.The chlorophyll content among the leaves was found to be maximum in leaves packed in polypropylene sleeves and stored under cold storage conditions (1.95 mg g^{-1}). The highest rate of respiration after one week of storage was observed in leaf samples stored in refrigerated condition without any packaging material (1.25%). The study revealed that packaging *Dracaena fragrans* cv. 'Massangeana' leaves in polypropylene sleeves with no perforations and storage for one week under cold storage conditions resulted in better vase life and reduced metabolic activities, which can be utilised to enhance the export potential of the leaves.

Keywords: Cut foliage, *Dracaena fragrans* cv. 'Massangeana', respiration, storage, vase life

Introduction

Cut foliages are essential components of the floricultural industry and are used extensively as fillers for decoration in floral compositions. The indoor foliage plants are not only decorative but are also beneficial in absorbing potentially harmful gases and cleaning the air inside the buildings (Pacifici et al., 2007).

Dracaena is one of the most important cut greens traded worldwide and used for its beautiful foliage. The word 'dracaena' is derived from the Romanised form of the Greek word 'Drakaina', meaning female dragon. *Dracaena fragrans* (corn plant) belonging to the family Asparagaceae are popular foliage plants. *Dracaena fragrans* cv. 'Massangeana', characterised by its sword-shaped dark green leaves with a yellow stripe along the centre, is one among them (Aziz et al., 1996). They are usually harvested when the leaf attains a length of about 75-85 cm. It is one of the most exported foliage plants from India, and the main destinations are Middle East countries and Europe.The export value of cut foliage both in fresh and dry forms account for 44 % of the total export of floriculture products from India in 2022-23 (Shamna, 2024).

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Cut foliage is highly perishable and tends to deteriorate in quality before reaching the customer. Improved postharvest techniques are immensely important in the reduction of losses and increasing the market value in the export of floricultural produce (Ferrante et al., 2002; Pacifici et al., 2007). Packing the cut foliage with an appropriate packing material protects them from physical damage, water loss and detrimental external conditions during transport by regulating water loss and respiration rates (Anand et al. 2020).

Since Kerala has a significant area devoted to the plantation industry, the commercialisation of cut foliage as an intercrop is a remunerative option. Many rubber farmers, from Kerala have successfully started intercropping with foliage species. Despite the production and export of cut foliage from Kerala, there is a lack of research studies on post harvest activities compared to those conducted on cut flowers.

Keeping the above facts in view, the present study entitled 'Vase life studies in *Dracaena fragrans* cv. 'Massangeana' as influenced by various storage conditions and packaging materials' was attempted with the objective of developing a cost-effective storage protocol to extend the vase life.

Materials and methods

Mature, healthy and undamaged leaves of *Dracaena fragrans* cv. 'Massangeana' were harvested from the plants in the poly house maintained by the Department of Floriculture and Landscaping, College of Agriculture, Vellanikkara. The experiment was laid out in a completely randomised design with two factors, namely storage conditions (Factor 1) and packaging materials (Factor 2), replicated twice.

Different treatments under each factor were as follows:

i) Storage conditions (Factor 1)

S_1: Storage in ambient conditions

S_2: Cold storage (12±1°C)

S_3: Refrigerated storage (4±1°C)

ii) Packaging materials (Factor 2)

P_1: 200 gauge thick non-vented Polyethylene

P_2: 200 gauge thick non-vented Polypropylene

P_3: 200 gauge thick perforated Polyethylene

P_4: 200 gauge thick perforated Polypropylene

P_5: Control (pre cooling only)

Replications: 2

The leaves were subjected to vase life studies after pre-cooling and storage and the effect of different packaging materials on the leaves was determined by recording the observations on a weekly basis.

Vase life (days)

The vase life was assessed daily after the pre-cooling treatment. One leaf from each treatment was placed in bottles of 150 mL capacity filled with distilled water. Vase life was determined based on visual changes like tip necrosis that extended beyond one centimetre, curling of leaves etc. and was recorded in days.

Change in fresh weight during vase life (%)

The change in fresh weight during vase life was calculated by recording the daily weight change from the day of storage up to the end of vase life. The cumulative weight loss was calculated from the following equation:

$$\text{Physiological loss of weight (\%)} = \frac{\text{Initial weight - Final weight}}{\text{Initial weight}} \times 100$$

Chlorophyll content (mg g^{-1})

The chlorophyll content of the leaves was calculated using the method suggested by Arnon (1949). The matured leaves were collected and cut into pieces by eliminating the midrib. Two hundred milligram of the sample was thoroughly ground using mortar and pestle, with 10 mL of 80% acetone. The ground material was then centrifuged for 10 minutes at 3000 rpm. The supernatant was collected and made up to

25 mL using 80% acetone. The optical density of the made up solution was measured at wavelengths 640 nm and 663 nm. The total chlorophyll was estimated using the following formula and expressed as mgg^{-1} of fresh weight.

Total chlorophyll =

$$(8.02 \times \text{OD at 663 nm}) - (20.2 \times \text{OD at 645 nm}) \times \frac{V}{1000 \times W}$$

Where,

OD - Optical density
V - Final volume of supernatant
W - Weight of the leaf sample taken in gram

Rate of respiration (% CO_2 evolved)

The rate of respiration was measured with a gas analyser (PBI Dansensor, CheckMate 9900, Denmark). The leaf samples were sealed in polyethylene sleeves and a hypodermic needle was used to draw air samples for 15 seconds through a septum pasted on the sealed sleeve. The rate of respiration was expressed as CO_2 evolved in percentage.

Results and discussion

Vase life (days)

The vase life of leaves subjected to various treatments exhibited notable variations based on the packaging materials and storage conditions involved. The maximum vase life was exhibited by leaf samples which were packed in non-vented polypropylene and stored in cold storage conditions for one week (20.50 days) (Table 1). This was followed by leaves which were stored in non-vented polyethylene sleeves and stored for one week under cold storage (17.50 days). The leaves stored under refrigerated conditions showed symptoms of chilling injury during storage, preventing them from undergoing vase life studies. The lowest vase life was observed in leaves stored in ambient condition (3.50 days). As the storage duration increased, the vase life of the leaves showed a decrease in all treatments under all conditions.

These results are in conformity with the works performed by Paulin (1976) and Mor (1989) in cut

Table 1. Effect of storage conditions and packaging materials on the vase life (days) of *Dracaena fragrans* cv. ‘Massangeana’

Storage conditions	Packaging materials	Vase life (days)			
		1 WAS	2 WAS	3 WAS	4 WAS
S_1-Ambient	P_1	8.5^{de}	4.5^{e}	4.5^{c}	-
	P_2	9.5^{d}	6.5^{d}	2.5^{d}	-
	P_3	7.5^{ef}	4.5^{e}	3.5^{cd}	-
	P_4	7.5^{ef}	3.5^{e}	2.5^{d}	-
	P_5	3.5^{g}	-	-	-
S_2 -Cold Storage	P_1	17.5^{b}	11.5^{b}	6.5^{b}	3.5
	P_2	20.5^{a}	14.5^{a}	8.5^{a}	3.0
	P_3	14.5^{c}	8.5^{c}	6.0^{b}	2.0
	P_4	14.0^{c}	7.0^{d}	4.5^{c}	1.0
	P_5	6.5^{f}	-	-	-
S_3 -Refrigeration	P_1	-	-	-	-
	P_2	-	-	-	-
	P_3	-	-	-	-
	P_4	-	-	-	-
	P_5	-	-	-	-
CD (0.05)	S	0.803	0.59	0.59	-
	P	1.27	0.932	0.932	-
	S x P	1.796	1.318	1.318	-
CV	7.36	9.77	15.36		

*WAS- Weeks After Storage - No observation recorded. P_1: Non-vented polyethylene sleeves., P_2: Non-vented polypropylene sleeves., P_3: Perforated polyethylene sleeves., P_4: Perforated polypropylene sleeves., P_5: Control

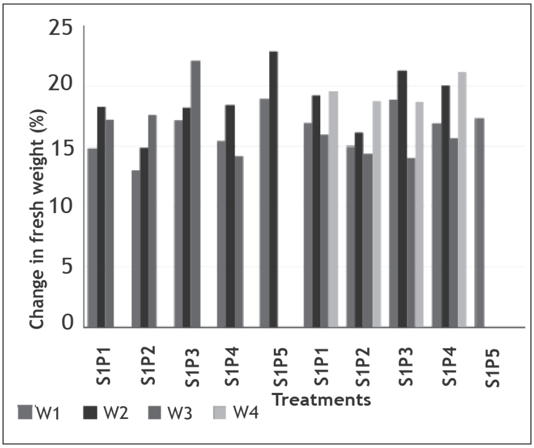

Figure 1. Effect of storage conditions and packaging materials on the change in fresh weight during vase life (%) of *Dracaena fragrans* cv. 'Massangeana'

tuberose spikes and Phavaphutanon and Ketsa (1989) in cut roses stored in cold storage conditions. When transferred to ambient conditions for the vase life studies, both studies showed an increased rate of metabolic activities such as respiration and ethylene evolution and further decreased the vase life.

In a study conducted by Kaushal (2020) using fern *Polystichum squarrosum*, it was observed that the cut fronds which were stored after wrapping in cellophane sheets for three days showed a superior vase life than the fronds which were stored for six days under the same conditions.

Change in fresh weight during vase life (%)

The fresh weight of leaves stored in different packaging materials was found to decrease as the storage duration increased. This is due to the increase in physiological loss of weight during various storage conditions. Among the leaf samples which were stored for one week under different conditions, the highest percentage change in fresh weight was recorded in leaves which were stored in control under the ambient conditions (18.90%). Change in fresh weight after one week of storage did not show significant interaction effect (Fig. 1).

Similar results were obtained in gerbera where the water absorption increased and fresh weight decreased with increasing period of dry storage (Sang, 1998) and in cut rose, the stems showed

Table 2: Effect of storage conditions and packaging materials on the chlorophyll content (mg g^{-1}) of *Dracaena fragrans* cv. 'Massangeana'

Storage conditions	Packaging materials	Chlorophyll content (mg g^{-1})			
		1 WAS	2 WAS	3 WAS	4 WAS
S_1-Ambient	P_1	1.69	1.63^{de}	1.57^{d}	1.43^{de}
	P_2	1.74	1.67^{d}	1.59^{cd}	1.47^{d}
	P_3	1.65	1.60^{ef}	1.53^{de}	1.44^{de}
	P_4	1.63	1.56^{f}	1.48^{ef}	1.35^{ef}
	P_5	1.56	1.50^{g}	1.38^{g}	1.27^{f}
S_2–Cold Storage	P_1	1.92	1.85^{b}	1.81^{a}	1.69^{a}
	P_2	1.95	1.94^{a}	1.84^{a}	1.60^{ab}
	P_3	1.85	1.76^{c}	1.66^{b}	1.49^{cd}
	P_4	1.85	1.75^{c}	1.64^{bc}	1.58^{bc}
	P_5	1.75	1.55^{fg}	1.44^{f}	1.25^{fg}
S_3 - Refrigeration	P_1	1.53	1.34^{i}	1.18^{i}	0.95^{h}
	P_2	1.51	1.41^{h}	1.26^{h}	1.15^{g}
	P_3	1.46	1.24^{j}	1.08^{j}	0.88^{h}
	P_4	1.42	1.21^{jk}	1.02^{k}	0.77^{i}
	P_5	1.36	1.16^{k}	1.01^{k}	0.52^{j}
CD (0.05)	S	0.022	0.025	0.025	0.046
	P	0.029	0.032	0.032	0.059
	S x P	NS	0.055	0.056	0.103
CV	1.40	1.67	1.84	3.83	

Means having different letter as superscript differ significantly within column continuous decrease in percent fresh weight in dry storage which was apparently due to loss of water from the cut flower as manifested by the deposition of water droplets on the inner surface of the polyethylene sleeves (Singh and Mirza, 2004).

A study to determine the most appropriate material for packaging in Asiatic lily was conducted by Beshir (2008), and it was concluded that the minimum weight loss in storage was observed in flowers wrapped in non-vented polyethylene sheets.

Chlorophyll content (mg g^{-1})

The chlorophyll content was found to decrease with the storage duration in all the treatments. The initial value of chlorophyll was noted as 1.96 mg g^{-1}. After the first week of storage, the chlorophyll content among the leaves was found to be maximum in leaves packed in polypropylene sleeves under cold storage conditions (1.95 mg g^{-1}) and the minimum value of chlorophyll was obtained in the leaves stored under refrigerated condition without any packaging material (1.36 mg g^{-1}) (Table 2). Generally, the chlorophyll content was observed to be highest in leaf samples stored under cold storage and minimum in leaves stored under refrigerated conditions.

The chlorophyll content of *Dracaena fragrans* cv. 'Massangeana' leaves is significantly influenced by various storage and temperature conditions. The leaves stored under refrigerated storage conditions showed visible symptoms of chlorophyll loss during the storage period.

In a study conducted by Punetha (2013) on the effect of various wrapping materials and storage duration on the chlorophyll content of cut rose cv. *Naranja*, it was observed that the chlorophyll content reduced gradually along the storage condition, but relatively lower compared to the other treatments wherein the rose flowers were wrapped in non vented polyethylene sleeves, which was on par with wrapping the flowers in cellophane sheet.

Similarly, cut carnation flowers packed in polypropylene at cold storage conditions recorded the highest chlorophyll content of carnation calyx on all the days of vase life study (Pranuthi et al., 2018).

Rate of respiration (% CO_2 evolved)

The rate of respiration gives a direct indication of the physiological condition of the living commodity. Respiration rate is expressed as CO_2 evolved in percentage and the observations were taken in weekly intervals. The respiration rates recorded were highest in case of the leaves stored in refrigerated conditions in all weeks (Figure 2).

The highest rate of respiration after one week of storage was observed in leaf samples stored in

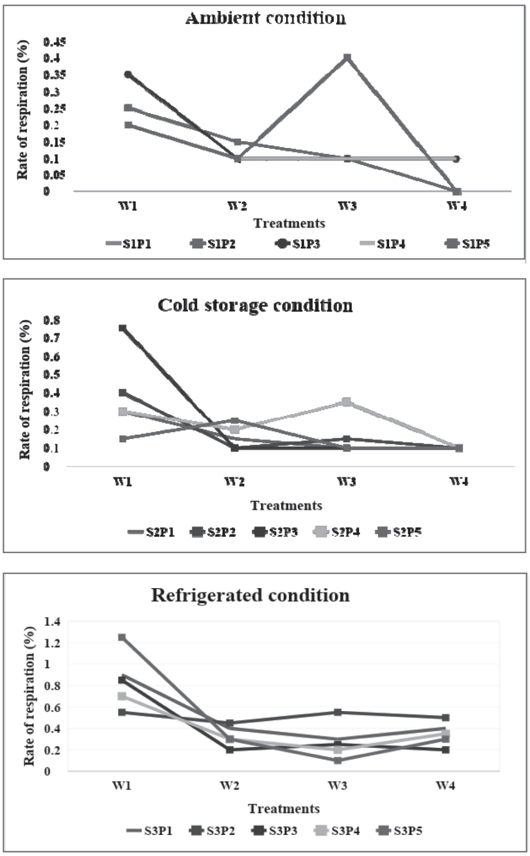

Figure 2. Effect of storage conditions and packaging materials on the rate of respiration (%) in *Dracaena fragrans* cv. 'Massangeana'

refrigerated condition without any packaging material (1.25%). This was followed by leaves which were packed in non-vented polyethylene sleeves and stored in refrigerated conditions (0.90%). The lowest rate of respiration was generally observed by leaves in the ambient storage condition.

Respiration can be used as a good index to predict the vaselife of flowers in a wide range of temperature conditions. In a study on soft shield fern (*Polystichum squarrosum*) conducted by Kaushal (2020), the rate of respiration was observed to be minimum in leaves which were subjected to cold storage conditions, when compared to the refrigerated storage. In cut Narcissus flowers, the respiration rate was exponentially increased over the temperature range of 0-25$^{\theta}$°C (De Costa et al., 2021).

Conclusion

From various observations, it could be concluded that a minimum percentage loss in weight (18.64%) was observed in leaves stored under cold storage conditions after packing in perforated polyethylene sleeves. Throughout the storage studies, the highest chlorophyll content was found to be present in leaves which were packed in both non-vented polyethylene (1.69 mg g^{-1}) and polypropylene sleeves (1.60 mg g^{-1}) and stored under cold storage conditions. The rates of respiration evolution showed a gradually declining trend throughout the storage period and after four weeks of storage, the leaves packed in polypropylene sleeves and control under ambient conditions showed the lowest rate of respiration compared to the other treatments.

The leaves stored under cold storage conditions exhibited better performance than those stored in ambient conditions.However, storing leaves in refrigerated conditions led to chilling injury as these leaves are tropical in origin. Additionally, an increase in storage duration resulted in a corresponding decrease in vase life and other important parameters.

Packaging in polypropylene sleeves with no perforations and storage for one week under cold storage conditions resulted in a better vase life as there was a reduction in the metabolic activities. This in turn retained the quality and appearance of the leaves, which are highly desirable to enhance the export potential of the leaves.

Acknowledgement

The research work forms a part of M.Sc. research programme of the first author and was funded by the Kerala Agricultural University.

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