The Bioscan 10(2): 695-698, 2015
AN INTERNATIONAL QUARTERLY JOURNAL OF LIFE SCIENCES
www.thebioscan.in

EFFECT OF PRE-STORAGE TREATMENTS, PACKAGING FILMS AND COLD STORAGE ON FLOWER QUALITY AND CHILLING INJURY IN TUBEROSE (*POLIANTHES TUBEROSA L.*) CUT SPIKES CV. PRAJWAL

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KEYWORDS
Thiadizuron
α-lipoic acid
Sucrose
Fresh weight
Chilling injury

Received on :
10.01.2015

Accepted on :
17.04.2015

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ABSTRACT
The investigations were conducted to study the effect of pre-storage pulsing and cold storage with different poly film packaging on flower quality of tuberose cut spikes. Pre-storage pulsing with TDZ and α-lipoic acid and storage with poly film packaging comprising of HDPE, LDPE and PP at 2°C temperature for a period of 15 days significantly influenced post storage quality and vase life of tuberose cut spikes. Tuberose cut spikes given pre-storage pulsing treatment with solution containing 100mg/L TDZ +15% sucrose or with 50mg/L α-lipoic acid + 15% sucrose for six hours, followed by packaging with HDPE 40 µ and stored at 2°C for 15 days significantly improved physiological parameters like retained higher fresh weight (96.29%), increased per cent of total dissolve solids (10.91°Brix), total soluble sugar level (15.01µg/mL) in florets tissue and vase life (7 days) as compared to all other treatments and control. These treatments further improved qualitative parameters like per cent floret opening (80%) and excellent overall quality (5%) with no symptoms of chilling injury. Tuberose cut spikes stored without any pulsing treatment, stored dry either without packaging or wet stored by holding in water were subject to severe chilling injury with inhibited bud opening after 15 days of cold storage.

INTRODUCTION

Tuberose (*Polianthes tuberosa* L.) cut spikes are highly popular during festivals or occasions like New Year day as well as inaugural or wedding ceremonies. India has an age old tradition of growing flowers for various aspects. Huge capital investment has been made by the growers for the production of cut flowers meant to be 100 per cent export oriented (Kumar *et al.*, 2012). Among various cut flowers, tuberose has been cultivated throughout the country. Adoption of proper post harvest treatments in cut flower is important to achieve good exportable quality. Thus, standardization and evaluation of proper technique of packaging and storage of tuberose is vital for development of market strategy and accessibility at international market for enhancing export potential. Storage of flowers at optimum stage and quality is important for high market value. Flower quality tends to decrease after dry storage of cut flowers (Van Doorn, 1999, Waithaka *et al.*, 2001). Wet storage ensures flower quality but only when stored for short duration as long duration storage results into increase in the stage of floret opening which again declines its market value. A modified atmosphere offers a viable option for long term storage of flowers. Different films like Polypropylene (PP), High Density Polyethylene (HDPE), Low Density Polyethylene (LDPE), *etc.* possess differential air permeability property and thus differentially influence the storage quality of flowers. The key to successful modified storage of fresh flowers is to use packaging films of suitable permeability so as to ensure and establish the optimal Equilibrium Modified Atmosphere (EMA) at low temperature (Day, 2001). Thus, there is need to develop proper technology for storage of tuberose cut spikes when there is market glut causing market fluctuations. Further, Waithaka *et al.*, 2001 had indicated deterioration in flower quality and floret opening of cut tuberose spikes owing to cold storage. Although, research on post harvest aspects is being conducted, systematic research on storage of cut tuberose spikes is meager. Hence, the experiment was planned to standardize storage technology using pulsing and packaging films for prolonging storage of tuberose cut spikes.

MATERIALS AND METHODS

The experiment was conducted at the Department of Floriculture and Landscape Architecture, ASPEE College of Horticulture and Forestry, NAU, Navsari Gujarat, during 2010 - 2011. The fresh tuberose cut spikes were harvested at early morning hours when lower most two florets opened and then basal part of stem kept in bucket containing water. Tuberose cut spikes were sorted and selected for uniform sizes (80 ± 5) cm and fresh weight (90 ± 5g).The experiment was laid out in the completely randomized design with Factorial concept (FCRD) consisting of eighteen treatments including control.Eighteen treatment combinations of pre-storage pulsing (T_0-water, T_1- 50 mg/L α-lipoic acid + 15% sucrose and T_3-100 mg/L TDZ + 15% sucrose) and storage method(P_1-

40 µ LDPE packaging, P_2-40 µ HDPE packaging, P_3-20 µPP packaging, P_4-40 µ PP packaging, P_5-CFB with no polyfilm packaging and P_6-holding in water) were prepared. Pulsing treatment was given for six hours and thereafter, pulsed spikes were divided into bundles each having10 spikes. Equal number of bundles well packed with different poly films, in CFB box (without any polyfilm packing as controls) and same number of bundles were held in and then immediately placed at 2ºC cold storage for a period of 15 days. 15 days later cut spikes were removed from cold storage, unpackaged and held in distilled water for recording observations. Per cent fresh weight, per cent floret opening, flower quality and vase lifein tuberose flowers were estimated according to Waithaka *et al.*, 2001. TDSof the petal tissue was measured by using hand refractometer, TSSin the petal tissue was determined as per the method of Franscistt *et al.* (1971) and chilling injuryin the spikes was estimated as described by Reid *et al.* (2009).

RESULTS AND DISCUSSION

Pulsing, packaging and their interactions significantly influencedfresh weight retention and floret opening as recorded at different days after storage (DAS). Significantly, maximum fresh weight (96.29 %) was observed in treatment combination comprising of pre-storage pulse treatment of 100mg/L TDZ and packaging with HDPE 40 µ (T_2P_2), which was at par with treatment α-lipoic acid 50mg/L + HDPE 40µ (T_1P_2,94.92%)at 3rd DAS. Further, significantly maximum TDS (10.91 ºBrix) and total soluble sugars (15.01 µg/mL) were also recorded in the same treatment combinations at 2ndDASwhile minimum TDS (6.96 °Brix)and total soluble sugars (8.76 µg/ml) were recorded in control (T_0P_3), Table 1. Per cent fresh weight retention is known to be dependent on maintenance of carbohydrate level and water uptake in cut flowers. Role of sucrose in influencing osmotic potential of petal cell and maintaining better balance in flowers is well known (Ho and Nichols, 1975). Thus, sucrose being taken up through vascular tissue indicated by water uptake (during pre-storage pulse) and upon accumulation in the petal cells as indicated by high TSS and TDS levelscontributed in high fresh weight retention (Table 1) (Ho and Nicholus, 1975 and Mayak and Halevy, 1974). Further, minimal respirational loss of carbohydrates as well as transpirational loss of water from the polyfilms sealed packaged produce occurs that retains its fresh weight (Zeltzer *et al.*, 2001, Kadar and Saltveit, 2003). Thus, sealed packaging of tuberose cut spikeswith poly films created passive modified atmosphere like conditions that contributed in fresh weight retention after cold storage.HDPE and PP were more effective in retaining fresh weight loss as the permeability of these films to CO_2 and water vapour is lower as compared to LDPE (Farber *et al.*, 2003).

Maximum chilling injury (94%) was recorded in control, followed by wet stored spikes (P_6) irrespective of pulsing treatment as recorded on 15thday of cold storage (Fig. 2). The development of chilling injury symptoms in tuberose cut spikes stored at 2ºC was inhibited by packaging with poly films. Higher per cent of chilling injury with increase in duration was observed in untreated (Control) cold stored spikes kept without

Table 1: Effect of pre-storage pulsing, packaging and storage (2ºC) on Floret opening (%), TDS (°Brix) in petals tissue, total vase life (days) in tuberose cut spikes cv. Prajwal

Treatments	Per cent fresh weight (%) of tuberose spikes 3 DAS in vase				TDS(°Brix) 2nd DAS			
	(T_0) No pulsing	(T_1) α-lipoic acid 50 mg/L	(T_2) TDZ 100 mg/L	(P) mean	(T_0) No pulsing	(T_1) α-lipoic acid 50 mg/L	(T_2) TDZ 100 mg/L	(P) mean
P_1 LDPE-40 μ	81.6	91.19	95.13	89.31	9.46	10.1	10.26	9.94
P_2 HDPE-40 μ	91.99	94.92	96.29	94.4	10.3	10.7	10.91	10.64
P_3 PP-20 μ	81.94	79.81	81.25	81	7.33	6.96	7.9	7.4
P_4 PP-40 μ	84.47	82.8	86.21	84.5	7.76	7.86	7.73	7.79
P_5 CFB (control)	-	-	-	-	-	-	-	-
P_6 Wet storage	74.43	80.43	78.1	77.65	7.13	7.26	7.36	7.26
(T) Mean	76.16	78.79	80.51	CV%	7	7.15	7.36	CV%
	T	P	TXP		T	P	TXP	1.72
S.Em. +	0.37	0.523	0.906	2	0.029	0.041	0.071	
CD	1.06	1.5	2.6		0.08	0.12	0.2	

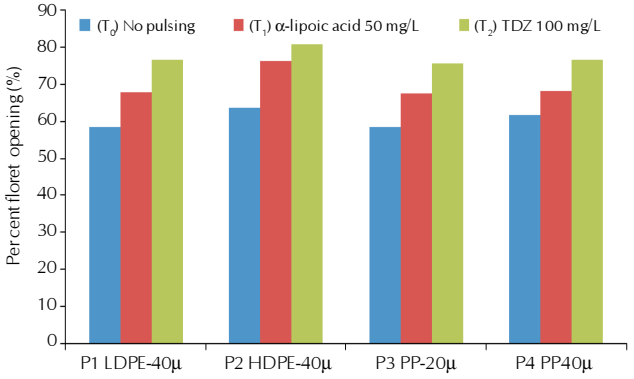
Table 1: Cont.....

Treatments	Total soluble sugars (µg/ml) in petals of tuberose 3 DAS in vase				Vase life of tuberose cuts pikes after 15 days of low temperature storage			
	(T_0) No pulsing	(T_1) α-lipic acid 50 mg/L	(T_2) TDZ 100 mg/L	(P) mean	(T_0) No pulsing	(T_1) α-lipoic acid 50 mg/L	(T_2) TDZ 100 mg/l	(P) mean
P_1 LDPE-40 µ	9.36	10.76	11.42	10.52	3.35	5.55	5.45	4.79
P_2 HDPE-40 µ	12.73	14.12	15.01	13.96	4.6	6.64	7	6.08
P_3 PP-20 µ	8.76	10.91	12.08	10.59	2.54	4.6	5.01	4.05
P_4 PP-40 µ	10.02	12.44	13.22	11.9	4.86	5.24	6	5.37
P_5 CFB (control)	-	-	-	-	-	-	-	-
P_6 Wet storage	9.27	12.47	12.25	11.33	2.16	3.03	3.27	2.93
(T) Mean	8.89	10.73	11.41	CV%	2.92	4.18	4.46	CV%
	T	P	TXP	4.63	T	P	TXP	5.74
S.Em. +	0.113	0.16	0.276		0.11	0.074	0.28	
CD	0.32	0.46	0.79		3.35	0.21	5.45	

(Untreated spikes (control) failed to show any floret opening due to chilling injury).

Table 2: Effect of pre-storage pulsing and packaging films on flower quality in cold stored tuberose cut spikes cv. Prajwal at 2nd, 4th and 6th DAS

Treatments	Flower quality (%) 2nd DAS	4th DAS	6th DAS
T_0P_1- (No pulse + LDPE 40 µ)	5.00	4.00	3.00
T_0P_2- (No pulse + HDPE 40 µ)	5.00	4.00	3.00
T_0P_3- (No pulse + PP 20 µ)	5.00	4.00	2.00
T_0P_4- (No pulse + PP 40 µ)	5.00	5.00	3.00
T_0P_5- control (in CFB box)	1.00	1.00	1.00
T_0P_6- Wet storage	3.00	2.00	2.00
T_1P_1- (α-Lipoic acid 50 mg/l + LDPE 40 µ)	5.00	5.00	3.00
T_1P_2- (α-Lipoic acid 50 mg/l + HDPE 40 µ)	5.00	5.00	4.00
T_1P_3- (α-Lipoic acid 50 mg/l + PP 20 µ)	5.00	4.00	3.00
T_1P_4- (α-Lipoic acid 50 mg/l + PP 40 µ)	5.00	5.00	3.00
T_1P_5- control (in CFB box)	1.00	1.00	1.00
T_1P_6- Wet storage	3.00	2.00	2.00
T_2P_1- (TDZ 100 mg/l + LDPE 40 µ)	5.00	5.00	3.00
T_2P_2- (TDZ 100 mg/l + HDPE 40 µ)	5.00	5.00	4.00
T_2P_3- (TDZ 100 mg/l + PP 20 µ)	5.00	4.00	3.00
T_2P_4- (TDZ 100 mg/l + PP 40 µ)	5.00	5.00	3.00
T_2P_5- control (in CFB box)	1.00	1.00	1.00
T_2P_6- Wet storage	3.00	3.00	2.00



(Untreated spikes (control) failed to show any floret opening due to chilling injury)

Figure 1: Effect of prestorage pulsing packaging and storage on per cent floret opening intuberose cut spikes cv. Prajwal on 4th day after 15 days of cold storage

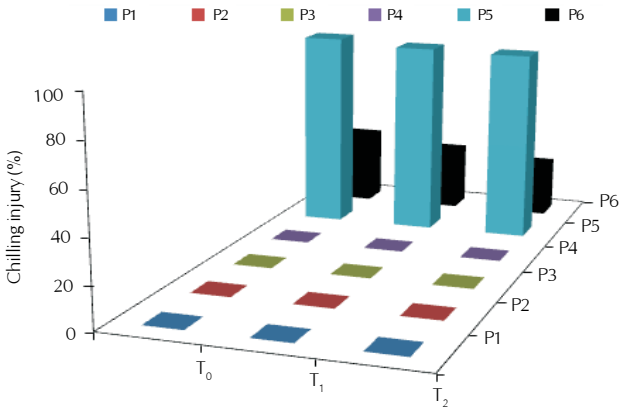


Figure 2: Effect of pre-storage pulsing, packaging and storage (2°C) on chilling injury in tuberose cut spikes cv. Prajwal on 15th day of cold storage

seal packaging as well as in wet stored tuberose cut spikes. Tropical and subtropical flowers are highly susceptible to chilling injury when subject to low temperature storage (Hunter, 2000). Desiccation during cold storage condition is one of sever component of chilling injury in fresh produce (Skog, 1998). One of the positive effects of MA conditions is the maintenance of high relative humidity and reduction of water loss from the produce (Saltveit, 1997). This was also observed in poly film packaged cold stored tuberose cut spikes (as indicated by negligible weight loss during storage) that resulted into alleviation of any desiccation symptoms. Further inhibition of certain chilling injury leafy vegetable like lettuce (Kadar and Saltveit, 2003), in banana and grape fruit (Nguyen *et al.*, 2004; Dou, 2004) and in Jasmine (Singh *et al.*, 2009) with modified atmosphere dry cold storage has been earlier reported. Atmosphere modified may also retard oxidation of phenolic compounds (Kadar *et al.*, 1989) and thus, contributed in alleviation browning and spotting chilling symptoms in tuberose cut spikes.

Tuberose cut spikes pulsed with 100 mg/L TDZ or 50 mg/L α-lipoic acid and stored in packaging with 40 µHDPE (T_2P_2) retained highest quality score (5, 5 and 4) at 2nd, 4th, 6th DAS respectively. Maximum per cent floret opening per spike (80.60 %) and vase life (7 days) were recorded in the same treatment (T_2P_2), followed by T_1P_2 (76.11% floret opening, 6.64 days vase life). Better flower quality was result of retained high fresh weight, with better floret opening and absence of chilling injury. Carbohydrate content in petals or tepals has been directly link to flower opening (Waithaka, 2001, Van der Meuler, 2001). Hence, higher TDS and TSS levels in petals with high fresh weight can be linked to better floret opening per cent. Goszczynska and Rudnicki (1988) also indicated that a modified atmosphere condition within the package regulates metabolic activity in flowers that influence flower opening.Similar findings of improved floret opening due to retained fresh weight have been earlier elucidated in rose (Madhubala *et al.*, 2008). Improved percent of floret opening with TDZ along with sucrose was earlier observed in tuberose (Sahare *et al.*, 2011), in gladiolus (Singh and Jegadheesan, 2003) and in iris (Macnish *et al.*, 2010). The significant

deterioration in quality of tuberose cut spikes at wet and dry storage condition was due to severe desiccation, water and sugar stress (TSS and TDS in petals tissues Table 1). Similarly, other scientists have also recorded the positive effect of pre-storage pulsing and seal packaging in different flowers *viz.,* with sucrose and polyethylene in tuberose (Waithaka *et al.*, 2001), with PP and 8HQ in gladiolus(Singh *et al.,* 2007; Singh *et al.,* 2008) with CFB and DMSO in rose (Singh and Mirza, 2004).

REFERENCES

Day, B. P. 2001. Modified atmosphere packaging of fresh fruits and vegetables. *Acta Horticulturae*. **553:** 585-590.

Dou, H. 2004. Effect of coating application on chilling injury of grape fruit cultivars. *Hort. Sci.* **39:** 558-561.

Farber, J. N., Harris, L. J., Parish, M. E.; Beuchat, L. R.,Suslow, T.V., Gorney, J. R., Garrett, E. H. and Busta, F. F. 2003. Microbiological safety of controlled and modified atmosphere packaging of fresh and fresh- cut produce.*Comprehensive review in food science and food safety*. **2:** 142- 158.

Franscistt, W., David, F. B. and Robert, M. D. 1971. The estimation of the total soluble carbohydrate in cauliflower tissue. Experiment in plant phyisiology, Van, Nostrand. *Reinhold Camp.* New York, pp. 16.

Goszczynska, D. M. and Rudnicki, R. M. 1988. Storage of cut flowers. *Hort. Rev.***10:** 35-62.

Ho, L. C. and Nichols, R. 1975. The role of phloem transport in the translocation of sucrose along the stem of carnation cut flowers. *Ann. Bot., (London).* **39:** 439-446.

Hunter, N. T. 2000. The art of floral design.Library of congress catalog in publication data 2nd ed. p. 159.

Kadar, A. A., Zagory, D. and Karbel, E. L. 1989. Modified atmosphere packaging of fruits and vegetables. *CRC Crit. Rev. Food Sci. Nutr.* **28:** 1-30.

Kumar, M. S., Ponnuswami, V., Jawaharlal, M. and Kumar, R. A. (2012) Effect of plant growth regulators on growth, yield and exportable quality of cut roses. *The Bioscan*. **7(4):** 733-738.

Macnish, A. J., Jiang, C. Z. and Reid, M. S. 2010. Treatment with thidiazuron improves opening and vase life of iris flowers. *Postharvest Boil. Technol*. **56:** 77-84.

Madhubala, L., Kumar, R. and Singh, K. 2008. Effect of pulsing and holding solutions on keeping quality of cut flowers of rose (*Rosa spp.*).*J. Ornam. Hort.* **11(1):** 54-57.

Mayak, S. and Halevy, A. S. 1974. The action of kinetin in improving water balance and delaying senescence process of cut rose flowers. *Pl. Physiol*. **50:** 341-346.

Nguyen, T. B. T., Ketsa, S. and Van Doorn, W. G. 2004. Effect of modified atmosphere on chilling induced peel browning in banana. *Postharvest Biol. Technol*. **31:** 313-317.

Reid, M. S. 2009. Handling of cut flowers for export. *Proflora bulletin* pp. 1-26.

Sahare, H., Singh, A., Dhaduk, B. K. and Chawla, S. L. 2011. Effect of pulsing on post harvestlife and quality of tuberose cut spikes cv. Prajwal. *J. Ornam. Hort.* **14(1&2):** 42-47.

Saltveit, M. E. 1997. A summary of CA and MA requirements and recomandations for harvested vegetables, In: M.E. Saltveit ed. CA' 97. *Proceedings of the 7th International controlled atmosphere research conference*. **4:** 13-18, p. 98-117.

Singh, A., Kumar, J. and Kumar, P. 2007. Effect of pulsing, modified atmosphere storage at low temperature and vase solution on flower quality and vase life of gladiolus cut spikes. *J. Ornam. Hort.* **10(2):** 96-100.

Singh, K., Singh, R. and Kumar, R. 2008. Effect of different polymeric films on modified atmosphere storage of gladiolus cut spikes. *J. Ornam. Hort.***11(1):** 49-53.

Singh, P. V. and Mirza, A. M. 2004. Postharvest life and quality of cut rose cultivar Super Star as influenced by packaging material. *J. Ornam. Hort.* **7(1):** 58-63.

Singh, V. P. and Jegadheesan, A. 2003. Effect of á-lipoic acid on senescence in Gladiolus flowers. *Indian J. Pl. Physiol.* pp. 516-521.

Skog, L. J. 1998. Chilling injury of horticultural crops. *Factsheet.* **98:** 1-11.

Van der Meuler-Muisers, J. J. M., Van Overen, J. C., Van der Plas, L. H. W. and Van Tuyl, J. M. 2001. Post harvest flower development in Asiatic hybrid lilies as related to petal carbohydrate status. *Postharvest Biol. Technol.* **21:** 201-211.

Van Doorn, W. G. 1999. Vascular oclussions in cut flowers-I.General principles and recent advances. *Acta. Horticulturae*. **482:** 59-63.

Waithaka, K., Reid, M. S. and Dodge, L. 2001. Cold storage and flower keeping quality of cut tuberose (*Polianthes tuberosa* L.). *J. Hort. Sci. Biotech.* **76(3):** 271-275.

Zeltzer, S., Meir, S. and Mayak, S. 2001. Modified atmosphere packaging of long term shipment of flowers. *Acta. Horticulturae*. **553:**