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EFFECT OF VARIOUS CHEMICALS WITH PACKAGING AND STORAGE ON TUBEROSE (*Polianthes tuberosa* L.) SHELF LIFE

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ABSTRACT: Tuberose occupies a very selective and special position among the ornamental bulbous plants for its beauty, elegance and sweet pleasant fragrance. It is also gaining priority in the loose flower trade. For prolonging the shelf life, tuberose florets (in bud) were harvested from cv. Prajwal, Arka Niranthara and Mexican Single and the shelf life of the harvested buds was studied with Boric Acid (2%, 3% and 4%) and citric acid (150, 300 and 450 ppm). The treated buds were kept in polypropylene (PP) bags with or without vent (0.2%) at 40C. It was found out that in cv. Arka Niranthara had maximum number of open flowers (45.33 %) after five days of treatment in citric acid at 450 ppm with the vented polypropylene bags. The fresh weight loss of the same variety was minimum (14.628 %) in the vented PP bags with 2% boric acid. In cultivar Mexican Single, 150 ppm citric acid and 2% boric acid were at par for shelf life of flowers opening (11.56 and 11.5 days, respectively) in non vented PP bags. The cultivar Prajwal also produced maximum percentage (30.67 %) of bud open after 5 days in 450 ppm citric acid i.e. with vented polypropylene bags. The maximum CO_2 rate (129.04 ml CO_2/kg/l) with zero bud rotting was also observed in cv. Prajwal in the treatment of 450 ppm citric acid with vented polypropylene bag.

Keywords : *Tuberose, boric acid, citric acid, shelf life*

Floriculture has become one of the important high value agricultural industries in many countries of the world. International trade in cut flowers is growing at a rate of 25 per cent annually. India has a long tradition of floriculture. India's share in the US $ 11 billion global market is only 0.65 per cent. The major flowers grown in India are rose, tuberose, gladiolus and jasmine. Tuberose (*Polianthes tuberosa* L.), a member of Agavaceae family, is a perennial bulbous plant (De Hertogh and Le Nard, 3). Tuberose, a multipurpose flowering plant, can be used in different forms and occasions. Its flowers can be used as loose flowers, cut flowers and extraction of concrete/absolute. The major portion of tuberose flowers consumption is in forms of loose flower, followed by cut flowers. The loose flowers are used for making garland and floral decoration, while containing 0.080-0.135% concrete which is used in high grade perfume industry (Singh *et al.,* 14).

Postharvest management and value addition to cut flowers can enhance prices up to 5-10 times of the produce. Therefore, there is need of specific care for extending flower shelf life for long time. The major problem of tuberose marketing is the short span of life of harvested flowers; the growers often face the problem of shortage in the peak season of flowering. The information on the area under floriculture and the production generated is highly inadequate for any loose flower like tuberose. Several attempts have been made to study the effect of different chemicals, sugar and germicide on longevity (Talukdar and Barooah, 15; Jowkar and Salehi, 11). Although tuberose has a high potential for a long shelf life after harvesting, it declines rapidly during marketing. Keeping this in view, this experiment was carried out in three different tuberose cultivars viz., Arka Niranthara, Prajwal and Mexican Single at Directorate of Floricultural Research During 2012-2013.

MATERIALS AND METHODS

The unopened flower bud of three different varieties of tuberose viz. Prajwal, Arka Niranthara and Mexican Single were harvested from the field of DFR, New Delhi, in the early morning (8:30 am). 20 flower buds of each variety were treated separately with the following treatment combinations (Table 1) and packed in 200 gauge polypropylene bags (PP). The weight of the flower buds were measured (in g) and kept for observations on single day interval.

The set of treatments were divided in non vented and 0.2% vented polypropylene (PP) bags of 200 gauge. The size of the PP bags used in the experiments was 21.6×20.9 cm. The treated bags with their respective controls were kept at 4°C and 70% RH. The shelf life (days) was recorded by fifty per cent drying or decaying of florets inside the polypropylene bags. The opening of flower bud was observed at every alternate day and the final open flower bud was counted last day of its shelflife.

The respiration rate was measured with the help of a silicon rubber septum at the centre of the

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polypropylene bags. They were kept at 25°C for 30 minutes accumulation of respiratory gases at the head space. After the specified time the head space gas was sucked to the sensor of the analyzer through hypodermic hollow needle at the display value of rate evolution of CO_2 concentration (%) was recorded. It was measured in the auto gas analyzer (Model: Checkmate 9900 O_2/CO_2, PBI Dansensor, Denmark). Rate of respiration was calculated on the basis of evolution of CO_2 from the sample per unit per unit time using the formula (Asrey *et al.,* 2).

Table 1. treatments for the storage and packaging of tuberose loose flowers

	Detail of treatments
T_1	Control
T_2	Sucrose 20% + GA_3 (100 ppm) + Boric Acid (2%)
T_3	Sucrose 20% + GA_3 (100 ppm) + Boric Acid (3%)
T_4	Sucrose 20% + GA_3 (100 ppm) + Boric Acid (4%)
T_5	Sucrose 20% + GA_3 (100 ppm) + Citric Acid (150 ppm)
T_6	Sucrose 20% + GA_3 (100 ppm) + Citric Acid (300 ppm)
T_7	Sucrose 20% + GA_3 (100 ppm) + Citric Acid (450 ppm)
TV_1	Control (vented)
TV_2	Sucrose 20% + GA_3 (100 ppm) + Boric Acid (2%)
TV_3	Sucrose 20% + GA_3 (100 ppm) + Boric Acid (3%)
TV_4	Sucrose 20% + GA_3 (100 ppm) + Boric Acid (4%)
TV_5	Sucrose 20% + GA_3 (100 ppm) + Citric Acid (150 ppm)
TV_6	Sucrose 20% + GA_3 (100 ppm) + Citric Acid (300 ppm)
TV_7	Sucrose 20% + GA_3 (100 ppm) + Citric Acid (450 ppm)

Respiration rate (ml CO_2/kg/h)

$$= \frac{CO_2\ \% \times \text{head space}}{100 \times \text{weight (kg)} \times \text{time}}$$

The experiment was laid out in completely randomized block design (CRBD) with three replications. The data were subjected to the analysis of variance (ANOVA) using the software package (SAS 8.1, Cary, NC, USA) (Gomez and Gomez, 6). In case of significant treatment effects, a comparison of means was performed by means of Duncan's multiple range test method at a significance level of 5% (p = 0.05). The per cent data was subjected to *Arc Sin* $\sqrt{\%}$ transformation before carrying out ANOVA

RESULTS AND DISCUSSION

The tuberose flowers var. Arka Niranthara treated with GA_3, citric acid and boric acid lowered the weight loss throughout the period of storage in non-vented PP bags compared to 0.2% vented PP bags (Table 2). By day 10th the weight loss in non vented control was 24.59% against 14.62 and 18.01% when the flowers were vented (TV_2) and non-vented (T_2) PP bags respectively with 2% boric acid and 100 ppm GA_3. Similarly the flowers treated with 2% boric acid in vented and non vented PP bags showed less weight loss in var. Prajwal *i.e.* 27.42% (in T_2) and 20.38% (in TV_2) respectively. The least weight loss (12.68 %) was observed in variety Mexican Single with 300 ppm citric acid (T_6) treatment with vented PP bag compared to others. Lower reduction in weight with citric acid was due to acidification of the solution, improvement in water balance and reduction in microbial growth (Durkin, 4).

The opening of flowers (%) was comparatively low in both the chemicals (boric acid and citric acid) for each packaging condition. It was evident from Table 2. that in Arka Niranthara minimum flower were opened in 10.33% and 10.57% days in T_5 and TV_2, respectively compared to both the control i.e., non-vented and vented conditions (25.5 and 25.54%, respectively). The var. Prajwal, flowers gave maximum flower opening

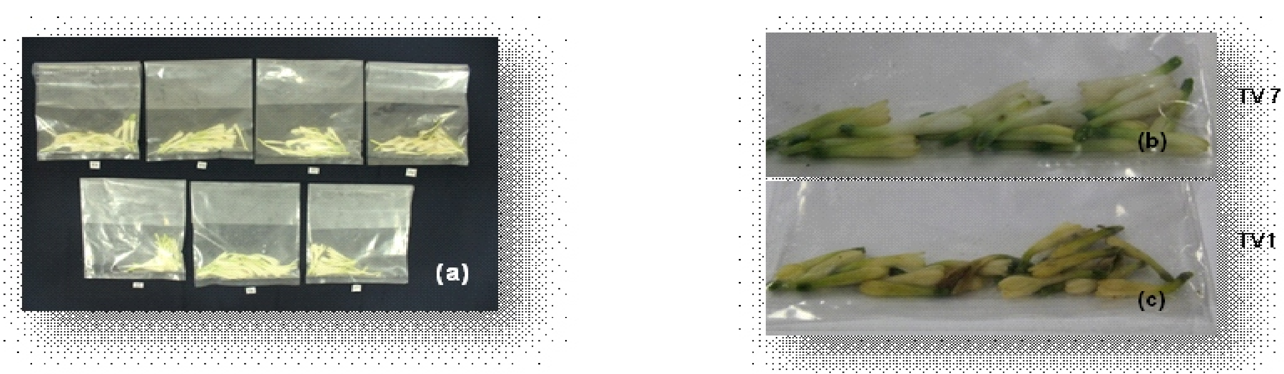

Figure 1 : (a) The treated (T_1 to T_7) flowers in cv. Mexican Single inside vented PP bags (b) and (c) Prajwal flowers in after 10 days of storage in non-vented PP bags.

Table 2. Effect of various chemicals on tuberose shelf life during packaging and storage.

Treatments	Fresh weight loss (%)*			Opening of flower (%)*			Shelf life (Days)			Rate of respiration (ml CO_2 /kg/h)		
Non-Vented Polypropylene bag	**Arka Niranthara**	**Prajwal**	**Mexican Single**	**Arka Niranthara**	**Prajwal**	**Mexican Single**	**Arka Niranthara**	**Prajwal**	**Mexican Single**	**Arka Niranthara**	**Prajwal**	**Mexican Single**
T_1	24.59 (29.67)	27.62 (31.69)	20.2 (26.71)	25.5 (30.33)	20.33 (26.85+)	35.5 (36.57)	5.57	8.67	7.79	139.05	148.5	125.55
T_2	18.01 (25.10)	27.42 (31.56)	15.36 (23.03)	20.33 (26.78)	20.18 (26.64)	20.33 (26.79)	12.09	12.97	11.5	158.3	154.3	134
T_3	22.82 (28.45)	20.28 (26.71)	21.40 (27.56)	22.56 (28.32)	15.37 (23.03)	25.19 (30.07)	10.65	9.07	10.23	157.9	155.9	123.2
T_4	20.00 (26.56)	22.04 (27.97)	14.18 (22.06)	25.75 (30.46)	20.67 (26.99)	30.67 (33.58)	7.98	8.97	10.45	150.8	158.3	129.04
T_5	19.62 (26.28)	23.33 (28.86)	19.20 (25.99)	10.33 (18.72)	25.5 (30.33)	30.4 (33.46)	8.05	7.56	11.56	154.5	148.9	126.04
T_6	27.28 (31.44)	24.38 (29.53)	12.68 (20.79)	25.10 (30.07)	25.19 (30.07)	30.33 (33.40)	7.79	6.98	7.45	141.3	159.3	127.3
T_7	23.01 (28.71)	23.9 (29.20)	19.13 (25.84)	30.67 (33.58)	30.45 (33.46)	35.25 (36.69)	7.03	6.54	7.63	145.43	165.4	128.56
Vented Polypropylene bag	**Arka Niranthara**	**Prajwal**	**Mexican Single**	**Arka Niranthara**	**Prajwal**	**Mexican Single**	**Arka Niranthara**	**Prajwal**	**Mexican Single**	**Arka Niranthara**	**Prajwal**	**Mexican Single**
TV_1	28.93 (32.46)	22.97 (29.52)	19.47 (26.13)	25.54 (30.33)	30.33 (33.40)	35.7 (36.69)	6.00	7.76	8.45	113.3	115	116.74
TV_2	14.62 (24.04)	20.38 (26.78)	16.37 (23.81)	10.57 (18.91)	25.10 (30.07)	30.33 (33.40)	12.4	10.97	10.54	112.56	113	119.9
TV_3	18.01 (25.10)	27.37 (31.50)	38.00 (38.06)	13.61 (21.64)	27.25 (31.44)	32.19 (34.54)	10.3	10.03	9.67	119	111.9	115.7
TV_4	23.35 (28.93)	24.88 (29.87)	20.60 (26.99)	24.34 (29.53)	20.67 (26.99)	35.12 (36.33)	7.94	8.97	8.23	113	115	114
TV_5	27.46 (31.54)	24.13 (29.40)	28.64 (32.33)	20.34 (26.78)	15.75 (23.34)	20.35 (26.78)	8.45	9.98	10.17	115	116.9	114.7
TV_6	27.94 (31.88)	18.35 (25.33)	22.48 (28.25)	21.67 (27.69)	20.12 (26.64)	34.67 (36.03)	8.93	7.57	8.45	113.1	109.04	112.45
TV_7	18.93 (25.77)	23.14 (28.73)	22.85 (28.52)	45.33 (42.30)	30.67 (32.96)	35.75 (36.69)	7.45	7.68	6.78	114.1	109.56	110
CD (P=0.05)	0.0207	0.0278	0.3369	0.9735	0.5479	0.4365	0.7779	0.7484	0.4831	7.9	8.91	9.1

*Arc Sin √% transformed values in Parenthesis.

(30.67%) in vented PP bag with TV_7 treatment. Among the two different chemicals used for the 2% boric acid concentration gave higher bud opening in var. Mexican Single for both vented (30.33 %) and non vented PP (20.33) bags. citric acid, especially in higher concentrations, increased the turgidity and the number of opened florets compared to other treatments. This may be due to reducing the solution viscosity and the microorganism growth (Alvarez *et al.* 1; Van Doorn and Peirik, 16) *via* lowering the pH of solution. For boric acid it might be due to membrane stability and resistance enhancement against senescence-related changes which will increase the amount of protein (Hashemabadi *et al.,* 8) therefore, increased bud opening.

Conquest to the maintaining higher shelf life, the flower packed in 2% boric acid gave superior result in both vented (12.4 days) and non vented (12.09 days) PP bags (Table 2). Similar results were found out in other two varieties with 2% boric acid treatment. In Prajwal and Mexican Single the maximum shelflife (12.97 and 11.5 days, respectively) was found out in T_2. The tuberose flowers treated with boric acid and packed in non-vented PP bags retained better colour and delayed development of brown colour. The retention of shelflife may be attributed to the increased CO_2 concentration and decreased O_2 concentration inside package.

By the day 7^{th} the respiration rate for the three varieties were lesser in boric acid treated PP bags compare to their respective control (Table 2). For cultivar Arka Niranthara the higher CO_2 (158.3 ml CO_2/kg/l) was found out in T_2 varieties by T_3 (157.9 ml CO_2/kg/l) and T_5 (154.5 ml CO_2/kg/l). Among all the three varieties, eventually the highest CO_2 concentration was found out in var. Prajwal with T_7 treatment (165.4 ml CO_2/kg/l) (Fig. 1) than others. Tuberose is an ethylene non-sensitive cut flower and so it is non-climacteric (Jowkar and Salehi, 11). Chemicals like boric acid and citric acid might have decreased microbial growth thereby helped in increasing shelf life recorded in the present investigation. Similar results had been recorded by several workers (Murali, 12; Gowda and Gowda, 7; Singh *et al.,* 13). The decrease in acidity with the storage period might be due to utilization of organic acids in the respiration process. A gradual decrease in acidity has also been reported by Josan *et al.* (10), Huelin (9) and El-Aswah *et al.* (5).

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