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EFFECT OF NANOSILVER AND SUCROSE ON POST HARVEST QUALITY OF CUT ASIATIC LILIUM CV. TRESOR

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ABSTRACT
An experiment was conducted under Completely Randomized Design at the Department of Nano science and Technology, Tamil Nadu Agricultural University, Coimbatore during the year 2011-12 to study the effect of different holding solutions with sucrose and silver nano particles on post harvest quality of cut Asiatic lilium cv. Tresor. Uniform sized lilium flower spikes at first bud colour break stage were harvested and kept in holding solutions comprised of Sucrose 2%, Nano Silver (NS) 25, 50 and 75 ppm alone and combinations viz., Sucrose 2%+ NS 25ppm, Sucrose 2%+ NS 50ppm, Sucrose 2%+ NS 75ppm and control (Using de-ionized water). Holding of lilium spikes with Sucrose 2%+ NS 50 ppm resulted in greater water uptake (16.97 g/stem) and flower size (17.82 cm) with maximum vase life of (17.8 days) as compared with (8.3 days) in control.

INTRODUCTION

Among various cut flowers, lilium has just opened its way in floriculture industry of our country due to its immense potential as cut flower. Lilium ranks 6th among the top ten cut flowers of the world. Large volume of cut flowers *i.e.*, around 28-32% are lost annually due to poor post harvest handling measures because of its perishable nature (Dadlani, 1997). Keeping quality of flower is decided by its hereditary factor. However, it can be manipulated to certain extent by using novel preservative treatments. Keeping of cut flowers in various preservatives has effectively been used form long time to improve their longevity (Gowda and Gowda, 1990; Pal *et al.*, 2003; Khan *et al.*, 2007).

Vase life termination for many cut flowers is characterized by wilting which is due to loss of water from the cells (He *et al.*, 2006). Water balance is a major factor determines quality and longevity of cut flowers. It is influenced by water uptake and transpiration and balance between two mentioned processes (Da Silva, 2003). When the amount of transpiration exceeds the volume of water uptake, water deficit and wilting develops (Halevy and Mayak, 1981). Low water uptake is often due to occlusions located mainly in the basal stem end (He et al., 2006), and microbes are a common cause of stem end blockage (Van Doorn, 1997). Many agents have been used in vase solutions of the cut flowers which extends vase life by improving water uptake. These include silver nitrate (Fujino *et al.*, 1983), aluminum sulphate (Ichimura and Shimizu-Yumoto, 2007) and 8-hydroxyquinoline sulphate (Ichimura et al., 1999). Therefore, it is important to use these materials in vase solutions to extend the vase life of cut flowers.

To improve the post harvest life of cut flowers, use of nano materials including Nanosilver has recently increased in the world. It has been widely used due to its anti bacterial property. It also has the additional benefit of high durability, simple and easy to use and lack o d side effect than other anti-bacterial (Van Doorm, 1997).

Nanometer sized silver (Ag+) particles are considered to more strongly inhibit bacteria and other microorganisms than Ag in various oxidation states *viz.*, Ag^0 Ag^+ Ag^{2+} Ag^{3+} (Furno *et al.*, 2004; Jilang *et al.*, 2004). Usage of nano-silver compounds (NS) in pulse and vase solution treatment for cut flowers is relatively new (Liu *et al.*, 2009; Solgi *et al.*, 2009) and has demonstrated importance as an antibacterial agent (Alt *et al.*, 2004; Morones *et al.*, 2005). NS releases Ag^+ (Lok *et al.*, 2007), which has been reported to interact with cytoplasmic components and nucleic acids, to inhibit respiratory chain enzymes and to interfere with membrane permeability (Russel and Hugo, 1994; Park *et al.*, 2005). Use of NS is becoming increasingly widespread in medicine, fabrics, water purification and various other industrial and non-plant applications (Jain and Pradeep, 2005; Dubas *et al.*, 2006; Chen and Schluesener, 2008).

With the above researches background present study has investigated effects of NS solution treatments on extending vase life of cut lilium flowers. Moreover possibility of change in flower colour or any sort of damage to leaves has been other considerations focused on current research.

MATERIALS AND METHODS

Lilium flowers were obtained from the M/s. Balaji Flowers, Devashola Estate, The Nilgiris. Flowers were obtained from the morning of spring (March - April) in 2012. Thereafter, they were kept under shade in the flower unit until being transported with in 3h to the Tamil Nadu Agricultural University. To minimize moisture loss, flowers were covered with plastic film during transportation. At the laboratory, stem ends were re-cut by ≥ 10 cm, and stems with about 50 cm long were used in experiments. Experiments were done in a Completely Randomized Design.

Vase solutions were freshly prepared at the beginning of experiments. A solution contains the following treatments.

T_1 - Nano Silver (NS) 25 ppm alone

T_2 - Nano Silver (NS) 50 ppm alone

T_3 - Nano Silver (NS) 75 ppm alone

T_4 - NS 25ppm + Sucrose 2%

T_5 - NS 50ppm + Sucrose 2%

T_6 - NS 75ppm + Sucrose 2%

T_7 - Sucrose 2%

T_8 - Control (De-ionized water)

Flowers were kept in conical glasswares containing 150 ml of prepared holding solutions with different concentration of sucrose and nano silver. Mouths of the glasswares were then covered with non-absorption cotton to minimize evaporation loss and prevent contamination.

Relative fresh weight (RFW)

The difference between the weight of the container and vase solution (with flower) and the weight of container and the vase solutions (without flower) were recorded at every alternate day interval to measure the fresh weight change of flower during that particular duration of period (He *et al.*, 2006). The weight of flower stalk on the first day of each experiment was assumed to be 100 per cent. Subsequent weights were referred to as percentage of the initial value.

$$\text{RFW}(\%) = \frac{\text{Fresh weight of stem in mentioned day}}{\text{Fresh weight of stem in day zero}} \times 100$$

Leaf water content

Water content was calculated as (Fresh weight – dry weight)/dry weight (Jones *et al.*, 1993). Water content was determined on days 0,1,4,7 and 10 for three replicate detached leaflets from different stem.

Vase solution uptake

The difference between consecutive measurements of the container and the vase solution (without flower) were recorded at every alternate day interval to measure the water uptake within that particular duration of vase period and presented as g per stem per day (He *et al.*, 2006).

Vase solution uptake rate (g stem^{-1} day^{-1}) = $(S_{t-1} - S_t)$

Where,

S_{t-1} = Weight of vase solution (g) on the previous day

S_t = Weight of vase solution (g) at t = day 1,2,3, etc.,

Days taken for bud opening

The number of days for flower bud opening was observed and expressed in days.

Open flower diameter

The diameter of the opened flowers was measured in cm across the centre of the flower at the largest point.

Vase life of flowers

The vase life of cut flower was recorded as per the method suggested by Nowak and Mynett (1979). The vase life of cut spike was recorded from the day of anthesis of the first flower bud to the senescence of last flower.

RESULTS AND DISCUSSION

In current study different concentrations of nano-silver (NS) were used as main source of variation. Results showed that these preservative solutions could extend the vase life of cut Lilium. Significant differences were found various concentrations of NS in extending the vase life of lilium flowers. Flowers held in all concentration of NS treatment showed longer vase lives than control (Fig.1). In that, the longest vase life was obtained with 50 ppm NS along with 2% sucrose combination. Water deficit in a cut stem standing in vase solution will develop when rate of water uptake is lower than the rate of transpiration (Van Doorn, 1997). Flower spike holded with 50 ppm NS + 2% sucrose suppressed water loss of cv. Tresor lilium and maintained more favourable water balance than control flowers. The short vase life of control flowers was caused by poor water relations. Onset of water stress can be delayed by reducing the rate of transpiration (Van Doorn, 1997). Results confirmed Marousky (1969) findings about the role of sugars in improving of water balance in plant, involving in the regulation of stomata action, the accumulation of sucrose in plant tissues, increasing of osmatic pressure and water absorption capacity and maintain cell turgity.

One of the most effective parameters on vase life and quality of cut flowers in fresh weight of them. With regards to relative fresh weight of the lilium flowers under different holding solutions, NS 50 ppm + sucrose 2% was increased fresh weight (106.90 %) against control (71.08 %). Pre-harvest factors have direct effect on fresh weight of cut flowers. Evaporation and transportation are two important roles to determine vase life. Wilting of petals reduces the ornamental value. As it supported in the experiments results NS in combination with other compounds had the greatest fresh weight (Fig.2).

Leaf water content for the holding treatments with 50 ppm NS + 2% sucrose (2.41g g DW^{-1}) was higher than for the control (1.26 g g DW^{-1}) (Fig.3). In control flowers, water declined more rapidly during the vase life period, and was significantly different from NS treatments on the end of the day. Similar result was obtained in cut rose Peitao Lu *et al.*, 2010

The greatest water uptake was to NS (50 ppm) + sucrose 2% (16.97 g/stem) which had significant differences with control treatment (10.42 g/stem). NS in combination with other compounds had positive effect in gerbera for good water uptake which was reported by Ansari *et al.*, 2011. NS may positively influence on water uptake in another way besides

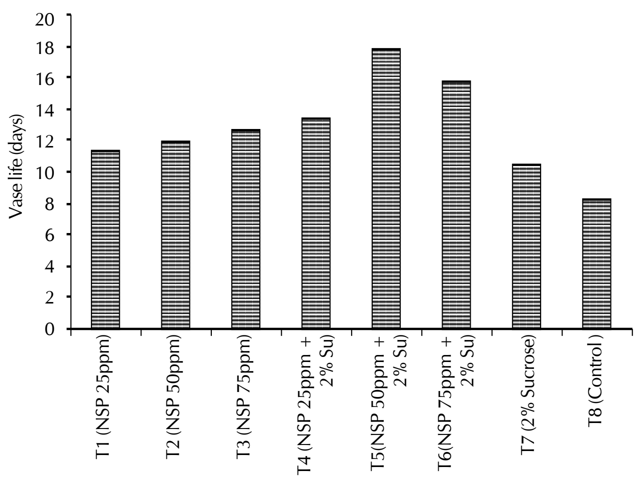

Figure 1: Effect of different treatments on vase life

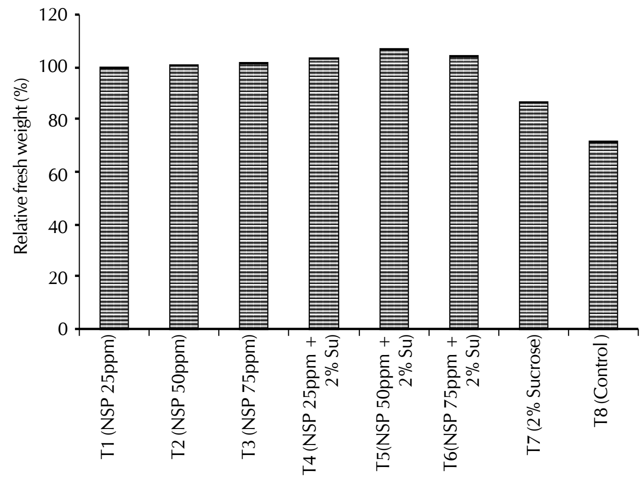

Figure 2: Effect of different treatments on relative fresh weight

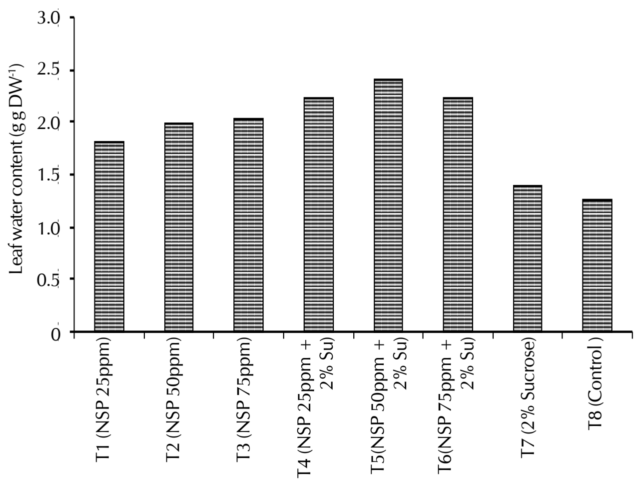

Figure 3: Effect of different treatments on leaf water content

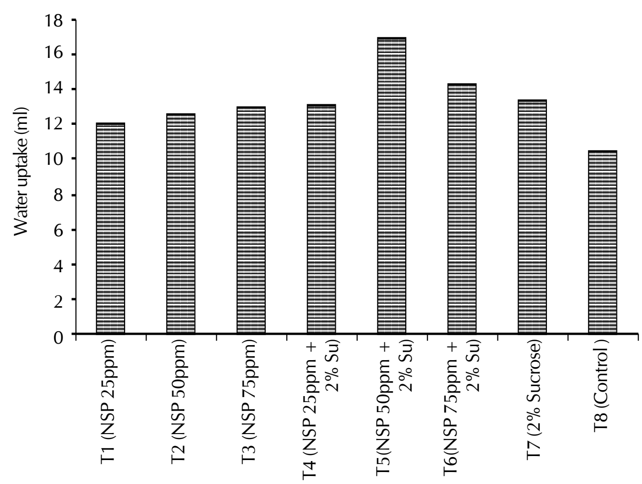

Figure 4: Effect of different treatment on water uptake

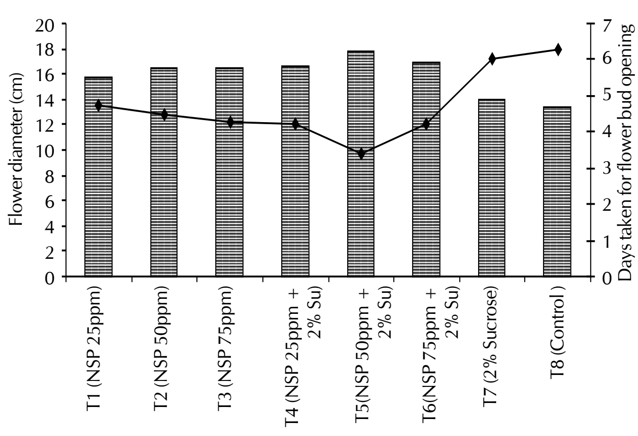

Figure 5: Effect of treatments on flower diameter and days taken for flower bud opening

an anti-bacterial effect. Van Meeteran *et al*. (2001) determined that $AgNO_3$ added to DI had a positive effect on *Bouvardia* water status and that use of tap water (containing mixture of ions) had a similar effect to $AgNO_3$ solution. Ions in water, particularly cations, can enhance flow through xylem vessels (Van Leperen, 1997) (Fig.4).

Days taken for flower bud opening (3.40 days) and flower diameter (17.92cm) were higher in the combination of NS 50 ppm along with 2% sucrose over control (Fig.5). Van Doorn (1997) reports also indicated that some cut flowers to opening need to a carbohydrate source. Halo and Mayak (1974) stated that some sugars affecting metabolism except manitol, because water potential reduction of Gladioli flowers and their negative water potential improve water movement in the stems. Results showed that use of sucrose in preservative solutions with bactericides cause to reach their maximum in growth, development and opening flowers.

Observations indicated that NS treatments had no effect on colour changes of petals in lilium cut flowers. Moreover our experiments indicated that NS treatments had a positive effect on increasing quality and vase life of cut flowers leaves of lilium.

Nano-silver as pulse and vase solution treatment for cut flowers is relatively new (Liu *et al.,* 2009; Solgi *et al*., 2009) and has demonstrated its importance as an anti-bactericidal agent which agent was improved with current study (Alt *et al*., 2004; Morones *et al*., 2005). Ohkawa *et al*. (1999) reported that silver-containing compounds extended the vase life of cut roses. The positive effect of a NS pulse treatment was attributed to inhibition of bacterial growth in the vase solution and at the end of cut stems during the first two days of the post harvest period which was confirmed with current study too. However, physiological activity of Ag+ from NS is also a possibility which needs more investigation

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