EVALUATION OF EFFECT OF SUPER ABSORBENT POLYMERS (SAPs) DEVELOPED IN SRI LANKA ON EXTENDING THE VASE LIFE OF CUT FLOWERS (*Chrysanthemum instagram*)

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INTRODUCTION

Chrysanthemum is considered as the most popular cut flowers in many parts of the world. Chrysanthemums have a long vase life (approximately two weeks under appropriated conditions) as opposed to most other cut flowers. It belongs to the family 'Asteracaea.' Its main difference from other flowers is its range. It has sprays (clusters of flowers), single flowers, pompoms and spiders. These main varieties are different from each other. The ideal day temperature for chrysanthemums is 20 ^{o}C – 27 ^{o}C and the night temperature is 12 ^{o}C – 20 ^{o}C. Maintaining flowers in clean water is important. If water is not changed, there could be bacteria and other pathogens growing thereby blocking the water circulation from the bottom of the stalk to the flower. So it is important to keep the water clean and change water every other day. Keeping quality is an important parameter for evaluation of cut flowers for both domestic and export markets (Malavige, 2016). Stem (stalk) bending is one of the major problems in some cut flowers. Cut flower industry in Sri Lanka uses chemical preservatives such as silver nitrate (AgNO3) and 8-hydroxyquinoline citrate to preserve the flowers for longer duration. These chemicals are expensive and hazardous to the environment. Some use less hazardous, low cost materials such as clorox or sodium hypochlorite (NaOCl), lime juice, vinegar, coconut water, Calcium Chlorite ($CaCl_2$), Aluminum Sulphate ($Al_2(SO_4)_3$) *etc.*(Ekanayake *et al.*, 2008). However these solutions are very difficult to handle, especially in decoration and in ornamental preparations. The present study is focused on introducing new media for survival of cut flowers using Super Absorbent Polymers (SAPs). SAPs are structurally cross linked, highly swollen and are hydrophilic polymer networks capable of absorbing a large amount of water or aqueous saline solutions, practically 10 to 1000 times of their original weight or volume (Ramazani-Harandi *et al*., 2006), in relatively short periods of times. The slow release of water to the growth media allows for moisture retention, reduced watering frequency and is economical. The aim of this study was to evaluate survival of cut *Chrysanthemum instagram* flowers on newly prepared survival media using three SAPs developed in Sri Lanka (hereafter named "SLSAPs").

METHODOLOGY

The experiment was conducted at the research laboratory of the Agricultural and Plantation Engineering of the Open University of Sri Lanka. Laboratory temperature was kept at 22^{o}C. *Chrysanthemums instagram* variety was selected for this experiment and same degree of mature flowers were purchased from florists in the early hours of the day and brought to the lab within half an hour. In the laboratory, flowers were dipped in a water bath to minimize the transport stress on flowers for 3hours and distal ends were re-cut before use. Three SLSAPs were prepared as described in Fernando *et al.*, (2015c) using three cellulose samples.

These are,
$SLSAP_{ALK}$ - SAP using cellulose extracted from alkaline pretreatment (Fernando *et al.*, 2015c)

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$SLSAP_{AHP}$ - SAP using cellulose extracted from alkaline hydrogen peroxide pretreatment (Fernando *et al.*, 2015b)

$SLSAP_{MwA}$ - SAP using cellulose extracted from microwave assisted alkaline pretreatment (Fernando *et al.*, 2015a)

These SLSAPs were allowed to swell in 0.23% Sodium Hypo Chlorite (NaOCl) solution and tap water (pH – 7.56, Electric conductivity- 0.6 mS). Thirteen treatments were prepared as follows,

T1 - 15g of swollen $SLSAP_{Alk}$ from 0.23% NaOCl solution
T2 - 15g of swollen $SLSAP_{AHP}$ from 0.23% NaOCl solution
T3 - 15g of swollen $SLSAP_{MwA}$ from 0.23% NaOCl solution
T4 - 14.25 g of swollen $SLSAP_{Alk}$ from tap water + 0.75 g of 1% $CaCl_2$ solution
T5 - 14.25 g of swollen $SLSAP_{AHP}$ from tap water + 0.75 g of 1% $CaCl_2$ solution
T6 - 14.25 g of swollen $SLSAP_{MwA}$ from tap water + 0.75 g of 1% $CaCl_2$ solution
T7 - 14.75g of swollen $SLSAP_{Alk}$ from 0.23% NaOCl solution + 0.25g of sucrose
T8 - 14.75g of swollen $SLSAP_{AHP}$ from 0.23% NaOCl solution + 0.25g of sucrose
T9 - 14.75g of swollen $SLSAP_{MwA}$ from 0.23% NaOCl solution + 0.25g of sucrose
T10 - 14g of swollen $SLSAP_{Alk}$ from tap water + 0.75g of 1% $CaCl_2$ + 0.25g of sucrose
T11 - 14g of swollen $SLSAP_{AHP}$ from tap water + 0.75g of 1% $CaCl_2$ + 0.25g of sucrose
T12 - 14g of swollen $SLSAP_{MwA}$ from tap water + 0.75g of 1% $CaCl_2$ + 0.25g of sucrose
T13 - 15g (15 ml) of tap water (without biocide) / Control (C)

Tap water solution was used as control medium. 0.25g of sucrose was added to some of the treatments without causing change in gel formation of SAPs. Glass test tubes (15ml) were used for the experiment. Swollen SLSAPs from 0.23% NaOCl were used for treatment No.1, 2, 3, 7, 8 and 9, the reason being that SAPs could swell well in that solution and swelling ratio (amount of water that can hold in 1g of dried SAP) of developed SAPs in NaOCl solutions were 134, 154 and 104 in $SLSAP_{Alk}$, SAP_{AHP} and SAP $_{MwA}$ respectively. Treatments No 4, 5, 6, 10,11 and 12 media were prepared by adding 0.75 g of 1% $CaCl_2$ solution to the swollen SAPs from tap water, the reason is that SAPs do not swell in $CaCl_2$ solution (swelling ratio <10 due to complex forms of SAP and Ca^{2+}). Each treatment was replicated three times and it was arranged according to Completely Randomized Design (CRD). Wilting conditions of flowers were visually observed daily and date of wilt recorded according to a scale shown in figure 1. Date of full bloom with no petal discoloration and wilting was analyzed in each treatment using Minitab version14.

Scores:
5 – Full bloom with no petal discoloration and wilting
4 - Full bloom with no petal discoloration and slight wilting
3 - Slight petal discoloration with moderate wilting
2 - High level of petal discoloration with moderate wilting
1 - Wilted flower with discolored petals

Figure 1. Scale used for the evaluation of flower quality (De Siva *et al.*, 2013)

RESULTS AND DISCUSSION

The statistical analysis revealed that treatments were significant for the number of days of survival of *Chrysanthemum instagram* flowers (P = 0.000). Results shown in figures 2 and 3 indicate flowers in T1, T2, T3, T4, T5 and T6 media kept for 7 - 9 days in full bloom showed no petal discoloration and wilting. All flowers under the above mentioned treatments wilted after 9 -11 days with high level of discoloring of petals and moderate wilting. Flowers under T7, T8, T9, T10, T11 and T12 were kept for 12-13 days in full bloom with no petal discoloration and wilting. However, after 13-16 days all flowers showed a slight petal discoloration with moderate wilting. Flowers in tap water (C) survived for approximately 9 days in full bloom with no petal discoloration and wilting. However immersed parts of the stalk were infected with microorganisms like fungus. Therefore, water had to be changed every 2 days. After 10-12 days high level of petal discoloration with moderate wilting was observed. Flowers in media without sucrose wilted and petals were discolored after 13 days while in media with sucrose they lasted 18 days. It can be concluded that SAPs with sucrose and biocide media are the best for survival of *Chrysanthemum instagram*. Jones, (2001) reported that chlorine is an important biocide that prevents contaminations by microorganisms. Further Salisbury and Ross (1996) reported that Ca^{2+} helps to strengthen plant cell wall structure. Also Ekanayake *et al.*, (2008) found that the lower concentrations (1%) of $CaCl_2$ were effective in preventing stalk bending in gerbera flowers. Furthermore, the flower benefits from sugars that the plant leaves manufacture through the process of photosynthesis. Once the flower is cut from the plant, the number of leaves providing food is greatly limited, as is the amount of light available for food production. As a result, the amount of food available to the flower is drastically reduced. To compensate this loss, sucrose is added to the water in which the flower stalks are placed to ensure continued development of the flower and greater longevity. The result of this study agrees with findings of earlier studies.

Figure 2. Photos taken 12 days after in survival media

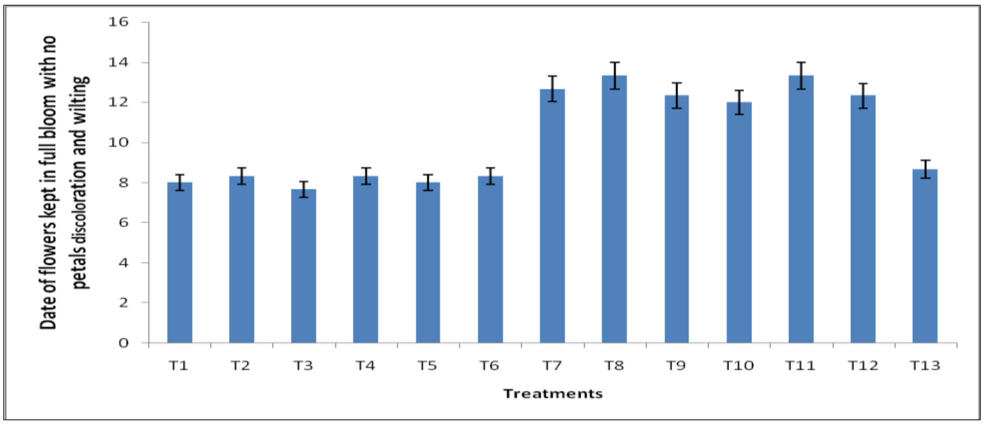

Figure 3. Number of days flowers survived in full bloom with no petal discoloration and wilting under each treatment

CONCLUSIONS

SLSAPs with sucrose and biocide media are the best among tested media for survival of *Chrysanthemum instagram.*

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