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EFFECT OF DIFFERENT FLORAL PRESERVATIVES ON VASE LIFE OF MARIGOLD (*Tagetes erecta L.*)

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ABSTRACT

Farmers have been growing marigold commercially but they are still lacking knowledge on procedure of postharvest handling of flowers. This has created a huge problem for those farmers since they cannot store their own produce for a longer period of time thus facing problems in marketing. In order to inform the farmers with the best means of preservation of cut flowers so that they could fetch the good market price for their product. A lab experiment to study "effect of different floral preservatives on vase life of marigold (Tagetes erecta L)" was conducted at Campus of Live Sciences, Tulsipur, Dang in a factorial Completely Randomized Design. Altogether 9 treatments were used as: Distilled Water, Silver Nitrate (100 ppm), Malic Acid (2000 ppm), Citric Acid (2000 ppm), Salicylic Acid (1000 ppm), Gibberellic acid (50 ppm), Kinetin (50 ppm), Naphthalene Acetic Acid (50 ppm), Silver Nitrate (50 ppm) + Citric Acid (1000 ppm) + Gibberellic acid (25 ppm). Results showed that the use of floral preservatives affects the parameters like flower diameter, weight, post-harvest life, blackening of petals and sepals and water uptake. It has been observed that minimum change in weight for kinetin (19.39%), minimum change in diameter for gibberellic acid (4.18%), maximum postharvest life was for gibberellic acid (14.66 days), minimum neck bending for kinetin (33%), maximum water uptake for kinetin (4.38%) and minimum blackening for growth hormones. From this experiment we can conclude that growth hormones (kinetin(50ppm) and gibberellic acid(50ppm)) are suitable for postharvest handling and storage of marigold.

Keywords: Floral preservatives, marigold, postharvest.

INTRODUCTION

Marigold is one of the most used cut and loose flowers during the cultural, religious and other functions in Nepal like wedding party, opening ceremony and many more popular flowers grown commercially for religious purpose, for decoration and mostly for Tihar Festival celebrated in the month of September/October. Many farmers cultivate marigolds for commercial purposes, and some of them have gained financially from doing so throughout regular and the off-seasons according to Adhikari and Pun (2011). Since Tihar is the time of year when flower sales are at its peak, farmers must plan their cropping calendar around that period in order to meet demand. Farmers should be ready to extend the vase life of the flower in case flowering occurs earlier since many reasons may affect the growth of crops. This will prevent farmers from suffering economic loss. Nepal imported Marigold worth Rs. 8100,000 and imported 150,000 garlands to fulfill the demand during Tihar according

to Chaudhary (2020). More than 1.81 million marigold garlands worth Rs 127 million were sold out during this year's Tihar. About 30 percent of the total flower imports were imported prior to Tihar's commencement.

Flowers, unlike other horticultural or agricultural crops, are exceedingly perishable. Postharvest losses in floriculture are higher than other sectors due to poor keeping quality. There is a significant increase in flower crop area, production, and productivity in Nepal. But there is an urgent need to reduce the massive postharvest losses in terms of value of the produce, which are estimated to be 30-40% of farm value.

According to Çelikel and Reid (2002), in order to extend the life and preserve quality of cut flowers after harvest, floral preservatives are widely employed in floral arrangements. Some of the floral preservatives are germicides, acidifiers, hormones and growth regulators (Hamza *et al.,* 2017). In this regard, the study explored the effect of different floral preservatives on increasing the vase life of marigold.

MATERIALS AND METHODS

Location of experiment site

The experiment was conducted at the Department of Horticulture, Campus of Live Sciences, Tulsipur, Dang Nepal during the month of September 2021. This place has a humid tropical climate. Annual high temperature 29.9˚C and annual low temperature 15.61˚C ("Tulsipur Climate Weather Averages", 2021). During the experiment, the mean temperature of lab was 21˚C and mean humidity was 60%.

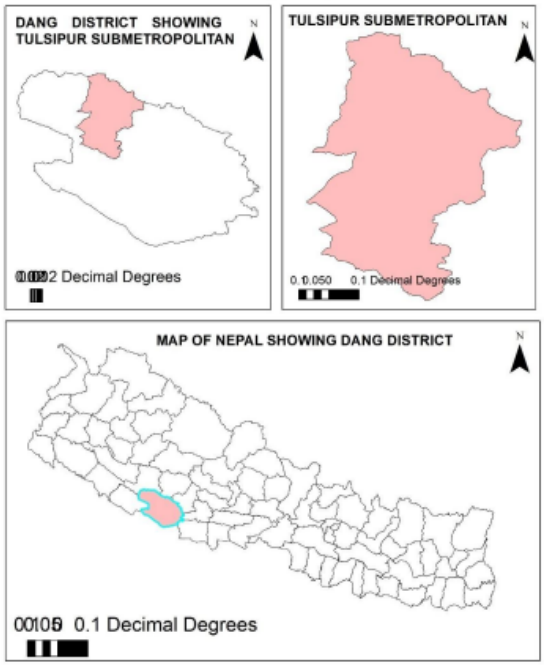

Figure 1. Map of experimental site

Selection of Variety

Variety selected was Inca II Orange was selected for the experiment.

Harvesting

Partially opened (25-50%) cut flower of marigold were harvested from Greencore Group Private Limited nursery, Hemantapur, Dang, Nepal in early morning to prevent water loss. Stems were wrapped by newspaper and were loosely tied with a rope. They were brought to horticulture lab of Campus of Live Sciences, Tulsipur after 15 minutes of journey from the nursery. In horticultural lab of Tulsipur stem were given slant cut because it exposes the greater stem area for increased water uptake.

Treatment details

Experiment is carried out with nine treatments in easily available commercial purpose flower vase. Out of which eight treatments were chemical with 10% sugar solution in each while the one is control. Treatment details are given below:

T0: distilled water, T1: silver nitrate, T2: malic acid, T3: citric acid, T4: salicylic acid, T5: gibberellic acid, T6: kinetin, T7: naphthalene acetic acid, T8: silver nitrate + citric acid + gibberellic acid

Design of experiment

The experiment was laid out in Completely Randomized Design. All nine treatments were applied in three set of replications. Each treatment had 3 stem of marigold cut flower.

Figure 2. Glimpse of experiment

Preparation of floral preservatives

Seven chemicals viz. silver nitrate, malic acid, citric acid, salicylic acid, gibberellic acid, kinetin, naphthalene acetic acid has used with 10% sugar solution and combination of silver nitrate, citric acid and gibberellic acid with 10% sugar solution. The stock solution of silver nitrate (100 ppm), malic acid (2000 ppm), citric acid (2000 ppm), salicylic acid (1000 ppm), gibberellic acid (50 ppm), kinetin (50 ppm), naphthalene acetic acid (50 ppm) were prepared.

Preparation of stock solution

1 g/L = 1000ppm or 1 mg/L= 1ppm

Procedure for preparing 100ppm of silver nitrate solution

0.1 g of silver nitrate powder was weighed by using weighing balance. The powder was poured into 1000 ml volumetric flask using a funnel. Little amount of distilled water was added and shaking and/or stirring the flask was done to dissolve the powder completely.

Further distilled water was added to the flask until lower meniscus reached to the 1-liter mark of the flask. The flask was closed with a plastic or wooden cap and stored in dark condition.

Since silver nitrate reacts immediately in presence of light, it must be stored in a black colored/painted flask or in a dark room. We can wrap the flask using black paper bag or black plastic.

For growers and producers to prepare 1000ppm solution:

If weighing machine is available one gram of preservative is weighed and dissolved to make a liter of solution

If weighing machine is not available, we can use teaspoon for approximately weighing the preservatives.

1 teaspoon = 5 grams of floral preservative powder (approximately)

So 1000ppm = 1 g/L = 1/5 teaspoon powder

Observations

After treatments were applied, different parameters of marigold stem contributing postharvest quality and vase life were monitored and recorded every day.

1. Fresh weight gain or loss (%)

Weight of treated stem were measured by using electrical weighing machine everyday

$$\text{Weight gain or loss (\%)} = \frac{Final\ Weight - Initial\ Weight \times 100}{Initial\ Weight}$$

2. Flower diameter (cm)

Diameter was measured by exploiting vernier calipers every day.

$$\text{Change in diameter (\%)} = \frac{Final\ Diameter - Initial\ Diameter \times 100}{Initial\ Diameter}$$

3. Volume uptake

Volume was measured using measuring cylinder

$$\text{Volume uptake} = \frac{Final\ Volume - Initial\ Volume \times 100}{Initial\ Volume}$$

4. Blackening

Blackening was determined by scoring.

5. Neck Bending

For determining neck bending daily observation was done.

$$\text{Neck Bending} = \frac{Total\ Number\ of\ Neck\ bent\ flowers \times 100}{Total\ number\ of\ flowers\ studied}$$

6. pH

pH of prepared solution was measured by using digital pH meter.

8. Post Harvest Life

Physical observation was done on alternate days.

Statistical analysis

After data collection data were entered in Microsoft excel then R-Studio software was used for data analysis. Significance of data were observed by ANOVA table at 5% level of

significance. After finding significance difference in some of the parameters further Least Significance Difference (LSD) was calculated in R-studio using the package Agricolae. After finishing the data analysis further result interpretation was done.

RESULTS AND DISCUSSION

Flower weight

Analysis of variation showed that there was not any significant difference in flower weight in different treatments. Maximum change in flower weight was found in control (38.81%) followed by malic acid (33.53%), salicylic acid (31.13%), citric acid (29.49%), naphthalene acetic acid (28.25%), gibberellic acid (26.86%), combination of silver nitrate, citric acid and gibberellic acid (26.54%), silver nitrate (23.39%) and minimum was found in kinetin (19.39%).

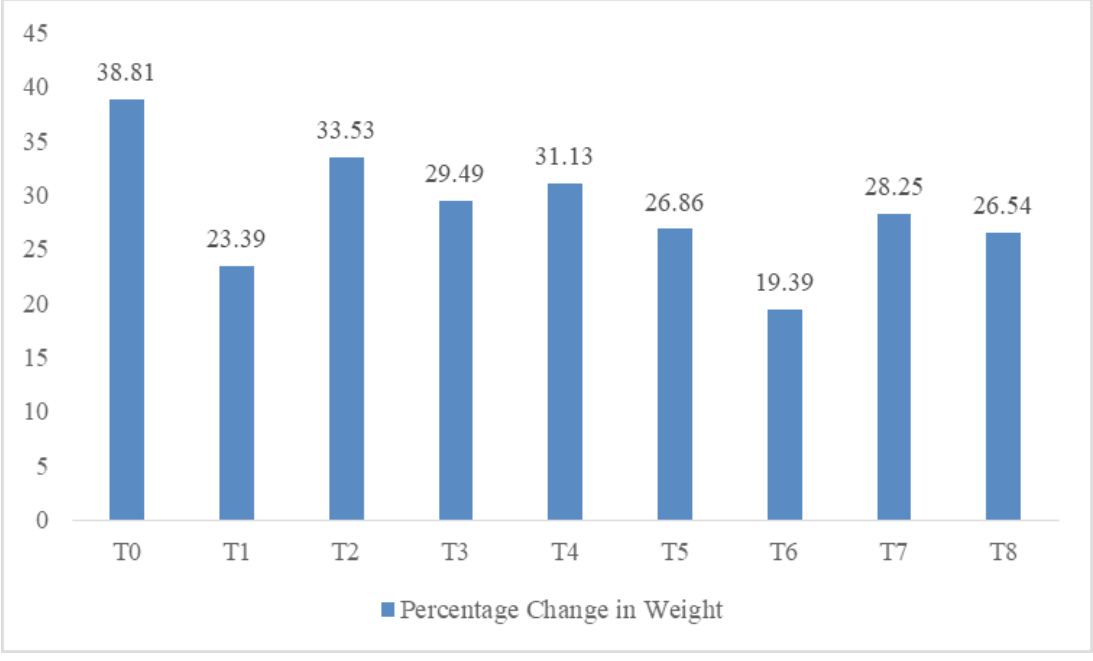

Figure 3. Bar graph showing percentage change in flower weight

The mean weight change was low in kinetin treatment because it helps greatly in water uptake, which maintains fresh weight and turgidity resulting in higher final weight as compared to other treatments. Kinetin being a growth promoter enhances the physiological activities rendering the senescence according to (Mayak & Halevy, 1974a). Naphthalene acetic acid and gibberellic acid treatments have the potential to raise the average weight of flowers (Tripathi *et al.,* 2003).

Flower diameter

The minimum change in diameter was observed in growth hormones i.e. gibberellic acid (4.18%), kinetin (6.23%), naphthalene acetic acid (8.62%), followed by combination of silver nitrate, citric acid and gibberellic acid (10.19%), malic acid (12.79%), salicylic acid (13.11%), citric acid (16.40%), control (18.25%) and the maximum change was observed for silver nitrate (23.58%).

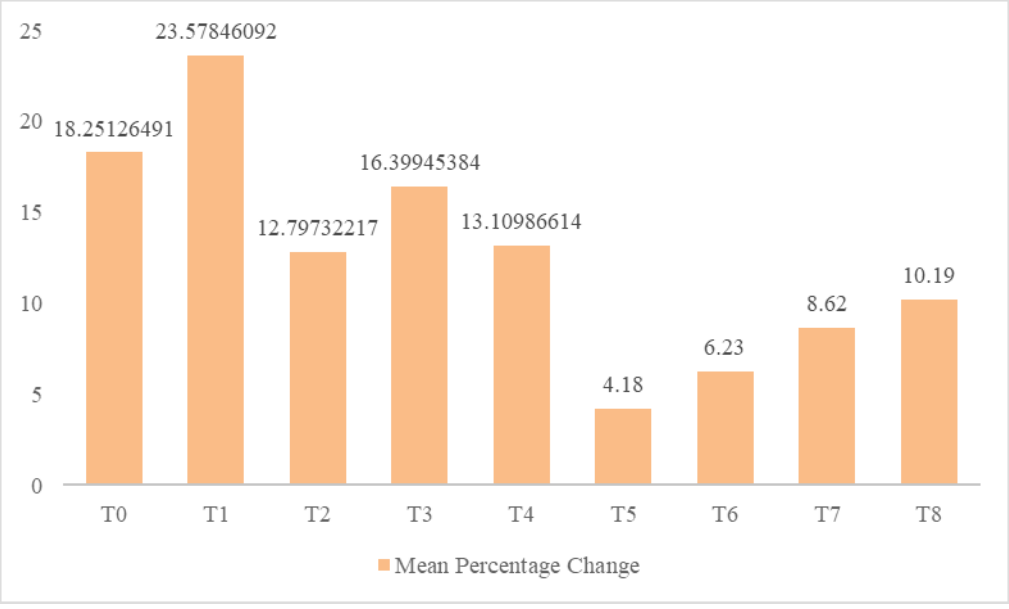

Figure 4. Bar graph showing percentage change in flower diameter

The major reason for minimum change in diameter for growth hormones accounts to the fact that they help in water absorption, maintenance of turgidity, anti-senescence property and promoting the physiological activities of cut flowers in vase (Horibe & Makita, 2021). The reason for maximum change in silver nitrate is due to limited water uptake as a result of controlling the bacterial growth (Abd El-Kafie *et al.,* 2014).

Volume uptake

The maximum uptake of solution was seen to be 24.09 ml from kinetin treatment followed by silver nitrate (22.99) with the smallest uptake from salicylic acid having treatment (6.33ml).

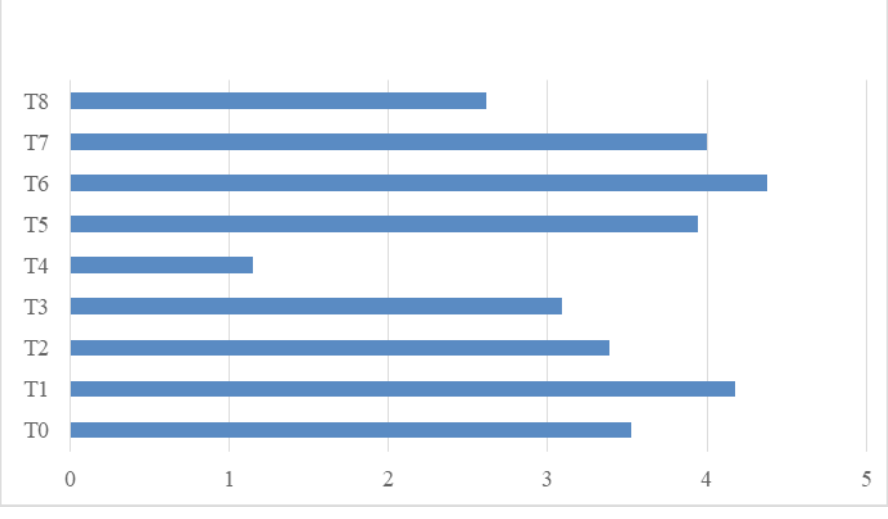

Figure 5. Line graph showing percentage change in water uptake

The less uptake of solution by salicylic acid treatment accounts for the fact that the higher concentration of the acid used destroys the xylem cells hindering the solution uptake. Kinetin helps to keep the xylem cells (Mayak and Halevy, 1974b).

Blackening

Blackening of petals and sepals was seen earlier in acidifiers (salicylic acid, citric acid) followed by control treatment and by biocides (silver nitrate, malic acid) and growth hormones (kinetin, naphthalene acetic acid, gibberellic acid).

Figure 6. Bar graph showing blackening score of marigold flower and stem

In the research done by Nowak and Mynett (1985) acidifiers destroys the living tissue when it stays in contact with living tissue for longer period of time and of high dose resulting in rapid senescence of flower. But growth hormones supply favorable environment for plant tissue and also act as anti-senescence agents.

Neck bending

100% neck bending was seen in salicylic acid treatment on an average of 4.11 days followed by 66.66% in citric acid on an average of 8 days with least in naphthalene acetic acid treatment (11.11%).

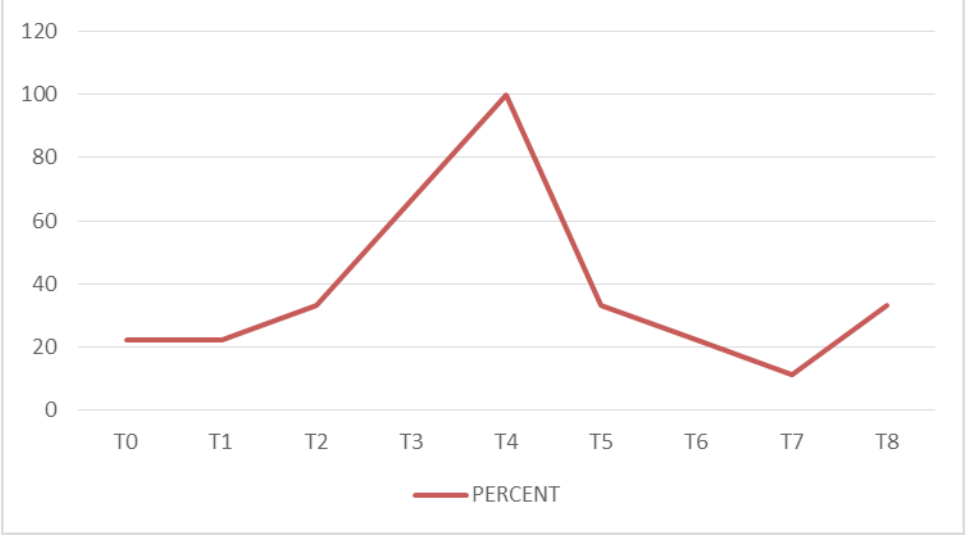

Figure 7. Line graph showing percentage of neck bending

The use of higher concentration of salicylic acid results in destroying and blockage of xylem cells easing the quicker neck bending process.

pH

Biocide (silver nitrate) and growth hormones (gibberellic acid, naphthalene acetic acid and kinetin) have normal pH of 7 which results to uptake more water hence, keep the freshness and increase the vase life. Low pH shows the higher percentage of floret opening resulting in the larger diameter of the flower.

Table 1. pH reading of various floral preservatives solution

Treatment	pH
TO	7
T1	6.6
T2	4
T3	4
T4	4
T5	7
T6	7
T7	7
T8	4

T0: distilled water, T1: silver nitrate, T2: malic acid, T3: citric acid, T4: salicylic acid, T5: gibberellic acid, T6: kinetin, T7: naphthalene acetic acid, T8: silver nitrate + citric acid + gibberellic acid

The pH value of growth regulators (kinetin, naphthalene acetic acid, gibberellic acid) is 7 as they are generally neutral in acidity while the other compounds like salicylic acid malic acid and citric acid being acidic in nature yields pH of 4 in solution.

Postharvest life

Among our treatments, largest vase life was found to be 14.66 days (about 2 weeks) for gibberellic acid, followed by kinetin (14.33 days), naphthalene acetic acid (13.33 days), silver nitrate (12 days) with smallest vase life for salicylic acid (9.33 days).

Table 2. Effect of various floral preservatives on postharvest life of marigold

Treatment	Days
T0	11
T1	12
T2	11.33
T3	10.33
T4	9.33
T5	14.66
T6	14.33
T7	13.33
T8	11.66

T0: distilled water, T1: silver nitrate, T2: malic acid, T3: citric acid, T4: salicylic acid, T5: gibberellic acid, T6: kinetin, T7: naphthalene acetic acid, T8: silver nitrate + citric acid + gibberellic acid

The higher value of post-harvest life gibberellic acid may be due to the fact that it delays the flower senescence by increasing the amount of disc floret open, delayed petal fading and abscission resulting in flower turgidity, reduced bent neck and improved flower (Emongor, 2004).

CONCLUSION

The present research entitled "Effect of floral preservatives on vase life of marigold (*Tagetes erecta* L.) cv. Inca II orange" under Tulsipur region of Lumbini province was conducted during 2021 at Department of Horticulture, Campus of Live Sciences Tulsipur, Dang. Complete Randomized Design was used with 3 replications in each treatment. The observation on change in flower diameter, flower weight post-harvest life and water uptake were recorded and the results were found optimum for kinetin (50 ppm) and gibberellic acid (50 ppm) treatments. From this research it can be concluded that floral preservatives play a key role on post-harvest parameters. The use of kinetin (50 ppm) as preservative was observed to be best for most of the parameter examined in this research i.e. change in weight, post-harvest period, neck bending and water uptake. For change in flower diameter gibberellic acid (50 ppm) was found to be best.

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