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Study on response of Marigold (*Tagetes erecta* L.) varieties for different vase solution to keeping quality and vase life of cut flower

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Abstract
The present study was carried out to find out the "Study on response of marigold (*Tagetes erecta* L.) varieties for different vase solution to keeping quality and vase life of cut flower" was studied at laboratory of Department of Floriculture and Landscape Architecture, College of Agriculture, IGKV, Raipur, (C.G) during season 2022-23. The experiment was laid out in Completely Randomized design (in Factorial arrangement). Under the present experiment, different varieties and vase solution were used. There were seven varieties *viz*. Arka Abhi (V_1), Arka Bahar (V_2), Arka Shubha (V_3), Punjab Gainda-1 (V_4), Calcuttia Gainda (V_5), Arka Bhanu (V_6), Pusa Basanti (V_7) and three vase solutions, *i.e.* tap (C_0) water, Citric acid 100 ppm (C_1), Aluminium sulphate 200 ppm (C_0) were used in combination of twenty one treatment. The result suggested that the relevant parameters of post-harvest quality of marigold stalk were significantly influenced by different varieties as well as by vase solution. The current study revealed that the among the cultivar; Arka Bhanu (V_6) and among the vase solution Citric acid @ 100 ppm (C_1) showed minimum physiological weight loss, minimum moisture loss per cent, minimum change in diameter of flower. Maximum solution uptake, maximum transpiration loss, maximum water loss uptake ratio, maximum number of days for deterioration, long vase life and late flower neck bent were also recorded under similar treatment *i.e.*, in Arka Bhanu and Citric acid 100 ppm. The treatment Tap water recorded with maximum physiological weight loss, maximum moisture loss per cent, maximum change in diameter of flower, maximum number of days for deterioration, maximum neck of flower.

Keywords: African marigold, varieties, vase solution, vase life

Introduction
Flowers are one of God's most beautiful boons to mankind, which brings joy and all Flowers symbolize beauty, love, purity, passion and tranquility. They are used on all religious festivals and occasions. Generally, flowers are offered by devotees in temple, gurudwara, church and masjid. Flowers are used in flower craft, arrangement of garland and bouquets. Flowers are used by people to express their affection for the other. Importance of flower is not restricted up to the beautification, decoration and preparation of garland but also have the industrial importance as coloring agents in the food and feed industries, as well as being used for antioxidants.

Marigold *(Tagetes spp.)* a member of Compositae family and is native of Central and South America especially Mexico. In India marigold is one of the most commonly grown flowers and used extensively on religious and social functions in different forms. It has gained popularity amongst the gardeners and flower dealers on account of its easy culture and wide acceptability. Further its habit of profuse flowering short duration to produce marketable flower wide spectrum of attention of colour, size and good keeping quality attracted the attention of producers and trade. Therefore, the commercial cultivation of marigold found its way in the vicinity of different big cities and towns.

Floral preservatives are a vital component of postharvest handling of cut flowers and are extensively used in floral arrangements to extend longevity and maintain quality (Nowak and Rudnicki, 1990, Celikel and Reid, 2002) [14, 1]. They maintain water uptake by controlling microbial growth and acidifying the solutions and provide sugars necessary to carry on metabolic activities after harvest. Moreover, they improve flower color development, flower opening and flower size (Nowak and Rudnicki, 1990) [14].

Different types of floral preservatives are aluminium sulphate, citric acid sliver thiosulphate, 8HQC, sugars. There antimicrobial compounds are used along with sugars to prevent microbial build-up in the solutions (Doorn, 1997) [3].

Citric acid and Aluminium sulphate are used to prevent microbial proliferation in vase solutions (Ichimura *et al.*, 2006) [5]. Sugars are an important component of flower foods because they provide carbohydrates to the cut stems to continue metabolic processes necessary for extension of vase life.

Material and Methods

The experiment was conducted at Laboratory at Department of Floriculture and Landscape Architecture, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G) Chhattisgarh in the year 2022. The experiment was designed as a complete randomized design (Factorial) with a total of 21 treatment combination. The treatments consisted of seven varieties (Arka Abhi, Arka Bahar, Arka Shubha, Punjab Gainda-1, Calcuttia Gainda Arka Bhanu, Pusa Basanti (Check variety), along with three vase solution *i.e.,* Tap water (Control), Citric Acid (100 ppm) and Aluminum Sulphate (200 ppm). The preservative solutions were made by dissolving specific chemicals in water. Each solution was freshly prepared as per treatment required with added 4% sugar. The solutions were then poured into bottle based on the treatment concentrations. A total of 250 ml of solution was filled into each bottle.

Result and Discussion

Physiological weight loss (%) and moisture loss (%)

Data presented in Table 1 show that the interaction between different varieties and vase solutions did not have a significant effect on physiological loss (%), moisture loss (%) and solution uptake (g), transpiration loss (g), although both factors individually had a significant impact. The minimum physiological weight loss (49.70 %) and moisture loss (70.26 %) was observed in Arka Bhanu (V_6) which was *at par* with Arka Shubha (V_3). While maximum physiological weight loss (52.21 %) and moisture loss (73.10 %) was noticed in Punjab Gainda-1 (V_4) and Pusha Basanti (V_7). Among the different vase solutions, Citric acid (C_1) 100 ppm recorded the significantly minimum physiological loss (%) of flowers (50.37 %) and moisture loss in (70.77 %). while the maximum physiological loss (%) of flowers (52.85 %) and moisture loss (73.29 %) was noted under Tap Water (C_0). These results Gupta and Dubey (2018) [4] also suggested that post harvest parameters of flowers and cultivars very considerably differed due to their genetic make-up. Different varieties responded different vase solution due to their genetics make up therefore the difference in moisture loss (%) among varieties had been observed. the result obtain in the present study was according to the result of Chingangbam and Yadav (2021) [2]. The moisture loss inter-related with physiological loss in weight (%). Increased physiological loss (%) in weight lead to decline in fresh weight of flower. Citric acid application in vase solutions affected water uptake, transpiration loss of water, maintained better water relationships and therefore improved cut flower moisture loss. Similar findings were reported by Uddiana *et al.* (2016).

Solution uptake and Transpiration loss

The maximum solution uptake (9.49 g) and transpiration loss (8.36 g) was noted in Arka Bhanu (V_6) which was statistically *at par* with Arka Abhi (V_1) and Arka Shubha. Whereas the minimum solution uptake (6.24 g) and transpiration loss (5.60 g) was observed in Pusa Basanti (V_7) and Arka Bahar (V_2). Among the different vase solutions, the maximum total uptake of solution/water (8.22 g) and transpiration loss (7.44 g) was noticed in Citric acid 100 ppm (C_1), while the minimum total uptake of solution/water (7.06 g) and transpiration loss (6.27 g) was recorded in the Tap water (C_0). The result solution uptake significantly varied with the different cultivars which might be due to well-developed water conducting tissues particularly xylem vessels in well responding cultivars. The results obtained in the present study was according to the result Patra and Mohant *et al.* (2017) [10]. Maximum transpiration/water loss was recorded in Arka Bhanu. This variation may be attributed to the fact that the performance of the cultivars may vary with the genetic makeup. The present study was according to the result of Siddiqua and Lakshmi (2017) [12]. Citric acid maintains a low solution pH, reducing microbial vessel blockage; additionally, added sucrose provides increased energy to stems, allowing them to maintain a steady metabolism over a longer period of time, resulting in increased water uptake and corresponding water loss. These results are in close association with Iqbal *et al.* (2016) [6].

Water uptake loss ratio

Different cultivars and vase solutions had a significant effect but their interactions were not significant. These data presented in Table 2. The maximum water uptake loss ratio (1.83) was observed in Arka Bhanu (V_6), which was statistically similar to Arka Shubha (V_3). The minimum water uptake loss ratio (0.88) was recorded in Calcuttia Gainda (V_5). Among the vase solutions, Citric acid 100 ppm (C_1) had the highest water uptake loss ratio (1.30), while Tap water (C_0) had the lowest ratio (1.02). These result maximum water uptake loss ratio was recorded in Arka Bhanu, this variation may be attributed to the fact that the performance of the cultivars may vary with the genotypic expression. Similar result have also been reported by Khan *et al.* (2018) [7] in chrysanthemum. The maximum uptake loss ratio indicates that there was a more uptake of water than there was a greater loss of water from the stalk, which raised the stalk water balances or water status above the less uptake loss ratio. This is due to influence of citric acid which helped in preventing xylem observation & improves water balances in cut stem. The results were in accordance to those found by Iqbal *et al.* (2016) [6].

Days taken to deterioration of flower (Days) and Flower with bend neck (Days)

Different varieties and vase solutions had a significant effect on the number of days taken for flower petals to deteriorate and neck bend of flower (days) but their interactions were non-significant. These data presented to Table 2. The maximum number of days deterioration (5.56 days) and late flower neck bend (7.56 days) was noted in Arka Bhanu (V_6) which was found *at par* with Arka Shubha (V_3) and Calcuttia Gainda (V_5). While the minimum number of days deterioration (3.00 days) and neck band of flower (5.56 days) was recorded in Arka Bahar (V_2) and Pusa Basanti (V_7). Among the vase solutions, tap water (C_0) had the maximum number of days deterioration (3.50 days) and neck of flower (5.08 days), while Citric acid had the minimum number of days deterioration of flower (4.00 days) and neck bend of flower (6.67 days). These result days to flower deterioration and neck bend significantly varied among the different

cultivars, it may be due to difference in genetic makeup. The results obtained in the present study was according to the results of Mehraja *et al.* (2016) [9] and Gupta and Dubey (2018) [4]. Addition of Citric acid and Aluminium sulphate flower preservative in vase solution might helped in prevention or reduction of population of these microorganism in vase solution. Nowak and Rudnicki *et al.* (1990) [14].

Vase life (Days)

The effect of different varieties and vase solution were found significant but effect of interaction was non- significant. These data presented Table 2. The long vase life for different varieties (8.67 day) was observed in Arka Bhanu (V_6) which statistically similar with Punjab Gainda-1 (V_4). The shortest vase life (6.00 days) was observed in Arka Bahar (V_7). Among the different vase solution, the maximum vase life (7.42 days) was recorded in Citric acid (C_1) whereas minimum vase solution (6.33 days) was recorded in Tap water (C_0 These result variations in vase-life may be attributed to differential accumulation of carbohydrates from varied leaf production, sensitivity of cultivars to ethylene and genetically framework of the plant. Similar finding reported by Kumar *et al.* (2017) [8] and Sharma and Mishra *et al.* (2017) [11]. Increased vase life in chemical preservative and improved solution helped in decreasing the bacterial population, water conductivity in cut flower xylem. Might be possible reason of increased vase life of cut flower of marigold under these treatments reported by Uddina *et al.* (2016) [13].

Table 1: Effect of different variety and vase solution on different parameters of African marigold

Treatment		Physiological loss in weight (%)	Moisture loss (%)	Solution uptake (g)	Transpiration loss of water (g)
variety					
V_1	Arka Abhi	50.12	71.69	8.32	7.26
V_2	Arka Bahar	51.22	71.51	6.73	5.60
V_3	Arka Shubha	51.65	71.98	8.10	7.42
V_4	Punjab Gainda-1	52.21	72.64	7.55	7.22
V_5	Calcuttia Gainda	52.03	72.60	7.37	6.76
V_6	Arka Bhanu	49.70	70.26	9.49	8.36
V_7	Pusa Basanti	52.18	73.10	6.24	5.76
Sem+		0.54	0.60	0.37	0.34
CD at 5%		1.53	1.72	1.06	0.98
Effect of vase solution					
C_0	Tap water	51.85	73.29	7.06	6.27
C_1	Citric acid	50.37	70.77	8.22	7.44
C_2	Aluminum sulphate	51.68	72.28	7.74	6.91
Sem+		0.35	0.40	0.24	0.23
CD at 5%		1.00	1.13	0.70	0.65

Table 2: Effect of different variety and vase solution on different parameters of African marigold

Treatment Variety		Water loss ratio	Days taken to deterioration of flower (Days)	Vase Life (days)	Flowers with bend neck (days)
V_1	Arka Abhi	1.23	4.00	7.22	5.67
V_2	Arka Bahar	0.97	3.00	6.00	5.78
V_3	Arka Shubha	1.27	4.11	7.33	5.89
V_4	Punjab Gainda -1	1.25	3.67	7.44	6.22
V_5	Calcuttia Gainda	0.88	3.22	6.56	6.56
V_6	Arka Bhanu	1.83	5.56	8.67	7.67
V_7	Pusa Basanti	0.96	3.33	6.22	5.56
Sem+		0.19	0.29	0.40	0.373
CD at 5%		0.54	0.84	1.15	1.0
C_0	Tap water	1.02	3.50	6.33	5.08
C_1	Citric acid	1.31	4.00	7.42	6.67
C_2	Aluminum sulphate	1.22	3.58	7.25	5.92
Sem+		0.12	0.19	0.26	0.26
CD at 5%		0.35	0.55	0.75	0.75

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