*Original Research Article……..*

**International Journal of Agricultural Invention**

**(online available at www.agriinventionjournal.com)**

***International Journal of Agricultural Invention* 9(1): 300-304: June, 2024**

**ISSN: 2456 – 1797 (P)**

# Effect of gibberellic acid and salicylic acid on the postharvest quality and seed characteristics of French Marigold (*Tagetes patula* L.) cv. Pusa Arpita

***Anupam Tiwari[1], Joginder Singh[1], Rajendra Kumar[1], M. S. Rathi[1], Rashmi Nigam[2], Sumit Pal[3]**

[1]Department of Horticulture, Janta Vedic College, Baraut, Baghpat, U.P., India
[2]Department of Plant Pathology, Janta Vedic College, Baraut, Baghpat, U.P., India
[3]Narayan Institute of Agricultural Sciences, GNSU, Jamuhar, Rohtas, Bihar, India
***Corresponding email**: *uniquetiwari77@gmail.com*

**ARTICLE INFO**

**Original Research Article**
Received on May 06, 2024
Revised on May 11, 2024
Accepted on June 09, 2024
Published on June 11, 2024

**Article Authors**
Anupam Tiwari, Joginder Singh, Rajendra Kumar, M. S. Rathi, Rashmi Nigam, Sumit Pal

**Corresponding Author Email**
*uniquetiwari77@gmail.com*

**PUBLICATION INFO**

International Journal of Agricultural Invention (IJAI)
**RNI:** UPENG/2016/70091
**ISSN:** 2456-1797 (P)
**Vol.:** 9, **Issue:** 1, **Pages:** 300-304
**Journal Homepage URL**
*http://agriinventionjournal.com/*
**DOI:** 10.46492/IJAI/2024.9.1.38

**ABSTRACT**

The present investigation was carried out during the winter season of 2021-22 at the Horticulture Research Block, Janta Vedic College, Baraut, Baghpat, to evaluate the effect of exogenous application of gibberellic acid ($GA_3$) and salicylic acid (SA) on the postharvest quality and seed attributes of French marigold (*Tagetes patula* L.) cv. Pusa Arpita. The experiment comprised eight treatments and one control, laid out in a randomized block design. The treatments consisted of varying concentrations of $GA_3$ (100 ppm and 150 ppm) and SA (150 ppm and 300 ppm), applied both individually and in combination. Results indicated significant improvement in flower diameter, fresh and dry weight of flowers, shelf life, seed yield per plant and 1000 seeds weight across treatments compared to the control. The combined application of $GA_3$ and SA i.e. $T_7$ ($GA_3$150 ppm + SA 150 ppm) recorded the highest values for flower diameter (4.53 cm), fresh weight of flower (4.68 g) and dry weight of flower (0.89 g), whereas treatment $T_8$ ($GA_3$150 ppm + SA 300 ppm) recorded maximum shelf life (5.50 days), seed yield per plant (4.76 g) and 1000 seeds weight (2.84 g). The individual application of $GA_3$ (150 ppm) or SA (300 ppm) also demonstrated significant improvements compared to the control, albeit less pronounced than the combined treatments. The study concludes that the combined effect of $GA_3$ and SA effectively enhances both postharvest flower quality and seed attributes in French marigold cultivation, suggesting potential strategies for optimizing growth regulator applications to improve ornamental and seed production traits.

**KEYWORDS**

French Marigold, Gibberellic Acid, Pusa Arpita, Salicylic Scid

**HOW TO CITE THIS ARTICLE**

Tiwari, A., Singh, J., Kumar, R., Rathi, M. S., Nigam, R., Pal, S. (2024) Effect of gibberellic acid and salicylic acid on the postharvest quality and seed characteristics of French Marigold (*Tagetes patula* L.) cv. Pusa Arpita, *International Journal of Agricultural Invention*, 9(**1**): 300-304. DOI: 10.46492/IJAI/2024.9.1.38

French marigold (*Tagetes patula* L.) is a widely cultivated ornamental plant renowned for its vibrant flowers and versatility in landscaping, garland making and phytoremediation (Singh, 2006). Beyond its ornamental appeal, French marigold is a valuable source of bioactive compounds and holds significant potential for seed production in both commercial and breeding contexts (Singh, 2014). However, the postharvest quality and seed attributes of marigold are frequently hindered by various physiological and environmental factors, underscoring the need for effective strategies to enhance these traits. The application of plant growth regulators, particularly gibberellic acid ($GA_3$) and salicylic acid (SA), has emerged as a promising approach to improve flowering and seed quality. $GA_3$ is well-documented for its ability to promote cell elongation, flowering and overall growth in numerous horticultural crops (Meena *et al*., 2017 and Kumar *et al*., 2017).

Conversely, SA, a phytohormone recognized for its antioxidant properties and role in stress mitigation, has been shown to enhance flower longevity, seed weight, and plant defense mechanisms (Poudel and Subedi, 2020). Notably, when applied in combination, $GA_3$ and SA can exhibit synergistic effects that improve growth, yield and quality traits across various ornamental species. Given these insights, the present study aims to evaluate the effects of exogenous applications of $GA_3$ and SA both individually and in combination. This research seeks to identify effective growth regulator treatments that can optimize both the ornamental value and seed productivity of marigold cultivation under open field conditions.

## Materials and Methods

The present investigation was conducted at the Horticulture Research Block of Janta Vedic College, Baraut, Baghpat, Uttar Pradesh, during the winter season of 2021-22. Baraut is situated at latitude of 29º 6` North and a longitude of 77º 16` East, at an altitude of 231 meters above mean sea level. The climate of the Baghpat region is characterized as subtropical, featuring very hot summers, relatively cool winters and an uneven distribution of rainfall. The soil in the experimental field was sandy loam, well-suited for marigold cultivation. Prior to planting, well-decomposed farmyard manure (FYM) was applied at a rate of 30 tons per hectare to enhance soil fertility, along with the recommended doses of nitrogen, phosphorus, and potassium (NPK) provided in the form of urea, single super phosphate and muriate of potash (MOP).

Uniformly sized and healthy seedlings of French marigold cv. Pusa Arpita, aged 25 days, were transplanted at a spacing of 60 cm × 45 cm on raised beds during the first week of November. The experiment was designed using a Randomized Block Design (RBD) with eight treatments along with a control and replicated thrice. The treatments included varying concentrations of gibberellic acid ($GA_3$) and salicylic acid (SA), applied both individually and in combination: T0 (control), $T_1$ ($GA_3$ 100 ppm), $T_2$ ($GA_3$ 150 ppm), $T_3$ (SA 150 ppm), T4 (SA 300 ppm), $T_5$ (GA3 100 ppm + SA 150 ppm), $T_6$ (GA3 100 ppm + SA 300 ppm), $T_7$ (GA3 150 ppm + SA 150 ppm), and $T_8$ (GA3 150 ppm + SA 300 ppm).

These growth regulators were applied as foliar sprays according to the treatment schedule in two doses *viz*., ten days after transplanting and twenty days after the first spray. Throughout the study, standard cultural practices were adhered to, including timely irrigation, weeding and fertilization as per recommendations. Data on postharvest quality attributes such as flower diameter, fresh weight of flowers, dry weight of flowers, shelf life, weight of seeds per plant and weight of 1000 seeds were collected for each treatment. Observations were recorded on five randomly selected plants from each treatment to assess postharvest and seed attributes. The collected data were analyzed statistically following the standard procedures outlined by (Gomez and Gomez, 1985).

## Results and Discussion

### Flower Daimeter (cm)

The results revealed significant improvement in flower diameter of *Tagetes patula* L. cv. Pusa Arpita due to the exogenous application of $GA_3$ and SA, individually and in combination (fig 1). The control ($T_0$) recorded the smallest flower diameter (3.49 cm), while the maximum diameter (4.53 cm) was observed in $T_7$ ($GA_3$ 150 ppm + SA 150 ppm), followed closely by $T_8$ (4.48 cm). Combined treatments outperformed individual applications, indicating a synergistic effect. $GA_3$ promotes cell elongation and division, whereas SA enhances metabolic efficiency and stress tolerance, leading to superior floral growth. These findings align with earlier studies (Poudel and Subedi, 2020; Sathappan, 2018).

### Fresh and Dry Weight of Flower (g)

The results indicated a significant increase in both fresh and dry weight of flower with the application of $GA_3$ and salicylic acid, either alone or in combination (fig 2). The control treatment ($T_0$) recorded the lowest fresh weight (3.75 g) and dry weight (0.58 g), while T7 ($GA_3$ 150 ppm + SA 150 ppm) exhibited the highest values of fresh weight (4.68 g) and dry weight (0.89 g). Combined treatments ($T_5$-$T_8$) performed better than individual applications, suggesting synergistic effects of $GA_3$ and SA on enhancing metabolic activities and cellular growth. These findings align with earlier research emphasizing growth regulator benefits in marigold (Saha *et al*., 2019 and Gad *et al*., 2016).


**Fig 1. Effect of $GA_3$ and SA on flower diameter of flower diameter (cm)**

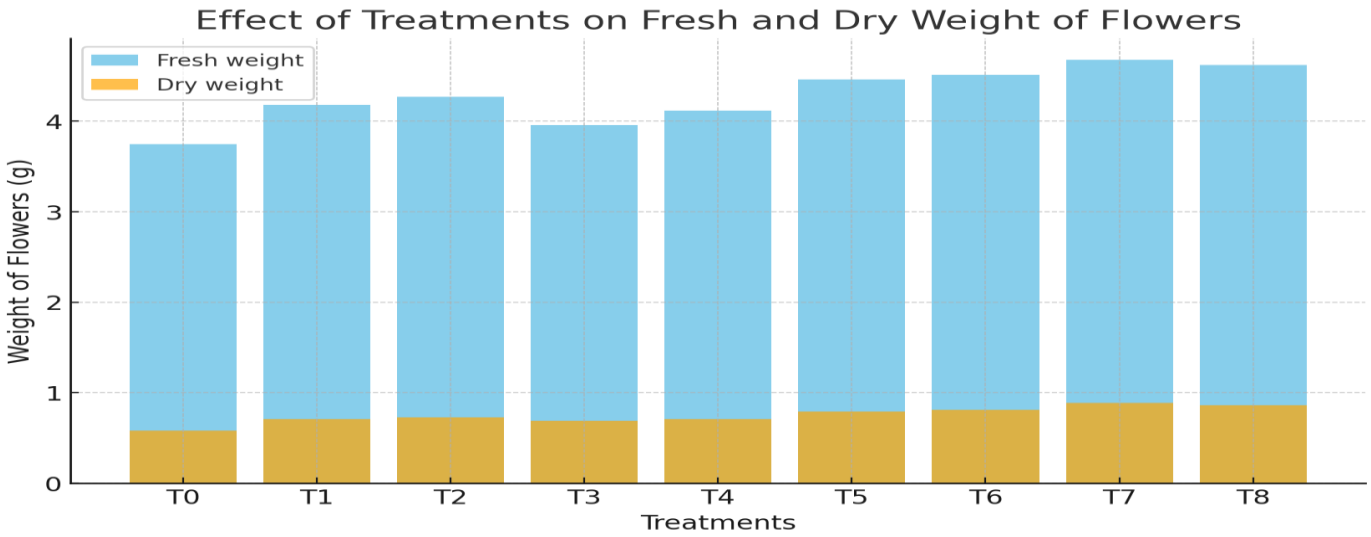


**Fig 2. Effect of $GA_3$ and SA on flower fresh and dry weight of flower (g)**

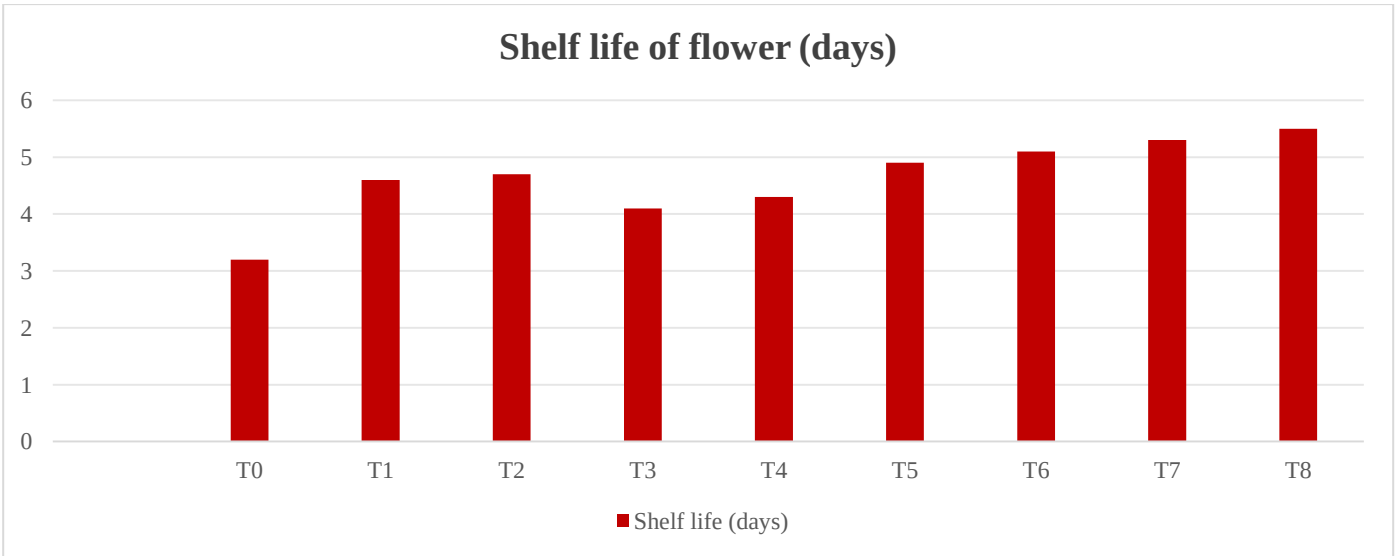


**Fig 3. Effect of $GA_3$ and SA on Shelf life of flower (days)**

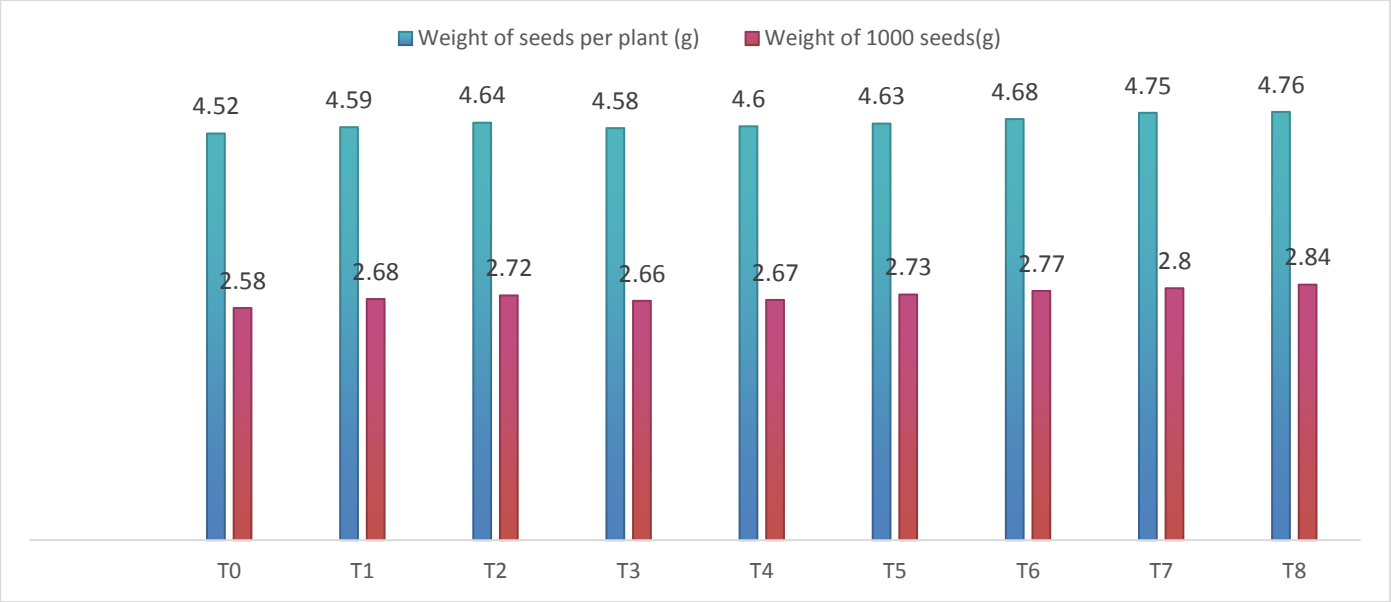


**Fig 4. Effect of $GA_3$ and SA on weight of seeds per plant (g) and weight of 1000 seeds (g)**

## Shelf Life (Days)

The data reveals a significant improvement in shelf life of flowers across treatments compared to the control ($T_0$). The control group recorded the lowest shelf life (3.2 days), while $T_8$ ($GA_3$ 150 ppm + Salicylic acid 300 ppm) exhibited the maximum shelf life (5.5 days). Treatments $T_7$ and $T_6$ also showed substantial enhancement, with shelf lives of 5.3 days and 5.1 days, respectively. These results suggest that the combined application of $GA_3$ and salicylic acid is more effective than their individual use, as seen in treatments $T_1$ to $T_4$, which ranged from 4.1 to 4.7 days. The improvement in shelf life can be attributed to $GA_3$'s role in delaying senescence by enhancing cell division and elongation, while salicylic acid reduces oxidative stress and maintains cellular integrity, ultimately prolonging flower freshness (Saeed *et al*., 2013).

## Seed Attributes

The data reveals that the application of growth regulators significantly enhanced seed attributes, with $T_8$ ($GA_3$ 150 ppm + Salicylic acid 300 ppm) showing the highest seed weight per plant (4.76 g) and 1000-seed weight (2.84 g), followed by $T_7$ ($GA_3$ 150 ppm + Salicylic acid 150 ppm) with seed weight per plant of 4.75 g and 1000-seed weight of 2.80 g. The control treatment ($T_0$) had the lowest values of 4.52 g for seed weight per plant and 2.58 g for 1000-seed weight.

The results suggest that the combined effect of gibberellic acid and salicylic acid improved seed development and quality by enhancing physiological processes related to nutrient mobilization, photosynthesis and hormonal regulation during seed filling. These findings are consistent with previous studies (Poudel and Subedi, 2020; Sathappan, 2018).

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