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FOLIAR APPLICATION OF HUMIC ACID AND SALICYLIC ACID ON GROWTH, FLOWERING AND YIELD OF CHRYSANTHEMUM CV. PADARI REVADI

Agriculture

Hemlata Khobragade Horticulture Section, College of Agriculture, Nagpur.

Shalini Badge* Horticulture Section, College of Agriculture, Nagpur. *Corresponding Author

Daiymanti Gudhekar Plant Pathology Section, College of Agriculture, Nagpur.

ABSTRACT

The present investigation the Study the "Foliar of humic acid and salicylic acid on growth, flowering and yield of chrysanthemum cv. Panadari Revadi" during the year 2021-22,rainy season under open condition at farm of Horticulture Section, College of Agriculture, Nagpur. The trial was conducted with nine treatments and treatments comprised of foliar application of humic acid and Salicylic acid viz., T1- (control), T2 - (1000 ppm HA), T3 - (2000 ppm HA), T4 - (3000 ppm HA), T5 - (4000ppm HA), T6 - (100 ppm SA), T7- (200 ppm SA), T8 (300 ppm SA) and T9 (400 ppm SA). The experiment was carried out in Randomized Block Design with four replications. Results revealed that Salicylic acid 200 ppm (T7) recorded significantly maximum vegetative growth i.e. plant height (58.04 cm), number of branches (7.71), stem diameter (0.66 cm), early initiation of flower bud(50.37 days), early fully opening of flower (19.60 days),early first harvest (81.31 days) with maximum flowering span (44.64 days), number of flower plant-1 (51.18), weight of flower (4.15g), yield of flower plant-1 (212.39 g) and yield per ha-1 (157.32 q).

KEYWORDS

Chrysanthemum, Salicylic acid, humic acid, growth, yield

INTRODUCTION

Chrysanthemum (*Dendranthema grandiflorum* (Ramat)) flower is one of the most versatile flower and are the second most popular flower, the first being roses in the world having various types, size and color. It is a leading commercial crop grown for cut and loose flowers and also as a pot plant (Navale *et al*., 2010). It is a native of China. It belongs to the family *Asteraceae* with more or less 200 cultivars. It is one of the top ten upper-class cut flowers globally, due to its various dazzling colors, shapes, excellent vase life and varying sizes (Leoni *et al*., 2019). In addition, the harvest stage of chrysanthemums must be carried out when their flowers are nearly perfectly open (Han, 2000). Considering the demand of flowers in market, a quality mainly depends on healthy growth of plant in different climatic conditions especially under biotic and abiotic stress.

Growth regulators such as salicylic acid (SA) and humic acid are usually used to regulate growth and flowering of ornamental flowering plants. Salicylic acid (SA) is a phenolic compound of hormonal nature produced by plants and plays an important role in responses to several abiotic stresses and to pathogen attack (Noreen *et al*. 2009, Abdelaal, 2015). SA has also been studied for its effects on various physiological processes related to growth and development of plants under normal conditions (no stress). Among these effects are the induction of flowering in herbaceous species (Hegazi and El-Shrayi, 2007), stimulation of root development, stomata closure and reduced transpiration (Singh and Usha, 2003), reversal of the effects of abscisic acid (Davies, 2004) and regulation of gravitropism (Hussein *et al*., 2007). The effect of SA as an endogenous regulator of flowering was demonstrated in a number of plant species belonging to different families (Hayat *et al*., 2007). In addition to regulate flowering time, SA also links defense responses and reproductive development (Martínez *et al*., 2004). Similarly, humic acid helps to play an important role in nutrient uptake of plant, reduce fertilizer requirement & increase flower yield. It stimulates plant enzyme & hormones and also promotes antioxidant activity. It was observed that humic acid treatment in pot marigold (*Calendula officinalis.* L) Significantly increase dry weight, plant height, leaves and number of flowers. (Mohammadipour *et al.* 2012).

The main objective of the current study was to investigate the effects of salicylic acid and humic acid and to determine the optimum concentration of each of them that gives the best growth and flowering of chrysanthemum.

MATERIALS AND METHODS

An experiment was conducted at the Research Farm of Horticulture Section, College of Agriculture, Nagpur during 2020-21. The experiment was laid in Randomized Block Design (RBD) with nine treatments replicated thrice at spacing 45 cm x 30 cm with gross plot size 1.80 m x 2.40 m. The treatments consisted of T1- Control (water spray), T2- Humic acid 1000 ppm, T3- Humic acid 2000ppm, T3- Humic acid 3000 ppm, T5-Humic acid 4000 ppm, T6- Salicylic acid 100 ppm, T7- Salicylic acid 200 ppm, T8- Salicylic acid 300 ppm and T9- Salicylic acid 400 ppm were applied as foliar spray. Chrysanthemum cv. Padari Revadi rooted cuttings were planted on 2nd September of 2020 on 1.80 m x 2.40 m bed contain 32 plants in each treatments.

All seedlings were similar in growth (having 7-8 leaves and 2-3 main roots per seedling) and 12 cm in length. A recommended dose of FYM @ 25 t ha^{-1} and standard dose of NPK @ 100:50:25 kg ha^{-1} was applied through Urea, SSP and MOP. The basal dose of 50 kg N and full dose of P and K was applied at the time of transplanting; remaining dose 50 kg N was applied at one month after transplanting.

As regards the treatments of humic acid, stock solution of desired quantity of HA (6000 mg) was dissolved directly in 6000 ml of distilled water. After that stock solution was made into different parts (1.0, 2.0, 3.0 and 4.0 ml) as it is readily soluble in 1000 ml water to make the required concentrations of HA (1000, 2000 and 3000 and 4000 ppm) and spray uniformly on plants. As regards the treatments of salicylic acid, one gram each of active substance of salicylic acid was dissolved in 10 ml of alcohol (C2H5OH) and final volume was made up to 1000 ml by adding distilled water and thus Stock solution of 1000 ppm salicylic acid was prepared. The stock solution thus prepared was used by adding distilled water to prepare the required concentration of salicylic acid as per the treatments (SA-100, 200,300 and 400 ppm) for foliar spray. Foliar spray of humic acid and salicylic acid in prescribed concentration of the treatments was undertaken on 30th , 60th and 90th day of transplanting of chrysanthemum seedling.

The growth substances were sprayed with the help of hand sprayer. The whole plant was sprayed completely by taking precaution to avoid the mixing of sprays from one treatment to another. All intercultural operation is carried as an when required. Observations were recorded on different growth and flower yield parameters viz., height of plant, number of branches, stem diameter, were recorded at 90 DAT and yield parameters viz., number of flower $plants^{-1}$, weight of single flowers, flower yield $plant^{-1}$ $plot^{-1}$ and ha^{-1} recorded at harvesting stage during the investigation.

Statistical analysis was done by using method of analysis of variance (ANOVA) for randomized block design (RBD) by Gomez and Gomez (1963). Whenever 'F' test was found significant for comparing the means of two treatments, critical difference (C.D. at 5%) was worked.

RESULTS AND DISCUSSION

Growth parameters

The data presented in Table 1 revealed that, different treatments showed significant differences with respect to vegetative growth parameters. It was observed that plant height (58.04 cm), number of branches plant^{-1} (7.71) and stem diameter (0.66 cm) was recorded significantly maximum in treatment salicylic acid 200 ppm and found statistically at par with the treatment humic acid 1000 ppm. However, minimum value in respect of plant height (43.50 cm), number of branches plant (5.47) and stem diameter (0.52 cm) was noticed in the control treatment. It was observed that maximum vegetative growth attained by chrysanthemum may be due to the rapid elongation, increased cell division and cell enlargement by exogenously application of salicylic acid. It may possible that salicylic acid could be involved in the regulation of cell enlargement and division in synergy with other substances such as auxin, IAA and phenolic which is recognized to regulate cell enlargement and division during root and shoot Similar finding of Kumar *et al.* (2015) results revealed that increase in primary and secondary branches with application of salicylic acid 200 ppm on China Aster cv. Kamini. Similar results were also reported by Gad El-Hak *et al.* (2012) with application of salicylic acid 200 ppm with humic acid 2 g l-1 increased the plant height in pea. Similar results were also obtained with the findings of Khobragade *et al.* (2019) in African marigold.

Flowering parameters

The data on presented in Table1, the days for initiation of first bud after planting ranged from 50.37 to 63.65 days during the experimental year. The minimum days (50.37 days) taken for imitation of first flower bud was recorded under treatment salicylic acid at 200 ppm which is at par with treatment salicylic acid at 100 ppm. However, the maximum days taken for initation of first flower bud (63.65 days) was observed in the treatment control (T1). Days to fully opened flower from flower bud from initiation of first flower buds ranged from 19.60 to 22.85 days. Significantly minimum days for fully opened flower (19.60 day) was recorded when plants sprayed with salicylic acid at 200 ppm which was at par with the treatment salicylic acid at 100 ppm. However, significantly maximum days to fully opened flower (22.85 days) was noticed in the treatment control. Similar results were also reported by Yeluguri *et al.* (2015) with salicylic acid 200 ppm in marigold crop, Ram *et al.* (2012) with salicylic acid 100 ppm for minimum days to first flower bud initiation in gladiolus.

Significant difference among the treatments was noticed in respect of days to first harvesting and total flowering span in chrysanthemum (Table1). Treatment salicylic acid 200 ppm recorded minimum days to first harvesting (81.31 days) with maximum flowering span (44.64 days) followed by treatments salicylic acid 100 ppm. The treatments control recorded significantly maximum days to first harvest (94.58 days) with minimum flowering duration (32.25 days). Similar results were obtained by Khodakhah *et al.* (2014) in tuberose. Choudhary *et al.* (2016) in African marigold showed that increased duration of flower was recorded in salicylic acid 1 mM l-1, Pawar *et al*. (2018) in gladiolus. The result showed that, the flowering span of gladiolus was noted significantly maximum with application of salicylic acid 150 ppm.

Table 1: Vegetative growth, flowering and yield as influenced by foliar application of Humic acid and Salicylic acid

Treatments	Plant height (cm)	Branches Plant^{-1}	Stem Diameter (cm)	Days to flower bud initiation (days)	Days to fully opened flower from bud emergence (days)	Days to first harvest (days)	Flowering span (days)	Weight of fresh flowers (g)	Number of flower plant^{-1}	Flower yield plant^{-1} (g)	Flower yield ha^{-1} (q)
T1 – Control	43.50	5.47	0.42	63.65	19.60	94.58	32.25	3.20	38.97	124.70	92.37
T2 - Humic acid 1000 ppm	55.30	7.10	0.52	54.23	22.30	96.15	33.24	3.70	39.98	147.92	109.57
T3 - Humic acid 2000 ppm	51.53	6.57	0.43	56.36	21.48	93.60	43.40	3.90	50.10	195.39	144.73
T4 - Humic acid 3000 ppm	51.72	6.07	0.47	57.20	21.46	95.20	38.40	3.50	44.47	155.64	115.18
T5 - Humic acid 4000 ppm	50.20	5.22	0.45	56.79	22.35	94.63	37.95	3.78	40.00	151.20	111.99
T6 - Salicylic acid 100 ppm	44.18	6.72	0.54	50.68	20.50	93.58	40.83	4.12	49.08	202.20	149.77
T7 - Salicylic acid 200 ppm	58.04	7.71	0.66	50.37	20.05	81.31	44.64	4.15	51.18	212.39	157.32
T8 - Salicylic acid 300 ppm	44.03	6.38	0.55	58.74	22.40	96.10	41.12	3.74	47.05	175.96	130.34
T9 - Salicylic acid 400 ppm	50.64	6.28	0.56	59.11	22.85	97.81	41.11	3.45	45.50	156.97	116.27
"F" Test	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig	Sig
SE (m)±	1.28	0.27	0.04	1.64	0.54	2.21	0.93	0.12	1.76	2.99	1.91
CD at 5%	3.84	0.81	0.13	4.92	1.63	6.61	2.78	0.36	5.28	8.97	5.72

Yield parameters

The different treatments showed significant differences with respect of weight of single flowers, number of flowers plant^{-1}. From the table 1 fresh weight of single flower ranged from 3.20 g to 4.15 g. and number of flowers plant^{-1} ranged from 38.97 to 51.18. The weight of single flower (4.15) and number of flower per plant (51.18) was noticed significantly maximum with the treatment salicylic acid at 200 ppm which was found to be at par with the treatment salicylic acid at 100 ppm (4.12 g & 49.08 respectively). While, minimum weight of flower (3.20 g), and number of flowers plant^{-1} (38.97) was noted with the control treatment. As regards flower yield plant^{-1} and ha^{-1} ranged from 124 .70 g to 212.39 g and 92.37 to 157.32 q respectively. The flower yield plant^{-1} (212.39 g) and ha^{-1} (157.32 q) was significantly maximum with the treatment of salicylic acid at 200 ppm respectively followed by the treatment salicylic acid at 100 ppm (202.20g & 149.77 respectively). While, minimum flower yield plant^{-1} (124.70 g) and ha^{-1} (92.37 q) was noted with the control treatment. The increase in the flower characters with salicylic acid application might be attributed to more tryptophan production which acts as a precursor of auxin which increases the vegetative growth and leads to production of more food material which in turn might have been utilized for better development of flowers. The salicylic acid might have altered the biophysical properties of cell wall and also there is a synergistic effect of salicylic acid and auxin, which ultimately favored photosynthesis and translocation of assimilates into flower organ. The results obtained during investigation are closely in agreement with the finding of Kumar *et al.* (2015) result revealed that, maximum weight of single flowers, number of flowers plant^{-1} with application of salicylic acid 200 ppm in China aster. Similar results were also reported by Chaudhary *et al.* (2015) with salicylic acid 1 mM l-1 for maximum number of flowers plant^{-1} in African marigold cv. Pusa Narangi Gainda. Khobragade *et al*. (2019) in African marigold showed that, number of flowers plant^{-1} and flower yield ha^{-1} was recorded maximum in salicylic acid at 200 ppm.

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