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Effect of Plant Growth Retardants on Growth and Flowering of Dahlia (*Dahlia variabilis* L.) CV. Edinburgh

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The present investigation was conducted in the Research Field, Department of Horticulture, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, from November 2021 to March 2022 to study the *effect of plant growth retardants on the growth and flowering of dahlia (Dahlia variabilis L.) cv. Edinburgh*. The seedlings were planted at a spacing of 50cm x 50cm from row to row and plant to plant to accommodate nine plants per 3- meter square area. The experiment's design used a Randomized Block Design with thirteen treatments that were duplicated three times. The plants were watered immediately after planting and at weekly intervals during the growing period. Based on the present investigation, the treatment T12 maleic hydrazide@1200ppm was found best in terms of plant growth parameters, flower, and yield of Dahlia. In terms of economics, the maximum Cost Benefit ratio (1: 2.62) was also found in treatment T12 maleic hydrazide@1200ppm, whereas the minimum Cost benefit ratio (1:1.33) was recorded in treatment T0 (Control).

Keywords: Retardants; growth; flowering; Dahlia (Dahlia variablis L.) cv. Edinburgh.

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1. INTRODUCTION

"Dahlia (*Dahlia variabilis* L) is one of the most popular bulbous flowers grown in many parts of the world for its beautiful ornamental blooms of varying shades of colors for the beautification of gardens and cut flowers. It belongs to the family Asteraceae having its origin in Mexico and received its name by Cavanilles in 1791. Dahlia (genus Dahlia), a genus of about 40 species of flowering plants in the aster family (Asteraceae)" [1]. "About six species in the Dahlia genus have been bred for cultivation as ornamental flowers and are popular in the floral industry and gardens. The thousands of dahlia cultivars are classed into various types: single, double, pompon, cactus, waterlily, peony-flowered, and dinner plate dahlias. Dahlias are tuberous perennials; most have simple leaves that are segmented, toothed, or cut. The compound flowers may be white, yellow, red, or purple"[2].

"Dahlia (*Dahlia variabilis* L) is a beautiful flower that, by its extraordinary quality, has attained the attention of many people worldwide. It is a perennial, half-hardy, herbaceous plant with a tuberous root system and erects growing habit (Marina, 2015). In India, it is mainly grown as a winter flower because of severe climatic conditions during summer. As a member of the Asteraceae, the flower head is a composite (hence the older name Compositae) with both central disc florets and surrounding ray florets" [2]. Even though each floret is a flower in and of itself, especially by horticulturists, they are frequently wrongly referred to as petals. Dahlias represent dignity and instability in the language of flowers, meaning my gratitude exceeds your care (Connolly, 2004). Dahlia offers a most extensive color range with two colors in the same flower because of the accumulation of anthocyanin and other flavonoids in their ray florets.

"Dahlias are an advantage for making bouquets and wreaths or vase decorations. The long clean, and stiff stocks are very suitable for handling and decoration. Developments after the discovery of growth regulators and their application in agriculture and especially in floriculture are significant. Regulations of plant growth and development using natural plant hormones for greater production have received the most attention. Growth and flowering responses of ornamental plants to these chemical substances have been intensively studied to have compact plants with a more significant number of flowers and also to hasten or delay flowering according to the grower's needs" [2].

Plant growth regulators (PGRs) are synthetically made organic compounds that are used to modify the growth of whole plants or specific plant components. Although photosynthesis supplies carbon and respiration energy for plant growth, a group of chemicals produced by plants known as plant growth regulators controls the growth and development of plants. At very low quantities, these compounds have an effect on plant processes. They can accelerate or retard plant growth. PGRs are sometimes confused with plant hormones, but there are specific differences among them as the agrochemical industry uses the term PGRs to indicate synthetic plant growth regulators. In contrast, "plant hormones are a group of naturally occurring, organic substances influencing physiological processes at low concentrations" (Davies, 2010).

1.1 Objective

1. To study the effect of different PGRs concentration on growth, quality and yield of dahlia.
2. To workout economics of various treatments.

2. MATERIALS AND METHODS

A field experiment was carried out in the Department of Horticulture, Naini, Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences during 2021-2022. The experiment was laid out in a randomized block design with thirteen treatments and three replications. The experiment included the application of different concentrations of plant growth regulators Ethephon, Alar, and Malelic hydrazibe (MH). Treatments were given with concentrations of Ethephon @ 300, 600, 900, and 1200 ppm, Alar @ 300, 600, 900, and 1200 ppm, and MH @ 300, 600, 900, and 1200 ppm, whereas water was sprayed on control plants. All the packages of practices were followed as per recommendation to raise a quality crop. Three plants were selected randomly from each treatment per replication, and the observations were recorded on various growth, flowering, quality, and yield parameters on these plants.

3. RESULT AND DISCUSSIONS

The result of the experiment has been presented under the following heading.

3.1 Vegetative Growth Parameters

Due to different concentrations of PGR, plant height varies significantly, and the maximum plant height (104.45 cm) was recorded in control, followed by treatment T1- ethephon @ 300ppm (104.22 cm). The shortest is found in the treatment T12-MH @ 1200ppm (90.11 cm). The difference in plant height may be due to the inhibition of gibberellin biosynthesis, which results in cell elongation and the suppression of apical dominance by inhibiting cell division. These results are in accordance with (Saiyad *et al.,* 2010 and Ahmad *et al.,* 2019) in dahlia.

Due to different concentrations of PGR, the no. of leaves varies significantly, and the maximum no. of leaves (138.00) was recorded in T12-MH @ 1200ppm, followed by treatment T11-ethephon @ 900ppm (132.56) and minimum no. of leaves (105.55) is found in the treatment T2-ethephon @ 600ppm. The difference in no. of leaves may be due to the increased number of branches. These results are in accordance with (Nagina *et al.,* (2015) in chrysanthemum.

Due to different concentrations of PGR, the no. of branches varies significantly, and the maximum no. of branches (8.22) was recorded in T12-MH @ 1200ppm, followed by treatment T11-ethephon @ 900ppm (7.33) and minimum no. of branches (5.78) is found in control.The difference in no. of branches may be due to the suppression of apical dominance by the growth regulators, thereby diverting the polar transport of auxins towards the basal buds leading to an increase in the number of laterals. These results are in accordance with [3] in dahlia.

Due to different concentrations of PGR, stem diameter varies significantly, and the maximum stem diameter (2.05 cm) was recorded in T12-MH @ 1200ppm, followed by treatment T11-ethephon @ 900ppm (2.02 cm) and minimum stem diameter (1.67 cm) is found in T2-ethephon @ 600ppm.The difference in stem diameter may be due to the growth regulators' decrease in the plant height, which increases the partition distribution of nutrients towards the lower parts. These results are in accordance with (Ahmad *et al*., 2019) and [3] in dahlia.

Due to different concentrations of PGR, the average length of branches varies significantly, and the maximum branch length (78.89 cm) was recorded in T2-ethephon @ 600ppm, followed by treatment T5- Alar @ 300ppm (78.11 cm) and minimum branch length (63.00 cm) is found in control. The decrease in branch length with the higher concentrations of growth regulators is due to inhibition of gibberellins biosynthesis, which reduces cell elongation. In comparison, these growth regulators at lower concentrations act as growth promoters, thus increasing the length of the branches. These results are in accordance with [4] in Zinnia elegans.

3.2 Flowering Parameters

Among the treatments, the minimum significant days to 1st flower bud initiation (67.87 days) was recorded in control, followed by T6 Alar @ 600ppm (68.17 days), and maximum days to1st flower bud initiation (79.36 days) was observed in T12 MH @ 1200ppm. This delay in flower bud appearance might be attributed to the suppression of apical dominance and increased vegetative growth in the form of branches by the growth retardants. Delay of flowering is often observed following the application of growth retardants, especially at very higher concentrations [5]. Similar results were recorded by [3] in dahlia.

Among the treatments, the maximum significant no. of flowers per plant (7.32) was recorded in treatment T12 MH @ 1200ppm, followed by T9 MH @ 300ppm (6.88), and the minimum no. of flowers per plant (4.58) was observed in treatment T0 Control. The probable reason for an increased number of flowers per plant in the best treatment is the production of more branches under the influence of growth retardants [6] and [7] in dahlia.

Among the treatments, the maximum significant days to complete opening of flower (12.67) was recorded in control, followed by T10 MH @ 600ppm (12.54), and minimum days to complete opening of flower (9.33) was observed in treatment T12 MH @ 1200ppm. The probable reason for the decrease in flowering duration might be the prolonged vegetative phase resulting in delayed flower bud appearance. **(**Arshid, A.L. 2009) also reported a reduction in flowering duration in chrysanthemum following treatment with chemical retardants.

Among the treatments, the maximum significant flower diameter (15.89 cm) was recorded in T12 MH @ 1200ppm, followed by T5 Alar @ 300ppm (15.22 cm), and minimum flower diameter (12.18 cm) was observed in control. The probable reason for the increase in flower diameter. The

Table 1. Effect of plant growth retardants on vegetative parameters of Dahlia (*Dahlia variabilis* L.) cv. Edinburgh

Treatments	Plant height	No. of leaves	No. of branches	Branch length	Stem diameter
Control	104.45	108.44	5.78	63.00	1.69
Ethephon @300ppm	104.22	116.22	7.33	69.44	1.83
Ethephon @600ppm	102.11	105.55	6.67	78.89	1.67
Ethephon @900ppm	93.67	118.89	7.00	68.78	1.79
Ethephon @1200ppm	92.56	120.56	7.22	69.67	1.78
Alar @300ppm	103.89	117.00	7.00	78.11	1.73
Alar @600ppm	99.45	120.44	6.89	73.56	1.70
Alar @900ppm	95.22	124.33	7.11	73.22	1.70
Alar @1200ppm	91.44	125.78	6.00	64.67	1.90
MH @300ppm	95.56	120.00	7.11	71.89	1.67
MH @600ppm	93.44	125.22	7.11	76.67	1.72
MH @900ppm	90.67	132.56	7.33	76.00	2.02
MH @1200ppm	90.11	138.00	8.22	69.45	2.05
F – Test	S	S	S	S	S
S. Ed	4.46	7.76	0.34	4.07	0.1
CD @ 5%	9.2	16.01	0.71	8.4	0.21

Table 2. Effect of plant growth retardants on floral parameters of Dahlia (*Dahlia variabilis* L.) cv. Edinburgh

Treatments	Days taken for first flower bud initiation	Complete opening of flower (days)	No. of flowers per plant	Flower diameter (cm)	Peduncle length (cm)
Control	67.87	12.67	4.58	12.18	20.45
Ethephon @300ppm	68.83	10.67	5.87	13.42	19.34
Ethephon @600ppm	68.33	12.33	6.72	13.79	13.67
Ethephon @900ppm	70.53	11.33	6.61	12.42	18.83
Ethephon @1200ppm	77.3	10.36	6.87	14.22	17.78
Alar @300ppm	68.31	10.33	5.91	15.22	16.22
Alar @600ppm	68.17	9.00	6.76	13.42	16.55
Alar @900ppm	71.26	8.67	6.51	13.78	17.00
Alar @1200ppm	69.99	12.47	6.82	14.78	19.56
MH @300ppm	71.94	9.00	6.88	13.5	17.5
MH @600ppm	72.15	12.54	6.71	12.22	20.00
MH @900ppm	70.9	12.00	6.33	13.79	19.00
MH @1200ppm	79.36	9.33	7.32	15.89	18.56
F – Test	S	S	S	S	S
S. Ed	2.17	0.69	0.28	0.9	1.03
CD @ 5%	4.44	1.41	0.58	1.86	2.13

Table 3. Effect of plant growth retardants on yield parameters and economics of Dahlia (*Dahlia variabilis* L.)

	YIELD PARAMETERS		ECONOMICS		
Treatments	**No. of Flowers per Plant**	**No. Flowers per hectare**	**Gross Return per hectare**	**Net Return per hectare**	**Cost-benefit ratio**
Control	3.78	113400	226800	129584	1.33
Ethephon @300ppm	4.56	136800	273600	176051	1.80
Ethephon@600ppm	5.56	166800	333600	235718	2.40
Ethephon@900ppm	5.44	163200	326400	228185	2.32
Ethephon@1200ppm	5.00	150000	300000	201452	2.04
Alar @300ppm	4.89	146700	293400	191684	1.88
Alar @600ppm	5.11	153300	306600	200384	1.88
Alar @900ppm	5.00	150000	300000	189284	1.70
Alar @1200ppm	5.78	173400	346800	231584	2.00
MH @300ppm	5.44	163200	326400	228031	2.31
MH @600ppm	5.33	159900	319800	220278	2.21
MH @900ppm	5.67	170100	340200	239525	2.37
F – Test	S	S			
S. Ed	15.58	6296.11			
CD @ 5%	31.84	12864.8			

increase in flower size is due to MH and might be due to the availability of more carbohydrates during the development of buds. Similar results were obtained by [8] in Rosa damascene.

Among the treatments, the maximum significant peduncle length (20.45 cm) was recorded in control, followed by T10 MH @ 600ppm (20.00 cm), and minimum peduncle length (13.67 cm) was observed in control. The probable reason for the decrease in peduncle length may be due to the inhibition of cell elongation by the growth retardants due to their inhibitory effect on gibberellin biosynthesis. Similar results were obtained by [3] in dahlia.

3.3 Yield Parameters

Among the treatments, the maximum significant no. of flower yield per plant (6.16) was recorded in T12 MH @ 1200ppm, followed by T8 Alar @ 1200ppm (5.78), and minimum no. of flower yield per plant (3.78) was observed in control. The probable reason for the increase in no. of flower yield per plant may be due to the rise in the number of branches. Similar results were obtained by **(**Ghadage et al., 2010) in gaillardia.

Among the treatments, the maximum significant no. of flower yield per hectare (184800) was recorded in T12 MH @ 1200ppm, followed by T8 Alar @ 1200ppm (173400), and the minimum no. of flower yield per hectare (113400) was observed in control. The probable reason for the increase in no. of flower yield per plant may be due to the rise in the number of branches. Similar results were obtained by [9] in marigold and [10] in dahlia.

4. CONCLUSION

The present investigation concluded that the plant growth regulator treatments significantly affected almost all the growth, flowering, yield characteristics, and quality of dahlia. Treatment T12, i.e., application of maleic hydrazide @ 1200 ppm, was found superior in terms of number of leaves (138.00), the highest number of branches (8.22), stem diameter (2.05cm), flower diameter (15.89cm), number of flower per plant (7.32), no. of flower yield/plant (6.16), no. of flower yield/hectare (184800), highest gross return (369600), net profit/ha (267772) and cost-benefit ratio (2.62) was obtained under the use of MH @ 1200 ppm(T12).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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