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Effect of Pinching and Foliar Application by Benzyladenine and Gibberellic Acid on Vegetative Growth and Chemical Composition of *Jatropha Multifida* Plants

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ABSTRACT

During the 2023 and 2024 growing seasons, this study was conducted at the nursery of the Department of Flowers, Ornamental Plants, and Landscape Gardens, Faculty of Agriculture, Alexandria University, Alexandria, Egypt. This study aimed to test the effect of applying foliar increasing the quality and performance of *Jatropha multifida* L. plants. The *J. multifida* seedlings were planted individually in plastic pots 30 cm in diameter. The plants were sprayed with gibberellic acid at the concentrations of 500, 1000, and 1500 mg/l and benzyladenine at the concentrations of 200, 250, and 300 mg/l, and the interaction between them. Gibberellic acid at 1000 mg/l and benzyladenine at 300 mg/l, when sprayed together, significantly increased plant height, number of leaves per plant, dry weight, area of leaves, stem diameter, dry weight, number of branches per plant, root length, and dry weight. However, the highest levels of chlorophyll, carbohydrates, nitrogen, phosphorus, and potassium were recorded in the leaves sprayed with a combination of gibberellic acid (1000 mg/l) and benzyladenine (250 mg/l).

INTRODUCTION

Medicinal plants are among Indonesia's abundant natural treasures and biological variety. Since ancient times, Indonesians have utilized the coral plant, or *Jatropha multifida* L. (*J. multifida*), as one of the numerous traditional medicinal herbs to treat a wide range of ailments. The benefits of *J. multifida* are not well understood by the average Indonesian. The plant's leaves, sap, and seed oil are beneficial components that have been used to treat a number of inflammatory skin conditions, open wound infections, and helminthiasis (Ivan *et al.,* 2019). *Jatropha* is native to Mexico and the Caribbean. This garden plant, Although native to Mexico and the Caribbean, *Jatropha* has been cultivated in South America, Africa, the Indian subcontinent, China, and Southeast Asia, and has now spread to Florida has now reached Florida. Consumption is mildly dangerous and causes gastrointestinal upset (Yotam *et al.,* 2000; see Figure 1).

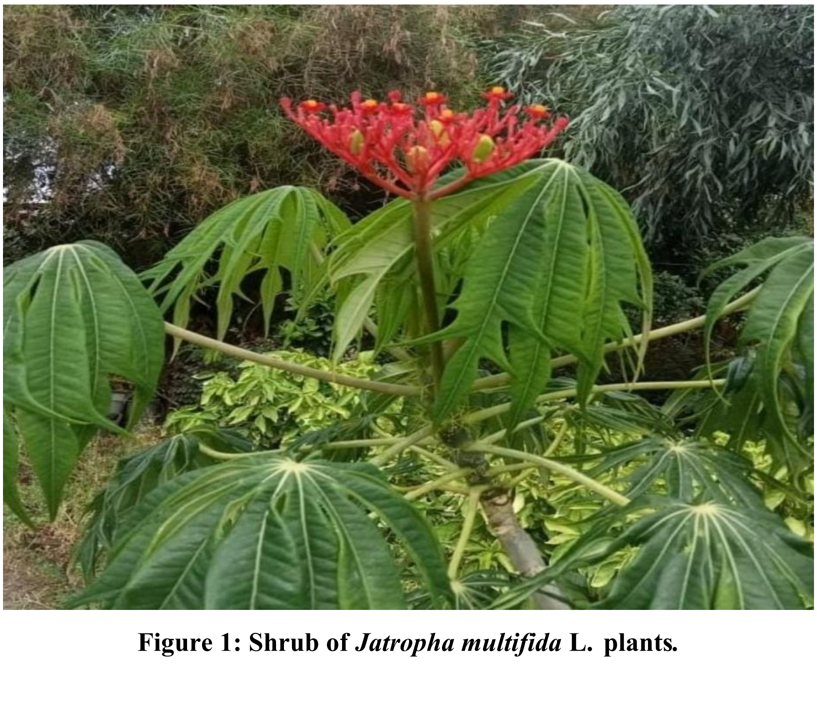

Figure 1: Shrub of *Jatropha multifida* L. plants.

Cytokinin-based plant growth regulators are very helpful for managing the traits of differentiation in cultured plants. They are essential to the mass production of plants because they are known to stimulate organ development and cell proliferation. Research is necessary to determine the ideal conditions because the effects of plant growth regulators differ greatly based on their type and concentration (Park and Park 2003; Kang *et al.* 2024).

Similar findings were reported by Ekaterine (2018). Classical phytohormones, specifically cytokinins, are crucial for plant growth and development at every stage. They postpone leaf senescence, enhance chloroplast differentiation, decrease apical dominance, control shoot and root growth, and accelerate cell division.

Cytokinins, in particular, 6-benzyladenine (6-BA), a plant growth regulator, have been utilized extensively in the cultivation of a variety of horticultural crops Zhang *et al.* (2016). According to Siddiqui *et al.* (2015), numerous investigations have demonstrated that 6-BA effectively delays plant senescence and significantly reduces lipid peroxidation and loss of membrane integrity in plant tissue. 6-BA therapy controls ROS production and membrane lipid metabolism, delaying mango fruit ripening and senescence Zhang *et al* .(, 2022), and Zhang *et al*.(2023).

Gibberellic acid (GA3), a plant growth regulator, is widely used in agriculture across many nations, including Egypt. One of gibberellins' most potent hormones is GA3. It is an endogenous and naturally occurring growth hormone that is administered exogenously as a plant growth regulator to hasten or speed up flowering.

Accelerate(earliness), (Gabr *et al.* 2021). GA3 affects many plant developmental processes, such as flowering, fruit development, dormancy breaking, and stem elongation via cell division and elongation (Neil and Reece, 2002). In the early phases of the blossoming process, GA3 can serve as a stand-in for cold. (Sałata *et al.,* 2013 and AL-Barbary 2022)

This study aimed to investigate a number of important traits of unpinched *Jatropha multifida* L. plants treated with foliar applications of gibberellic acid (GA_3) and benzyladenine (BA), as well as the effects of these treatments on preserving landscape plants of commercial quality.

MATERIALS AND METHODS

This study was carried out at the nursery of the Department of Flowers, Ornamental Plants, and Landscape Gardens, Faculty of Agriculture, Alexandria University, Alexandria, Egypt, during the growing seasons of 2023 and 2024. The purpose of the study was to ascertain how benzyladenine (BA) and GA_3 foliar sprays affect the yield and quality of *Jatropha multifida* L. plants. The nursery is where the plant was acquired. Due to its beautiful blossoms, this shrub is utilized for landscaping and adornment. They bought the shrub from a nursery.

On March 5th, 2023 (during the first season) and 2024 (during the second season), homogeneous seedlings of *J. multifida*.

(25–30 cm tall, with an average of four leaves per plant) were planted separately in plastic pots (30 cm in diameter) with 10 kg of sandy soil. Table 1 shows measurements of the chemical components of the soil.

Three sprays per season, starting on April 5th (in both seasons) and continuing every 30 days until June 5th (in both seasons),the following treatments were applied to the plants to the plants: 500, 1000, and 1500 mg/l of GA3, and 200, 250, and 300 mg/l of BA, and the combination of these. Chemicals were obtained from Sigma Trading Company. Tap water was sprinkled on the control plants. In both seasons, the plants were harvested on July 5.

To provide NPK chemical fertilization, each plant pot received 2.0 g of Milagro Amino leaf 20-20-20 fertilizer during both seasons. Fertilization treatments were applied every day during the growing season, which lasted from March 5 to July 5. Furthermore, the weeds were picked out by hand as soon as they appeared.

Data were recorded as follows:

(1) Vegetative growth parameters: Plant height (cm), number of leaves per plant, dry weight of leaves (g), leaves area (cm^2) as calculated by **Koller (1972)**, stem diameter (cm), dry weight of stem (g), number of branches per plant root length (cm) and dry weight of root(g).

(2) Chemical analysis determination:All chemical analyses had been performed in the Chemistry lab, Department of Soil and Water, Faculty of Agriculture, Alexandria University.

Table1: Some chemical analysis of the used sandy soil for the two successive seasons 2023 and 2024.

Season	pH	EC (dsm^{-1})	Soluble cations (mg/l)				Soluble anions (mg/l)		
			Ca^{++}	Mg^{++}	Na^{+}	K^{+}	HCO_3^-	Cl^-	SO_2^{--}
2023	7.87	1.51	3.1	4.2	5.4	1.1	3.5	6.5	2.4
2024	7.92	1.43	3.4	2.9	5.2	0.9	3.2	6.3	2.1

The total amount of chlorophyll (mg/l) in accordance with **Nornai (1982),** the amount of chlorophyll in leaf samples was measured as mg/g fresh matter.

- The leaves' total carbohydrate content (%) was calculated using the Dubois *et al.* (1956) method.
- Using the Pregl (1945) modified micro Kjeldahl method, the amount of nitrogen (%) in the digested solution was determined
- Phosphorus (%) in the leaves was calculated using the procedures described by Murphy and Riley (1962).
- Potassium (%) in the leaves was calculated using the procedures outlined by Page *et al.* (1982).

A full randomized block design (RCBD) was used in the experiment, and 16 treatments were divided into three replicates, each including three plants. An analysis of variance (ANOVA) was employed to evaluate the data using the SAS program (SAS Institute, 2002), and the LSD test was utilized to compare the mean values at the 5% level (Snedecor and Cochran, 1989).

RESULTS AND DISCUSSION

1. Vegetative growth

1.1. Plant height (cm)

The findings in Table 2 demonstrate that BA and GA3 treatments significantly affected plant height. When compared to the control plants, the plants sprayed with a solution of 300 mg/l BA and 1000 mg/l GA3 showed the maximum plant height in both seasons. Similar to other vegetative growth parameters, other vegetative the maximum plant length was 67.83 cm in the first season and 69.66 cm in the second when the plants were sprayed with a combination of 1000mg/l GA3 and 300 mg/l BA. However, in the first and second seasons, the control plants produced the shorter plants, 57.50 and 56.66, respectively. The growth in plant height increased significantly after treatment with 300 mg/l of BA and 1000 mg/l of GA3.

1.2. Number of leaves per plant

The information in Table 2 indicates that the number of leaves on *J. multifida* plants was significantly impacted by the various GA3 and BA treatments. The plants that were sprayed with 1000 mg/l of GA3 and 300 mg/l of benzy BA produced significantly more leaves, with mean leaf numbers of 48.66 and 48.16 in the first and second seasons, respectively. In contrast, in the first and second seasons, the control plants produced the fewest leaves per plant (33.83 and 28.00, respectively). The stimulatory impact of BA on the growth of additional leaves per plant may be the cause of these results. This result may be attributed to the enhanced development of plant leaves following exposure to 1000 mg/l of GA3 and 300 mg/l of BA.

Table 2: Mean values of plant height, number of leaves, dry weight and leaf area of *Jatropha multifida* L. plants as influenced by gibberellic acid (GA_3) and benzyladenine (BA) in the two seasons of 2023 and 2024.

Treatments (mg/l)	Plant height (cm)		Number of leaves per plant		Dry weight of leaves (g)		leaf area (cm^2)	
	2023	2024	2023	2024	2023	2024	2023	2024
Control	57.50	56.66	33.83	28.00	8.25	8.21	76.00	75.34
GA500	62.83	61.00	42.16	42.16	11.32	12.39	101.09	98.17
GA1000	63.16	61.33	42.66	42.66	12.80	13.19	100.51	99.17
GA1500	64.33	62.33	42.83	43.33	13.20	13.35	102.00	102.01
BA200	58.66	56.66	35.00	33.83	8.70	10.28	85.76	82.84
BA250	57.83	59.16	39.00	36.66	9.03	10.62	85.25	83.75
BA300	57.83	58.50	40.00	37.66	9.51	11.13	89.76	88.34
GA500 + BA200	60.00	60.33	40.33	38.00	10.18	11.26	93.09	90.67
GA500 + BA250	61.00	60.50	40.33	39.66	10.42	11.37	93.92	90.75
GA500 + BA300	61.33	60.50	41.66	40.00	10.88	11.42	96.17	95.18
GA1000 + BA200	64.83	63.16	47.50	45.83	15.45	14.26	107.33	106.51
GA1000 + BA250	66.33	64.83	48.50	46.16	15.78	14.96	107.00	107.00
GA1000 + BA300	67.83	69.66	48.66	48.16	16.19	17.85	108.00	107.50
GA1500 + BA200	62.00	62.66	44.00	44.16	13.28	13.38	103.34	102.00
GA1500 + BA250	63.16	62.83	46.33	44.66	13.88	13.56	105.00	105.00
GA1500 + BA300	64.33	64.83	46.66	45.16	14.32	13.74	106.50	105.17
L.S.D. at 0.05	6.59	5.47	7.84	9.42	5.33	4.68	8.35	8.75

1.3. Leaves dry weight (g) per plant

Additionally, Table 2 demonstrates that spraying 1000 mg/l of gibberellic acid and 300 mg/l of BA combined considerably improved the dry weight of leaves on *J. multifida*. plants. In comparison to the control (8.25 and 8.21 g per plant in the first and second seasons, respectively), the results showed values of 16.19 and 17.85 g per plant in the first and second seasons. Therefore, when compared to plants sprayed with any other amount, the data in Table 2 show that *J. multifida*. When the plants were sprayed with

GA3 at 1000 mg/l and BA at 300 mg/l, combined considerably enhanced the dry weight of their leaves. These findings are associated with the stimulatory impact of gibberellic acid on increasing the dry weight of leaves.

1.4. Leaf area (cm^2)

The findings in Table 2 demonstrate that the leaf area of *J.multifida* plants was significantly impacted by the various GA3 and BA treatments. Comparable increases in leaf area were observed in both them GA3 and BA treatments. With mean areas of 108.00 and 107.50 cm2 in the first and second seasons, respectively, the plants sprayed with 1000 mg/l of GA3 and 300 mg/l of BA produced leaves that were notably larger than those of the control plants. In the first and second seasons, the mean areas of the leaves formed by the control plants were 76.09 and 75.34 cm2, respectively.

1.5. Stem diameter (cm)

Table 3 shows that spraying *J. multifida*. Plants with the combination of 1000 mg/l of GA3 and 300 mg/l of BA produced the largest stem diameters (1.07 and 1.04 cm in the first and second seasons, respectively) against 0.81 and 0.83 cm, respectively, for the control treatment.

1.6. Dry weight of stem (g)

As shown in Table 3, when *J multifida*. plants were sprayed with 1000 mg/l of GA3 and 300 mg/l of BA, the highest stem dry weight values were 4.48 and 4.35 g in the first and second seasons, respectively. In contrast, it was found that spraying with tap water (control) decreased the stem dry weight to 3.26 and 3.41 g, respectively, in the first and second seasons, in comparison to other treatments.

1.7. Number branches per plant

Plants *J. multifida* sprayed with a mixture of 1000 mg/l gibberellic GA3 and 300 mg/l BA developed the most branches per plant, yielding 7.00 and 7.33 branches in the first and second seasons, respectively, according to the results shown in Table 3. On the other hand, during both seasons, control plants generated the fewest branches per plant, averaging 4.00 and 4.00 branches per plant. When 300 mg/l of BA and 1000 mg/l of GA3 were sprayed concurrently, the number of branches per plant increased, supporting the plant.

Table 3: Mean values of diameter, dry weight of stem and number of branches of *Jatropha multifida L.* plants as influenced by gibberellic acid (GA3) and benzyladenine (BA) in the two seasons of 2023 and 2024.

Treatments	Stem diameter (cm)		Dry weight of stem (g)		Number of branches per plant	
	2023	2024	2023	2024	2023	2024
Control	0.81	0.83	3.26	3.41	4.00	4.00
GA 500	0.91	0.93	3.84	3.94	4.00	4.33
GA 1000	0.92	0.95	3.90	3.97	4.00	4.33
GA 1500	0.92	0.96	3.93	4.00	4.00	4.33
BA 200	0.83	0.89	3.51	3.72	4.66	5.00
BA 250	0.87	0.89	3.64	3.79	5.33	5.66
BA 300	0.86	0.91	3.64	3.88	5.33	5.66
GA500 + BA200	0.88	0.94	3.68	3.90	4.66	5.00
GA500 + BA250	0.90	0.94	3.78	3.92	5.00	5.33
GA500 + BA300	0.90	0.94	3.79	3.92	5.33	5.66
GA1000 + BA200	1.01	0.99	4.26	4.10	5.33	5.66
GA1000 + BA250	1.02	1.03	4.31	4.33	6.00	6.66
GA1000 + BA300	1.07	1.04	4.48	4.35	7.00	7.33
GA1500 + BA200	0.99	0.97	4.16	4.04	4.66	5.00
GA1500 + BA250	0.99	0.97	4.18	4.07	5.00	5.33
GA1500 + BA300	1.01	0.97	4.21	4.09	5.66	6.00
L.S.D. at 0.05	0.10	0.13	0.42	0.49	1.01	1.07

1.8. Root length (cm)

The tallest root lengths, measuring 87.70 and 85.04 cm, respectively, were produced by spraying 1000 mg/l of GA3 and 300 mg/l of BA together on *J. multifida*. plants. This was in contrast to the results of the control treatment, which were 71.20 and 64.54 cm in the first and second seasons, as shown in Table 4. Simultaneous spraying of 1000 mg/l GA3 and 300 mg/l BA results in an increase in root length.

1.9. Dry weight of root (g)

J. multifida plants sprayed with BA at 300 mg/l and GA3 at 1000 mg/l simultaneously produced the heaviest root dry weights, 5.54 and 5.07 g in the first and second seasons, respectively, when compared to other treatments, according to Table 4. In contrast, spraying with tap water in contrast, the control treatment reduced the root dry weight to 2.84 and 2.97 g, respectively. The increase in root dry weight that occurs when BA (300 mg/l) and GA3 (1000 mg/l) are applied simultaneously supports these findings.

2. Chemical constituents

2.1. Total chlorophyll content (mg/g F.W)

The overall chlorophyll contents were significantly affected by the GA3 and BA treatments, according to the results of the leaf chemical analysis in Table 5. The first and second seasons had the highest mean readings, 4.42 mg/g and 4.79 mg/g, respectively. Throughout the first and second seasons, the values were recorded with 1000 mg/l GA3 and 250 mg/l BA treatments, respectively. For plants sprayed with tap water (control), the lowest mean values were 3.90 and 4.22 mg/g in the first and second seasons, respectively.

2.2. Total carbohydrates content (%)

The results in Table (5) also show that most of the tested concentrations of GA3 and BA increased the mean total carbohydrates in the leaves of *J. multifida* .plants when compared to the control. Out of all the plants that received the different treatments, the plants that were sprayed with a combination of 1000 mg/l of GA3 and 250 mg/l of BA had the highest levels of total carbohydrates in their leaves in the first and second seasons, respectively, at 15.01 and 15.09 percent. On the other hand, the mean total carbohydrates, 11.59 and 11.69, respectively, were generated by the control plants in the first and second seasons. The total carbohydrates after being treated with 250 mg/l of BA and 1000 mg/l of GA3.

2.3. Nitrogen percentage in leaves (%)

The data in Table 5 also show that the *J. multifida* plants sprayed with 1000 mg/l of GA3 and 250 mg/l of BA had a significantly mean nitrogen content in their leaves than the control. As a result, the first and second seasons had nitrogen concentrations of 3.25% and 2.96%, respectively. Results were lowest for plants sprayed with tap water (control) 2.80% and 2.56% in the first and second seasons, respectively.

Table 4:Mean values of root length and root dry weight of *Jatropha multifida L.* plants as influenced by gibberellic acid (GA3) and benzyladenine (BA) in the two seasons of 2023 and 2024.

Treatments	Root length (cm)		Dry weight of root (g)	
	2023	2024	2023	2024
Control	71.20	64.54	2.84	2.97
GA 500	79.70	71.873	3.92	3.79
GA 1000	80.20	72.37	4.24	3.95
GA 1500	82.04	73.87	4.28	4.10
BA 200	73.04	65.54	3.17	3.42
BA 250	71.70	69.04	3.43	3.45
BA 300	71.70	68.04	3.44	3.51
GA500 + BA200	75.20	71.04	3.53	3.62
GA500 + BA250	76.87	71.20	3.59	3.74
GA500 + BA300	77.20	71.20	3.67	3.75
GA1000 + BA200	82.87	75.20	4.97	4.62
GA1000 + BA250	85.37	77.54	5.11	4.69
GA1000 + BA300	87.70	85.04	5.54	5.07
GA1500 + BA200	78.20	74.37	4.42	4.23
GA1500 + BA250	80.20	74.54	4.46	4.38
GA1500 + BA300	82.04	77.54	4.79	4.45
L.S.D. at 0.05	10.54	8.17	1.96	1.75

Table 5: Mean values of chemical constituents of *Jatropha multifida* plants as influenced by gibberellic acid (GA3) and benzyladenine (BA) in the two seasons of 2023 and 2024.

Treatments	Chlorophyll content (mg/g F.W)		Carbohydrates Content in leaves (%) D.W		Nitrogen content (%)		Phosphorus content (%)		Potassium content (%)	
	2023	2024	2023	2024	2023	2024	2023	2024	2023	2024
Control	3.90	4.22	11.59	11.69	2.80	2.56	0.153	0.129	2.085	1.845
GA 500	4.01	4.33	12.22	12.32	2.88	2.65	0.162	0.138	2.165	1.932
GA 1000	4.10	4.42	12.88	12.87	2.97	2.70	0.170	0.144	2.248	1.988
GA 1500	4.04	4.37	12.503	12.56	2.92	2.67	0.165	0.140	2.198	1.952
BA 200	4.00	4.30	12.19	12.12	2.87	2.63	0.160	0.135	2.155	1.908
BA 250	4.10	4.40	12.86	12.78	2.96	2.71	0.17	0.143	2.245	1.985
BA 300	4.06	4.34	12.64	12.40	2.93	2.65	0.167	0.140	2.215	1.935
GA500 + BA200	4.15	4.45	13.20	13.02	3.01	2.73	0.175	0.147	2.295	2.012
GA500 + BA250	4.40	4.80	14.88	15.04	3.23	2.97	0.196	0.170	2.515	2.255
GA500 + BA300	4.29	4.69	14.15	14.44	3.13	2.89	0.186	0.162	2.415	2.175
GA1000 + BA200	4.14	4.49	13.15	13.24	3.02	2.75	0.174	0.149	2.292	2.035
GA1000 + BA250	4.42	4.79	15.01	15.09	3.25	2.96	0.198	0.170	2.532	2.245
GA1000 + BA300	4.19	4.59	13.52	13.87	3.05	2.83	0.178	0.155	2.335	2.108
GA1500 + BA200	4.18	4.54	13.41	13.60	3.04	2.81	0.177	0.152	2.325	2.078
GA1500 + BA250	4.33	4.64	14.40	14.15	3.17	2.86	0.190	0.159	2.455	2.142
GA1500 + BA300	4.25	4.60	13.86	13.93	3.10	2.83	0.183	0.156	2.382	2.112
L.S.D. at 0.05	0.06	0.08	0.45	0.52	0.06	0.05	0.006	0.006	0.061	0.058

2.4. Phosphorus percentage in leaves (%)

The findings in Table (5) also show that the *J. multifida* plants sprayed with 1000 mg/l of gibberellic acid and 250 mg/l of BA had a significantly higher mean phosphorus content in their leaves compared to the control. As a result, the first and second seasons' phosphorous contents were 0.198 and 0.170 %, respectively. The lowest values, 0.153 and 0.129 %, respectively, were observed in plants sprayed with tap water (control) in the first and second seasons.

2.5. Potassium percentage in leaves (%)

The findings in Table 5 also show that the *J. multifida* plants sprayed with 1000 mg/l of gibberellic acid and 250 mg/l of BA had significantly greater mean potassium concentrations in their leaves compared to the control. As a result, potassium levels were 2.245% in the first season and 2.532% in the second. In the first and second seasons, the plants that were sprayed with tap water (control) had the lowest values, 2.085% and 1.845%, respectively.

DISCUSSION

Effect of Benzyl Adenine:

One of the best growth regulators, BA, has been used to affect branching and other plant development processes. Ibrahim *et al.,* (2010) revealed their findings on croton plants. Spraying Zantedeschia *aethiopica* solution boosted the plant's leaf count, according to Majidian *et al.,* (2012). Our results showed that BA efficiently prevents and degradation of chloroplast and chlorophyll. Rose plants treated with 200 mg/l of BA showed benefits in plant spread, shoot length and diameter, and the number of cut stems/m^2 (Vasudevan and Kannan, 2015). These gains resulted in a decrease in leaf senescence and an increase in total chlorophyll content. Chlorophyll growth is stimulated by cytokinins. El-Shanhorey and Yousef (2023) assert that chlorophyll is essential to photosynthesis from the standpoint of light energy absorption and utilization.

Mondal and Sarkar (2017) investigated how BA affected the hybrid tea rose cultivar "Bugatti" in terms of growth, flowering, yield, and quality metrics. They discovered that biosynthesis and the breakdown of chlorophyll in photosynthesis are directly impacted by growth regulators of plant development. Plants treated with 100 mg/l of BA exhibited the largest floral diameter, the greatest spread, and the most flowers per plant in the cup stage. BA produced the greatest number of secondary shoots, the largest leaf area, the highest stalk diameter, and the longest blossom duration at 200 mg/l. When compared to other treatments, they concluded that BA 200 mg/l generated the highest-quality blooms. Chrysanthemum was subjected to foliar application of several plant growth regulators

(PGRs), according to Bala and Singh (2018).

According to the study, BA 200 mg/l had the longest bloom life and the highest floral diameter. Kapri (2018) looked into how GA_3 and BA affected post-harvest characteristics and lily blossoming. Different concentrations of GA_3 and BA (100, 150, and 200 mg/l) were applied to the plants. The results demonstrated that a single 100 mg/l dose of BA produced the biggest diameter, the lowest number of days required for buds to acquire color, and the longest vase life. However, GA_3 200 mg/l exhibited early blooming. Sijo *et al.,* (2020) evaluated how GA_3 and BA affected the morphological and floral characteristics of roses. Treatments with 200 mg/l and 250 mg/l of GA_3 and 200 mg/l and 250 mg/l of BA were applied topically. The plants that received foliar treatment with 200 mg/l of BA had the greatest number of leaves per branch, plant spread, and total number of branches per plant. An experiment by Jayshree *et al.,* (2020) examined the effects of GA3 and BA on the morphological behavior of Asiatic lilies.

Effect of Gibberellic acid:

By promoting cell division and expansion, chemical growth regulators particularly gibberellins—increase plant growth and internode length. According to reports, GA3 can raise the fresh and dry weights of numerous woody species as well as the stem length, stem diameter, number of branches, and root length (Mohamed, 2011; Ibrahim *et al.* 2010 and Hananfy *et al*. 2019).

It has been demonstrated that GA3 increases the activity of the oxgenase carboxylase non phosphate ribulose (Rabisco) enzyme, a crucial enzyme in photosynthesis in plants.GA3 affects the rate at which plants' dry matter accumulates because it speeds up photosynthesis by increasing the surface area of the leaves (Lester *et al.,* 2002). GA3 affects the rate at which plants' dry matter accumulates because it speeds up photosynthesis by increasing the surface area of the leaves (Lester *et al.,* 2002). Nonetheless, GA3 is used to regulate plant growth by boosting meristimatic activity, which encourages cell division and elongation in *Corchourus olitorius* (Bhattuchajee *et al.,* 2002).

The effects of different GA3 concentrations (50, 100, 150 and 200 mg/l) on the gladiolus cv. vegetative and floral characteristics were investigated by Aier *et al.,* (2015). According to Ibrahim *et al*. (2010) on croton plants, Halter *et al.,* (2005) observed that artichoke plants treated with GA3 had larger leaf areas. By increasing meristimatic activity and promoting cell division and elongation, GA3 is to control plant growth. El-Shanhorey and Sorour (2015) and Sorour and El-Shanhorey (2016) studied plants of the genus *Dracaena marginata.*GA3 affects cellular processes such as lengthening and promoting cell division, which increases vegetative development. Palei *et al.,* (2016) looked at the effects of a number of plant growth regulators on the growth, flowering, and yield characteristics of African marigolds. When GA_3 100 mg/l was compared to the other PGR, they saw a rise in plant height, the number of branches and leaves per plant, early flower bud initiation, first flower opening, flower weight per plant, and flower count per plant. Sumalatha (2017) conducted a study to evaluate the effects of GA3 on the vegetative "Menorca" (*Lilium longifolium*), floral, and bulb features of the Asiatic lilium variety. The plants were sprayed with four different doses of GA_3 (50, 100, and 150 mg/l), thirty days after they were planted. GA_3 100 mg/l demonstrated the most encouraging outcomes in comparison to other therapies. In comparison to the control, there was a considerable increase in plant height, flower buds per plant, spike length, bulb weight, bulblet weight, and bulblet number. Holkar *et al*., (2018) found that the gladiolus cv. "Summer Shine" was affected by GA_3 and BA.

Separately and in different combinations, GA3 (150, 200, and 250 mg/l) and BA (100, 200, and 300 mg/l) were used. The results showed that AlshakhalandQrunfleh (2019), *Cyclamen persicum* flowers grow faster when GA_3 is sprayed compared to untreated controls.

Additionally, they simultaneously open more blooms. Mishra *et al.* (2019) claim that GA_3 treatment has a major effect on the growth and yield traits of *Amaryllis belladonna* in terms of height, flower stalk length, and number of days needed to initiate buds, the plants treated with GA_3 were the tallest. Jayshree *et al.,* (2020) examined the impact of varying gibberellic acid concentrations (50, 100, and 150 mg/l) on the morphological behavior of Asiatic lilies. Early sprouting (6.00 days), a maximum plant height of 83.13 cm, a maximum leaf number of 67.25, a leaf length of 10.27 cm, and a leaf width of 2.52 cm were all results of applying 200 mg/l of GA_3. Patel (2020) evaluated the effects of foliar application of plant growth regulators on potted hibiscus plant growth and bloom. Applying GA3, BA, and salicylic acid in varying amounts (control) had a substantial impact on the vegetative growth, flowering characteristics, and plant pigments of *Hibiscus rosa-sinensis* plants. After being treated with 100 ppm GA3 for 30, 60, and 90 days, the plants reached their maximum height, spread, shoot length, and leaf area. More flowers per plant, more flowers per branch, larger-diameter blooms, and longer vase lifetimes were also seen. Higher levels of anthocyanins and chlorophyll were found in the plant flowers. It was found that different GA_3 concentrations had a substantial effect on calendula's capacity to produce high-quality flowers (Shrestha *et al.,* 2020). They saw the blossoming and the first bud form early on. According to a study by Yogendra (2023), the application of GA3 significantly increased plant spread, flower counts, branch and leaf counts, early blooming, and seed yield. Furthermore, it was discovered that GA_3 more efficiently speeds up blooming for commercial use.

CONCLUSIONS

Plants are indirectly impacted by the degree of flawless physiological interactions without developing deformities. These factors provide strong evidence for the need for growth regulators for marketing to raise quality. Gibberellic acid at 1000 mg/l and benzyladenine at 300 mg/l were the treatments that yielded the best results, even though their means did not differ considerably from one another. were seen in plant height, number of leaves per plant, dry weight of The greatest differences from other treatments were observed in the length and dry weight of the roots, the area of the leaves, the diameter and dry weight of the stem, the number of branches per plant, and gibberellic acid at 1000 mg/l and benzyladenine at 300 mg/l. The greatest differences from other treatments were observed in the length and dry weight of the roots, the area of the leaves, the diameter and dry weight of the stem, the number of branches per plant, and gibberellic acid 1000 mg/l and benzyladenine at 300 mg/l. The combination of 1000 mg/l gibberellic acid and 250 mg/l benzyladenine was the most effective therapy for total chlorophyll, carbohydrate, and nitrogen levels, as well as phosphorus and potassium levels, when compared to the control.

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الملخص العربي

تأثير التطويش ورش البنزيل أدنين وحمض الجبريليك على النمو الخضرى والتحليل الكيماوى على نباتات الجتروفا المرجانية

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فرع بحوث الحدائق النباتية بأنطونيادس– الإسكندرية– معهد بحوث البساتين – مركز البحوث الزراعية

تمت هذه الدراسة خلال موسمى 2023 و2202 فى مشتل قسم الزهور ونباتات الزينة– كلية الزراعة (الشاطبى) – جامعة الإسكندرية، الإسكندرية. كان الهدف من هذه الدراسة هو معرفة تأثير الرش بحمض الجبرللين والبنزيل أدنين على تحسين جودة نباتات الجاتروفا المرجانية. تم زراعة شتلات الجاتروفا فى أوانى بلاستيكية ذات قطر 30 سم. رشت النباتات بحمض الجبرللين بتركيزات (500 و 1000 و 1500 ملجم/لتر) كذلك بالبنزيل أدنين بتركيزات (200 و 250 و 300 ملجم/لتر). وكانت النتائج المتحصل عليها أظهرت أن رش نباتات الجاتروفا بحمض الجبرللين 1000 ملجم/لتر بالإضافة إلى البنزيل أدنين 300 ملجم/لتر أعطى نتائج معنوية فى كل من أرتفاع النبات، عدد الأوراق، الوزن الجاف

للأوراق، المساحة الورقية، قطر الساق، الوزن الجاف للساق، عدد الأفرع على النبات، طول الجذور، الوزن الجاف للجذور. بينما أظهرت نتائج رش النباتات بحمض الجبرلين 1000 ملجم/لتر بالإضافة إلى البنزيل ادنين 250 ملجم/لتر أعطى نتائج معنوية فى كل من محتوى الكلوروفيل الكلى ومحتوى الكربوهيدرات الكلية، نسبة النيتروجين فى الأوراق ونسبة الفوسفور فى الأوراق ونسبة البوتاسيوم فى الأوراق.