Response of Celosia Argentea (Plumosa) to Spraying With Growth Regulars (ABA and GA₃)

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Abstract

The experiment was carried out in lath house, College of Agriculture / University of Kirkuk for the agricultural on 15-3-2021. The concentrations of Abscisic acid (ABA) were (0, 10, 20, 40) mg.L⁻¹, Gibberellin (GA₃) were (0, 50, 100, 200) mg.L⁻¹. Results showed that Spraying with a concentration of 40 mg.L⁻¹ of ABA and a concentration of 100 mg.L⁻¹ of GA₃ gave a significant increase in most of the vegetative and flowering characteristics, as it was superior in plant height, number of plant branches, leaf area, chlorophyll percentage, wet and dry weight. As for the characteristics of flower growth, it was significantly superior in number of flowers, flower diameter, vase life, number of flowering branches, wet and dry weight of flowers.

Keywords: Celosia argentea, ABA and GA₃, Plumosa.

1. Introduction

Celosia argentea (plumosa) belongs to the family Amaranthacea and is native to Asia, plant high 70-100 cm, the stem is flat cylindrical, leaves are broad, lanceolate, alternately pedunculated, the inflorescence is velvety, feathery, in conical ears, either upright or drooping with colors Crimson, golden yellow, pink or purple, it is grown in back panels or as potted plants, prefers sunny locations and does not tolerate frost, It multiplies by seeds, which are shiny, lentil-shaped, planted in the spring, and it is one of the summer annuals that are planted in gardens. Its flowers are used medically, as they contain astringent and useful substances in relieving pain and treating dysentery, in addition to the fact that its flowers are suitable for picking and are considered semi-dry, so they are useful in drying and coordinating in dry bouquets [1]. Growth regulators are organic compounds being foodstuffs that provide carbon, energy, and nutrients necessary for the plant by stimulating, activating or modifying one of the vital processes in the plant. The formation of ABA takes place inside the chloroplasts in the mesophyll of plant leaves. There is a relationship between the concentration of ABA and GA₃ within the plant tissues. When the concentration of ABA decreases in the living plant tissues, the rate of GA₃ rises in the spring or summer, and the pathway of ABA production and gibberellin in plant tissues are involved in the biological interactions, place of production, formation and physiological effects of ABA on seed formation and flowering growth [2]. Also, [3] indicated that plant development is regulated by the addition of phytohormones (gibberellins, abscisic acid, porphyrin and cytokines).

Increasing evidence suggests that Abscisic acid (ABA) is a natural regulator of perianth senescence in flowers. The hormone is present in higher amounts in naturally senescing petals [4], and in petals senescencing prematurely in response to water [5], or an alteration in light quality [6]. Gibberellins are naturally found in all plants, and the coronary aperture, fresh leaves, and arboreal fruits, as well as modern embryos, are a major source of these compounds, the roots also produce free gibberellins inside the plant, as they move from the bottom to the top of the plant without hindrance [7]. That GA₃ binds to sugars and amino acids to form glycosides and cystides [8], [9] indicated that when spraying Celosia argentea with GA₃ at concentrations (0, 25, 50) mg.L⁻¹ led to the emergence of a significant increase, as it was found that treating it with the last concentration gave the highest rates for the characteristics of flower diameter, wet and dry weight of the flower compared to treatment of comparison. [10] stated that spraying Carnation with four concentrations of GA₃ (0, 100, 200, 300) mg.L⁻¹ led to a significant increase in all studied traits, and the treatment was superior to 300 mg.L⁻¹ by giving it the highest rate of length Flower stem, flower diameter, reduced date of first flower appearance, moderate increase in wet and dry weight and flowering age.

2. Materials and Methods

The experiment was carried out in the lath house of the College of Agriculture / University of Kirkuk for the agricultural season 2021, where the seeds planted on 15-3-2021 with two seeds in each pot of 25 cm size after filling them with a mixture...
of (soil + peat moss) at a ratio of 1:3. In the experiment, four concentrations of Abscisic acid and Gibberellin were used. The concentrations of Abscisic acid (ABA) were (0 , 10 , 20 , 40) mg.L\(^{-1}\), while the concentrations of Gibberellin (GA\(_3\)) were (0 , 50 , 100 , 200) mg.L\(^{-1}\). The plants were sprayed three times after two months of planting until completely wet using manual sprayers. The second spray was 20 days after the first spray, and the third spray was sprayed 20 days after the second spray. Fungicides (PREVICUR) and insecticides (CONFIDOR) were used in the form of a weekly preventive program by irrigating the soil at a concentration of (1) ml.L\(^{-1}\) of water for the purpose of protecting plants from fungal and insect infections, experiment was completed on 5-7-2021. The experiment was designed with randomized complete block design (RCBD), three replicates and the number of plants in the replicator was 16 plants. The averages were compared using the least significant difference L.S.D to show the statistical differences. The following data were recorded: (The data was taken when the first flower bud appeared on the plant).

2.1. Vegetative characteristics

Plant height (cm), total number of branches/Plant\(^{-1}\), number of leaves, stem diameter, leaf area (cm\(^2\)), percentage of total chlorophyll, wet weight (gm), dry weight (gm).

2.2. Floral characteristics

Number of flowers/plant\(^{-1}\), first flower diameter (cm), flower stem length (cm), flower stem diameter (cm), vase life (day), flower wet weight (gm), flower dry weight (gm), date the appearance of the first flower (day).

3. Results and Discussion

3.1. The vegetative growth characteristics

Table (1-A) indicates that spraying Celosia argentea plants with ABA concentrations had a significant effect on most of the studied vegetative growth characteristics, as the treatments led to a significant increase in plant height, number of branches, number of leaves, stem diameter, leaf area, percentage of chlorophyll, and wet and dry weight (1.23 cm), 90.3 branches/plant, 22.7 leaves/plant, 20.8 mm, 2.30 cm\(^2\), 1.20%, 25.22 g, 3.15 g) respectively at a concentration of 40 mg.L\(^{-1}\) compared to the untreated plants that recorded the lowest levels. As for spraying with Gibberellin, it is noted from Table (1-B) that the concentration of 200 mg.L\(^{-1}\) showed a significant increase in plant height as it reached 01.22 cm, number of branches 10.3 branches/plant, number of leaves 22.8 leaves/plant, stem diameter 2.31 mm, area Leafy 02.30 cm\(^2\), the percentage of chlorophyll was 3.21 % and the wet and dry weight was 25.22 (g) and 14.18 (g) compared with the control plants. As for the interaction between the concentrations of both ABA and GA\(_3\) growth regulators, Table (1-C) indicates that there were significant differences in most vegetative growth characteristics at a concentration of 40 mg.L\(^{-1}\) for ABA and 200 mg.L\(^{-1}\) for GA\(_3\).

3.2. The flowering growth characteristics

It was noted in Table (2-A) that all concentrations of ABA led to a significant increase in the number of flowers and that the increase was directly proportional to the increase in concentration. The concentration of 40 mg.L\(^{-1}\) recorded the highest increase in the number of flowers and flower diameter reached 60.5 flowers/plant. 30-7 cm, the length of the flower stem was 60.22, the diameter of the flower stem was 60.4 mm, the flowering age was 11.7 days, the wet and the dry weight of the flowers was increased, which amounted to 14.40 g and 41.30 g, respectively, and the date of the appearance of the first flower was 32 days.

Table (2-B) indicates that a significant increase in the number of flowers resulted when spraying plants with two concentrations of GA\(_3\) 100-200 mg.L\(^{-1}\), which amounted to 3.7 and 3.8 flowers/plant, as well as the results were significant in flower diameter, which reached 32.6 cm, flower stem length 15 cm, the diameter of the flower stem 3.6 mm, vase life 22.5 day, the wet and the dry weight of the flower (3.32 and 3.12) gm and the date of the appearance of the first flower 103.2 days. As for the interaction effect between ABA and GA\(_3\) growth regulators, Table (2-C) indicates that the interaction was significant in all studied characteristics.
**Table 1.** Effect of spraying ABA and GA3 and the interaction between them on the vegetative growth characteristics of Celosia argentea (plumosa).

### A- Effect of spraying ABA

| dry weight (gm) | wet weight (gm) | percentage of total chlorophyll | leaf area (cm²) | stem diameter | number of leaves | total number of branches.plant¹ | plant height (cm) | treatment mg.1⁻¹ |
|----------------|----------------|---------------------------------|-----------------|---------------|-----------------|--------------------------------|------------------|-----------------|
| 22.8           | 20.15          | 11.16                           | 4.22            | 11.3          | 20.3            | 11.2                          | 11.2             | ABA₀           |
| 23.9           | 30.16          | 20.11                           | 12.25           | 66.5          | 21.3            | 12.2                          | 3.13             | ABA₁           |
| 11.10          | 40.17          | 20.19                           | 11.26           | 21.7          | 26.5            | 15.2                          | 2.22             | ABA₂           |
| 3.15           | 25.22          | 1.20                            | 2.30            | 20.8          | 22.7            | 90.3                          | 1.23             | ABA₃           |
| 5.1            | 8.9            | 0.39                            | 2.1             | 15.1          | 0.2             | 24.1                          | 0.26             | L.S.D          |

### B- Effect of spraying GA3

| treatment | mg.1⁻¹ |
|-----------|---------|
| 11.7      | 12.11   |
| 40.8      | 20.11   |
| 11.10     | 23.15   |
| 14.12     | 25.30   |
| 8.1       | 10.11   |

### C- Interference effect between ABA and GA3

| treatment | mg.1⁻¹ |
|-----------|---------|
| 11.8      | 14.10   |
| 12.8      | 14.13   |
| 10.9      | 28.15   |
| 40.11     | 11.20   |
| 11.8      | 50.9    |
| 11.9      | 20.14   |
| 12.9      | 30.16   |
| 4.10      | 11.21   |
| 4.8       | 21.10   |
| 5.9       | 1.20    |
| 52.9      | 22.21   |
| 28.9      | 33.24   |
| 22.7      | 14.12   |
| 24.8      | 18.19   |
| 24.9      | 11.20   |
| 22.8      | 12.21   |
| 5.60      | 12.11   |

- **ABA₀**
- **ABA₁**
- **ABA₂**
- **ABA₃**

1. Plant height (cm)
Table 2. Effect of spraying ABA and GA$_3$ and the interaction between them on flowering growth characteristics of Celosia argentea (plumosa).

### A- Effect of spraying ABA

| date the appearance of the first flower (day) | flower dry weight (gm) | flower wet weight (gm) | vase life (day) | flower stem diameter (cm) | flower stem length (cm) | first flower diameter (cm) | number of flowers/plant$^1$ | studied characteristic | treatment mg.1$^{-1}$ |
|---------------------------------------------|------------------------|------------------------|----------------|--------------------------|------------------------|---------------------------|---------------------------|----------------------|-----------------------|
| 32                                          | 11.15                  | 11.30                  | 11.3           | 11.3                     | 3.15                   | 11.3                      | 0.05                      | ABA$_0$              |                       |
| 88                                          | 11.20                  | 36.35                  | 8.4            | 60.3                     | 21.19                  | 02.5                      | 30.3                      | ABA$_1$              |                       |
| 90                                          | 12.25                  | 40.39                  | 30.6           | 50.4                     | 33.20                  | 80.6                      | 50.3                      | ABA$_2$              |                       |
| 120                                         | 41.30                  | 41.40                  | 11.7           | 60.4                     | 60.22                  | 30.7                      | 60.5                      | ABA$_3$              |                       |
| 120                                         | 04.1                   | 07.8                   | 23.1           | 32.0                     | 82.1                   | 80.1                      | 12.4                      | L.S.D 0.05           |                       |

### B- Effect of spraying GA$_3$

| date the appearance of the first flower (day) | flower dry weight (gm) | flower wet weight (gm) | vase life (day) | flower stem diameter (cm) | flower stem length (cm) | first flower diameter (cm) | number of flowers/plant$^1$ | studied characteristic | treatment mg.1$^{-1}$ |
|---------------------------------------------|------------------------|------------------------|----------------|--------------------------|------------------------|---------------------------|---------------------------|----------------------|-----------------------|
| 90                                          | 80.7                   | 11.20                  | 11.3           | 14.3                     | 3.10                   | 55.4                      | 1.4                       | GA$_0$               |                       |
| 88                                          | 30.8                   | 11.31                  | 11.4           | 33.4                     | 40.11                  | 60.5                      | 52.5                      | GA$_1$               |                       |
| 87                                          | 11.9                   | 1.31                   | 20.9           | 22.5                     | 30.12                  | 61.6                      | 3.7                       | GA$_2$               |                       |
| 103.2                                       | 3.12                   | 3.32                   | 22.5           | 3.6                      | 15                     | 32.6                      | 3.8                       | GA$_3$               |                       |
| 3.8                                         | 2.4                    | 4.11                   | 3.1            | 08.1                     | 07.1                   | 97.1                      | 42.3                      | L.S.D 0.05           |                       |

### C- Interference effect between ABA and GA$_3$

| date the appearance of the first flower (day) | flower dry weight (gm) | flower wet weight (gm) | vase life (day) | flower stem diameter (cm) | flower stem length (cm) | first flower diameter (cm) | number of flowers/plant$^1$ | studied characteristic | treatment mg.1$^{-1}$ |
|---------------------------------------------|------------------------|------------------------|----------------|--------------------------|------------------------|---------------------------|---------------------------|----------------------|-----------------------|
| 1.80                                        | 10.8                   | 11.21                  | 21.4           | 20.3                     | 40.11                  | 30.4                      | 11.6                      | ABA$_0$              |                       |
| 40.89                                       | 90.8                   | 30.22                  | 26.5           | 50.4                     | 40.12                  | 32.4                      | 3.7                       | GA$_1$               |                       |
| 40.88                                       | 11.10                  | 31.30                  | 80.6           | 30.5                     | 90.13                  | 11.5                      | 3.8                       | GA$_2$               |                       |
| 30.96                                       | 14.13                  | 18.36                  | 90.7           | 80.7                     | 21.16                  | 32.8                      | 11.10                     | GA$_3$               |                       |
| 93                                          | 20.9                   | 11.22                  | 20.5           | 30.4                     | 30.12                  | 4.5                       | 4.7                       | GA$_0$               |                       |
| 96                                          | 4.10                   | 30.27                  | 80.6           | 13.5                     | 40.13                  | 66.5                      | 30.8                      | GA$_1$               |                       |
| 98                                          | 14.12                  | 41.12                  | 30.8           | 12.6                     | 50.15                  | 12.5                      | 4.9                       | GA$_2$               |                       |
| 80                                          | 40.18                  | 11.44                  | 40.9           | 08.7                     | 70.16                  | 11.10                     | 4.4                       | GA$_3$               |                       |
| 83                                          | 80.0                   | 12.10                  | 22.5           | 90.5                     | 20.14                  | 62.6                      | 90.5                      | GA$_0$               |                       |
| 90                                          | 2.9                    | 41.11                  | 20.7           | 82.6                     | 30.15                  | 72.7                      | 40.6                      | GA$_1$               |                       |
| 91                                          | 20.9                   | 20.12                  | 30.8           | 30.7                     | 30.16                  | 83.8                      | 80.7                      | GA$_2$               |                       |
| 77                                          | 20.4                   | 4.15                   | 89.8           | 30.8                     | 4.20                   | 10.9                      | 20.8                      | GA$_3$               |                       |
| 95                                          | 50.9                   | 14.12                  | 20.8           | 90.7                     | 90.15                  | 90.8                      | 80.7                      | GA$_1$               |                       |
| 100                                         | 3.10                   | 18.16                  | 10.9           | 40.8                     | 14.19                  | 95.8                      | 3.8                       | GA$_2$               |                       |
| 102                                         | 12                     | 4.20                   | 20.9           | 30.9                     | 12.20                  | 11.10                     | 40.9                      | GA$_3$               |                       |
| 1.70                                        | 1.9                    | 3.18                   | 62.1           | 40.3                     | 60.4                   | 33.9                      | 0.05                      | L.S.D 0.05           |                       |

4. Discussion

The reason for a significant increase in all the studied characteristics of Celosia argentea plant represented by vegetative and flowering growth to the role of growth regulators ABA and GA$_3$ is to increase the osmotic pressure of cells, which facilitates
the access of water and nutrients, which increases the size and breadth of cells, which leads to an increase in the diameter of the flower, the thickness of the flower stem and height, the increase is attributed to the role of GA₃ in increasing the vascular bundles, which contribute to the transfer of water and nutrients after absorption from the roots to the leaves to carry out the process of photosynthesis and then the transfer of manufactured materials to the rest of the plant parts [11],[3]. The increase in the dry matter of the flowers is due to the effect of GA₃ in increasing the vegetative and root growth, which was positively reflected in the outputs of the photosynthesis process in the manufacture, transport and accumulation of nutrients in the flowers. Also, the GA₃ compounds and plant hormones were higher in the flower compared to the flower stem after spraying by GA₃, which leads to the effect In reducing the level of ABA, which leads to the acceleration of the intensification of buds and early flowering, the reason is attributed to the role of GA₃ in activating genes, resulting in RNA, protein and enzymes needed for chemical transformations. GA₃ acts as a receptor for the metabolites of food and transports them to the top of the apical meristem, leading to cell division [12].

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