# Effect of Spraying with Putrescine and Indole Acetic Acid on Two Strains of *Antirrhinum majus L.*

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## ABSTRACT

The experiment was carried out in one of the plastic houses of Baqubah center nursery affiliated with Diyala Agriculture Directorate during the Agricultural season 2021-2022 to study the effect of, on growth and flowering of two strains (white and red) of snapdragon plant cv. 'Opus'. Foliar spraying with putrescine led to a significant increase in most of the vegetative and flowering growth characteristics, and spraying treatment with a concentration of 150 mg.$L^{-1}$ led to a significant increase in the characteristics represented by hight plant, number of leaves and flower stem length, while spraying treatment with a concentration of 50 mg.$L^{-1}$ was significantly superior and gave the best results represented by the number of florets in the inflorescence and the first basal floret opening date.Foliar spraying with Indole acetic acid led to a significant increase in vegetative and flowering growth characteristics, spraying treatment with concentration of 50 mg.$L^{-1}$ excelled and gave the best results for the vase life. It is clear from the results that the two strains varied in the characteristics of vegetative and flowering growth, where they varied in the strength showing of the traits, as the white strain outperformed in most of the vegetative and flowering traits and showed a significant increase in the number of leaves, leaf area, length of the flower stem and the vase life, while the red strain showed a superiority in number of inflorescences.The result of the interaction between foliar spraying with putrescine and Indole acetic acid for two strains of snapdragon plant showed a significant effect on all vegetative and flowering growth characteristics of the plant, the interaction treatment between the red strain and spraying with Indole acetic acid at a concentration of 150 mg.$L^{-1}$ recorded the best results for number of inflorescences while the interaction treatment between the white strain and spraying with putrescine at a concentration of 50 mg.$L^{-1}$ was superior, and the best results were recorded for the traits represented by number of florets per inflorescence and the first basal floret opening date.

**KEYWORDS:** Putrescine, Indole Acetic Acid, *Antirrhinum majus* L.

## INTRODUCTION

Snapdragon (*Antirrhinum majus*) is a special cut flower that can be grown in greenhouses and open fields [9]. The Snapdragon is grown in Iraq as an annual winter plant and sometimes stays for two years if planted in a place protected from the summer heat. Its flowers are found in a simple raceme colourful raceme and the florets are either single or layered, and the flower of the inflorescence open from bottom to top and gradually Flowers are suitable for picking, as plants are suitable for planting in pots, in basins or panels, and are also used for planting on Boarder rose [5] ; [6] ; [ 2]. Snapdragon belongs to the family Scrophulariaceae[17] . A common polyamine is putrescine (diamine) [24]. Polyamines have several regulatory functions in plants that are associated with the regulation of many physiological processes such as organogenesis, embryogenesis, flowering and development, root growth and tuber formation, leaf senescence, inhibition of ethylene biosynthesis, fruit ripening and development, and plant response to biotic and abiotic stresses [14[ ; [12] ; [30]. Plant growth regulators contribute to the regulation of physiological activities in plants, as they work to activate or inhibit vegetative growth, flowering, fruiting, or any other physiological process. Auxins are plant hormones which are organic substances that promote the growth of cell elongation when applied in low concentrations to parts of plant tissues in biological assays. In addition to the most common auxin, IAA, there are several other natural auxins that have been reported to occur in plants. All natural auxins are found in plants as free acids and in bound forms [19]. Auxins are responsible for cell elongation and organ development or formation [25], as well as a role in root formation [29], and young, actively growing tissues such as apical meristems, lateral buds, and young leaves are

the most important centers of auxin building [31 ]. The aim of the study is he suitability of these varieties to local conditions and their response to treatment with growth regulators, in order to reach the best vegetative and flower qualities.

## MATERIALS AND METHODS

The experiment was carried out in one of the greenhouses of Baquba center nursery affiliated to Diyala Agriculture Directorate during the agricultural season 2021-2022. The experiment was conducted for the period from 2021/12/19 to 2022/5/5, and the research steps started by planting the seeds of *Antirrhinum majus L.* cultivar 'Opus' imported from the Dutch company Syngenta in tray containing Peat moss on 2021/11/17. The cultivation medium used in the experiment was prepared, which consisted of a mixture of loamy soil and peat moss in a ratio of 3 loamy soil: 1 peat moss. Random samples were taken from agricultural soil and some chemical and physical properties were analysed before planting in the Central Laboratory for Soil, Water and Plant Analysis, University of Baghdad / College of Agricultural Engineering Sciences, Table (1).

| **parameters** | **Value** | **Unit** |
|---|---|---|
| EC (1:1) | 2.48 | dS $m^{-1}$ |
| PH (1:1) | 7.25 | - |
| Organic matter | 4.58 | % |
| CaCO3 | 135.00 | g $kg^{-1}$ |
| **Available minerals** | | |
| Nitrogen | 33 | mg $kg^{-1}$ |
| Phosphorous | 5.14 | mg $kg^{-1}$ |
| Potassium | 254.14 | mg $kg^{-1}$ |
| **Soil Composition** | | |
| Clay | 68 | g $kg^{-1}$ |
| silt | 60 | gm $kg^{-1}$ |
| Sand | 872 | g $kg^{-1}$ |
| Texture class | **Sand** | |

The experiment included the study of two factors, the first factor represented the use of two strains, the white strain and the red strain of the variety 'Opus', and the second factor represented by foliar spraying with Putrescine(importing from the British company Sigma Aldrich ) and indole acetic acid(produced from a German company) at concentrations 0, 50, 100 and 150 mg L-1 and symbolized by 0, Put50, Put100 and Put150, and symbols IAA50, IAA100 and IAA150, respectively, the concentration of the active substance is 99%. The plants were sprayed twice, the first after the emergence of 5-4 true leaves and the second one month after the first spray and with an interval of two days between spraying each factor of the study. A diffuser (liquid soap) was added with the spray solution. The plants were sprayed with the used concentrations until completely wet using a 2-liter hand sprayer.

The study was carried out as a factorial experiment with two factors (2×7) and with three replications according to the Randomized Complete Block Design (RCBD) to study the effect of two factors, the first two strains (white and red), and the second foliar spraying with Putrescine symbolized by Put and indole acetic acid symbolized by IAA, so the number of experimental units is 42 experimental units, each containing 8 pots in each pot of one plant, thus the number of

plants is 336. The number of treatments and their combinations used in the experiment is 14 treatments for each replicate.

The vegetative growth characteristics represented by plant height, number of leaves, leaf area, percentage of carbohydrates in leaves, frist basal floret opening date, number of florets per inflorescence, flower stem length and Vase life were measured. The percentage of carbohydrates in the leaves was calculated according to the method of Herbert [22]. The data were analyzed according to the SAS (2003) statistical program and the arithmetic averages were compared using a test Duncan's polynomial at the 0.05 probability level [3].

**Results and discussion**

**I. Effect of foliar spraying with Putrescine and indole acetic acid of two strains of *Antirrhinum majus* L. and the interaction between them on vegetative growth characteristics.**

The results of Table (2) showed that all concentrations of Putrescine and indole acetic acid led to a significant increase in plant height compared to the control treatment. The treatment of spraying with Putrescine at a concentration of 150 mg.$L^{-1}$ was superior in giving the highest plant height of 111.49 cm, while the lowest plant height was when the control treatment was 102.11 cm. The results showed that there were no significant differences between the two strains in the trait of plant height. The interaction treatments between the two studied factors had a significant effect on the plant height trait. The interaction treatment between the white strain and spraying with Putrescine at a concentration of 150 mg $L^{-1}$ was superior in recording the highest plant height of 112.55 cm, in When the interaction treatment between the red strain and spraying with distilled water (the comparison), the lowest plant height was 100.55 cm.

It was observed from the results of Table (2) that spraying Putrescine at a concentration of 150 mg $L^{-1}$ led to a significant increase in the number of leaves compared to the control treatment, as the average number of leaves was 433.37 leaf per plant $^{-1}$, but it did not differ significantly from the two treatments of spraying with Putrescine at concentrations 50 and 100 mg.$L^{-1}$ as they recorded the number of leaves of 430.52 and 415.21 of leaf per plant $^{-1}$, while the comparison treatment recorded the lowest number of leaves of 307.04 of leaf per plant $^{-1}$. The results showed that there were significant differences between the two strains in the average number of leaves, as the white strain outperformed significantly by giving it the highest number of leaves amounting to 421.90 leaf per plant $^{-1}$, while the red strain recorded the lowest number of 349.39 leaf per plant $^{-1}$. The results of the interaction treatments between the two studied factors indicated that there were significant differences in the average number of leaves, and the interaction treatment between the white strain and spraying with Putrescine at a concentration of 150 mg $L^{-1}$ was superior in recording the highest average number of leaves amounting to 498.79 leaves$^{-1}$, while it was lower when treating the interaction between The red strain and spraying with distilled water (the comparison) amounted to 293.54 leaves$^{-1}$.

**Table (2): Effect of spraying with Putrescine and Indole acetic acid on two strains of *Antirrhinum majus* L. on the vegetative growth.**

| Characters / Treatments | | plant height (cm) | no.leaves leaf plant$^{-1}$ | Leaves area (cm$^2$) | Total carbohydrate (%) |
|---|---|---|---|---|---|
| **0** | | 102.11 e | 307.04 c | 2949.7 d | 6.66 d |
| **Put50** | | 107.94 bcd | 430.52 a | 4466. 8 ab | 8.24 d |
| **Put100** | | 109.61 b | 415.21 a | 4723.0 a | 10.22 c |
| **Put150** | | 111.49 a | 433.37 a | 4625.6 a | 11.69 c |
| **IAA50** | | 108.44 bc | 366.54 b | 3712.7 c | 10.64 c |
| **IAA100** | | 106.99 cd | 375.33 b | 4157.2 b | 15.68 b |
| **IAA150** | | 106.32 d | 371.56 b | 4472.4 ab | 18.37 a |
| **Effect of Strain** | | | | | |
| **Strain** | **White** | 107.68 a | 421.90 a | 4516. 6 a | 10.20 b |
| | **Red** | 107.44 a | 49.9 b | 3799.9 b | 13.09 a |
| **Effect of Put and IAA × Strain** | | | | | |
| **0** | **White** | 103.67 f | 320.54 ef | 3130.8 gh | 5.63 g |
| | **Red** | 100.55 g | 293.54 f | 2768.7 h | 7.70 g |
| **Put50** | **White** | 109.55 bc | 484.62 a | 4892.8 bc | 6.76 fg |
| | **Red** | 106.33 ed | 376.41 bcd | 4040.7 ef | 9.72 de |
| **Put100** | **White** | 108.33 bcd | 465.29 a | 5611.3 a | 8.62 ef |
| | **Red** | 110.88 ab | 365.12 bcd | 3834.8 ef | 11.83 cd |
| **Put150** | **White** | 112.55 a | 498.79 a | 5205.3 ab | 11.72 cd |
| | **Red** | 110.44 ab | 367.96 bcd | 4046.0 ef | 11.66 cd |
| **IAA50** | **White** | 109.22 bc | 382.91 bc | 3856.6 ef | 9.02 ef |
| | **Red** | 107.66 cd | 350.16 cde | 3568.8 fg | 12.27 cd |
| **IAA100** | **White** | 106.44 ed | 392.71 bc | 4273. 3 ed | 13.61 c |
| | **Red** | 107.55 cd | 357.95 cde | 4041.2 ef | 17.75 b |
| **IAA150** | **White** | 103.99 ef | 408.50 a | 4646.0 cd | 16.04 b |
| | **Red** | 108.66 bcd | 334.62 def | 4298.8 ed | 20.70 a |

**Means in each column followed by similar letters are not significantly different (P>0.05) according to Duncan's Multiple Range Test (DMRT).**

The results of Table (2) showed that spraying Putrescine at a concentration of 100 mg L$^{-1}$ led to a significant increase in leaf area compared to the control treatment, The average leaf area was 4723.0 cm$^2$, but it did not differ significantly from the treatment of spraying with Putrescine at a concentration of 150 mg.L$^{-1}$, which amounted to 4625.6 cm$^2$, while the lowest average leaf area was when the

comparison treatment was 2949.7 $cm^2$. The results showed that there were significant differences between the two strains in the average leaf area, as the white strain outperformed by giving it the highest average leaf area amounted to 4516.56 $cm^2$, while the red strain recorded the lowest average leaf area amounted to 3799.86 $cm^2$. Foliar area the interaction treatment between the white strain and spraying with Putrescine at a concentration of 100 mg $L^{-1}$ was superior in recording the highest average leaf area of 5611.3 $cm^2$, while the interaction treatment between the red strain and spraying with distilled water (comparison) recorded the lowest leaf area of 2768.7 $cm^2$.

The results of Table (2) show that spraying indole acetic acid at a concentration of 150 mg $L^{-1}$ led to a significant increase in the percentage of total carbohydrates in the leaves as the percentage reached 18.37 %, compared to the comparison treatment that recorded the lowest percentage of 6.66%. There were significant differences between the two strains in the percentage of total carbohydrates in the leaves, as the red strain outperformed by giving it the highest percentage of 13.09%, while the white strain recorded the lowest percentage of 10.20%. The results of the interaction treatments between the studied factors indicated that there were significant differences in the percentage of total carbohydrates in the leaves, and the interaction treatment between the red strain and spraying with indole acetic acid at a concentration of 150 mg.$L^{-1}$ excelled in recording the highest percentage of 20.70%, while the interaction treatment between the strain was recorded. Whitening and spraying with distilled water (comparator) the lowest percentage was 5.63%.

**II. Effect of foliar spraying with Putrescine and indole acetic acid on two strains of Antirrhinum majus L. and the interaction between them on flowering characteristics.**

The results of Table (3) showed that spraying Putrescine at a concentration of 50 mg $L^{-1}$ led to the early opening of the frist basal floret opening date, and it took a period of 102.42 days, compared to the treatment of spraying with distilled water (the comparison) which took a period of 108.81 days. The results of the table showed that there were no significant differences between the two strains in the date of opening of the first basal floret opening date. The results of the interaction treatments between the two studied factors indicated that there were significant differences in the date of the emergence of the flowering in. The interaction treatment between the white strain and the Putrescine spraying at a concentration of 50 mg $L^{-1}$ led to the early opening of the first basal floret opening date, which lasted for a period of 98.84 days, while the treatment of the interaction between the white strain and spraying with distilled water (comparator) delayed the date and took a period of 112.79 days.

The results of Table (3) show that all concentrations of Putrescine and indole acetic acid led to a significant increase in the number of florets increased the most when treated with Putrescine at 50 mg $L^{-1}$, resching 40.71 florets per inflorescence. Significantly different from the treatment of Putrescine spraying at concentrations 150 and 100 mg $L^{-1}$, where the number of florets was 39.49 and 38.55 rosette floral $inflorescence^{-1}$, respectively, while the lowest number of florets was in the pink inflorescence when the comparison treatment was 26.33. The results of the table showed that there were no significant differences between the two strains in the characteristic of the number of flowers in the inflorescence. The results of the interaction treatments between the two studied factors indicate that there are significant differences in the number of florets trait. The interaction treatment between the white strain and the Putrescine spray at a concentration of 50 mg $L^{-1}$ was superior in recording the highest number of florets amounted to 40.77 floral inflorescence $^{-1}$, while the interaction treatment between the white strain and the spray was recorded. With distilled water (comparison), the lowest number of florets was 25.55 floral inflorescence $^{-1}$.

**Table (3): Effect of spraying with Putrescine and Indole acetic acid on two strains of *Antirrhinum majus* L. on the flowering growth.**

| Characters / Treatments | | The first basal floret opening date(day) | The number of florets per inflorescence (floret) inflorescence$^{-1}$). | Flower stem length (cm) | Vase life (day) |
|---|---|---|---|---|---|
| **0** | | 108.81 A | 26.33 C | 79.25 B | 7.95 B |
| **Put50** | | 102.42 C<br>BCD | 40.71 A | 84.08 AB<br>85.70 | 9.16 A |
| **Put100** | | 105.19 B | 38.55 A | 85.70 A | 9.44 A |
| **Put150** | | 105.93 B | 39.49 A | 86.33 A | 8.61 AB |
| **IAA50** | | 105.27 B | 34.21 B | 82.87 AB | 9.55 A |
| **IAA100** | | 104.76 B | 35.05 B | 79.95 B | 9.22 A |
| **IAA150** | | 106.33 B | 32.21 B | 80.91 B | 8.99 AB |
| **Effect of Strain** | | | | | |
| **Strain** | **White** | 105.49 A | 35.15 A | 84.10 A | 10.11 A |
| | **Red** | 105.57 A | 35.29 A | 81.35 B | 7.86 B |
| **Effect of Put and IAA × Strain** | | | | | |
| **0** | **White** | 112.79 a | 25.55 e | 80.08 bce | 8.56 def |
| | **Red** | 104.82 b | 27.01 e | 78.41 e | 7.33 f |
| **Put50** | **White** | 98.84 c | 40.77 a | 86.83 ab | 9.77 bcd |
| | **Red** | 106.00 b | 40.66 a | 81.33 bcde | 8.55 def |
| **Put100** | **White** | 105.38 b | 40.55 a | 86.08 abc | 9.88 bcd |
| | **Red** | 104.99 b | 36.55 abc | 85.33 abc | 9.00 cde |
| **Put150** | **White** | 105.49 b | 40.10 a | 89.33 aa | 9.77 bcd |
| | **Red** | 106.38 b | 38.88 ab | 83.33abcde | 7.44 ef |
| **IAA50** | **White** | 104.41 b | 31.77 d | 84.16abcde | 11.44 a |
| | **Red** | 106.13 b | 36.66 abc | 81.58 bcde | 7.66 ef |
| **IAA100** | **White** | 105.23 b | 35.55 bcd | 80.16 cde | 11.00 ab |
| | **Red** | 104.29 b | 34.55 bcd | 79.75 de | 7.43 ef |
| **IAA150** | **White** | 106.29 b | 31.77 d | 82.08 bcde | 10.33 abc |
| | **Red** | 106.36 b | 32.66 cd | 79.75 de | 7.66 ef |

**Means in each column followed by similar letters are not significantly different (P>0.05) according to Duncan's Multiple Range Test (DMRT).**

The results of Table (3) show that spraying Putrescine at a concentration of 150 mg $L^{-1}$ led to a significant increase in the length of the flower stem, which reached 86.33 cm, compared to the comparison treatment, which recorded the lowest length of the flower stem, which was 79.25 cm. The results of the table showed that there were significant differences between the two strains in the characteristic of flower stem length, and the white strain was superior by giving it the highest flower stem length of 84.10 cm, while the red line recorded the lowest flower stem length of 81.35 cm. The results of the interaction treatments between the two studied factors indicated that there were significant differences in the length of the flower stem, and the interaction treatment between the white strain and the Putrescine spray at a concentration of 150 mg $L^{-1}$ was superior in recording the highest length of the flower stem reached 89.33 cm, while the interaction treatment between the red strain and spraying with distilled water was recorded. (Comparison) The minimum length was 78.41 cm.

The results of Table (3) showed that spraying indole acetic acid at a concentration of 50 mg $L^{-1}$ led to a significant increase in the vase life, as the longest vase life was recorded at 9.55 days, compared to the comparison treatment that recorded the lowest vase life of 7.94 days. The results of the table showed that there were significant differences between the two strains in the vase life, and the white strain outperformed for recording the longest vase life of 10.11 days, while the red strain recorded the lowest vase life of 7.86 days. The results of the interaction treatments between the studied factors indicated that there were significant differences in the characteristic of flowering age, and the interaction treatment between the white strain and spraying indole acetic acid at a concentration of 50 mg $L^{-1}$ was superior in recording the longest vase life of 11.44 days, while the interaction treatment between the red strain and spraying with distilled water was recorded. (Comparative) The lowest vase life was 7.33 days.

**DISCUSSION**

The increase in plant height, number of leaves and leaf area when treated with Putrescine may be due to the fact that this substance participates in a wide range of biological processes, including cell division and differentiation, growth development and response to abiotic stresses [26]. The leaf and flower stem length when treated with Putrescine indicated that this compound is one of the compounds of the low molecular weight organic group of polyamines and contains in its composition two or more active amine groups that are clear in activating the biological activity and this stimulates the increase in the rates of cell division, elongation, differentiation and widening [18];[4]. Also, Putrescine or polyamine compounds can have an effect as growth regulators, as their low molecular weights and cationic charge benefit in the speed of their transfer between plant parts and the inclusion of their effect in regulating growth [21]. The increase in plant height and number of leaves as a result of spraying with Putrescine is in line with what was found by [33] and [15] and [31] and [10], The increase in the number of florets may be due to the fact that these compounds are involved in a wide range of biological activities, which in turn include plant development, differentiation, flowering and embryo growth, or the increase may be due to the effect of these compounds on growth by improving Vegetative growth and then giving the best results of flowering growth [13].

The results indicated that foliar spraying with indole acetic acid had a positive effect on most of the characteristics of vegetative and flowering growth, auxin stimulates growth (elongation and cellular expansion) through changes that occur in the softness of the cell wall, and since the cell wall consists of pectic and cellulosic materials, so it is believed that auxin causes the removal of ions that bind to carboxyl groups responsible for determining growth, which results in the decomposition of the components of the cell wall and its softening, so the cellulosic materials increase and pectin as a result of auxin treatment [1]. The results showed a significant increase in

the characteristics of flowering growth when plants were sprayed with indole acetic acid at a concentration of 150 mg $L^{-1}$ this may be due to the increase in vegetative growth indicators, which leads to an increase in the efficiency of the photosynthesis process and metabolic reactions in the plant, and thus better processing of processed nutrients in the leaves and their transmission to flowers and the increase in cell division processes [8]. The results indicated a difference between the two strains among them, for the characteristics of vegetative and flowering growth, where they varied in the strength of displaying traits, and the white strain lost in most of the vegetative and floral traits. The differences between varieties or strains in vegetative traits may be attributed to genetic factors mainly as the variety differs from the other variety in the display of traits [16], development, productivity and quality of flower crops after harvest depend mainly on the genetic ability of the variety to show traits [20], and the differences between varieties are due to the genetic composition of the plant, and also changes in the size of flowers may be due to their association with vegetative growth.

## CONCLUSION

The results showed that the red strain is superior to the white strain in most of the studied traits percentage of carbohydrates, nitrogen, phosphorous and potassium in leaves and number of inflorescences. The interaction between Indole acetic acid and the red strain showed a significant increase in the percentage of nitrogen, phosphorous and potassium and the number of inflorescences compared to untreated plants.

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