Effect of humic and salicylic acid spraying on vegetative traits of Acacia Senna surattensis L.

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Abstract
The study was conducted in the field of the Department of Horticulture and Landscape Engineering, College of Agriculture, Tikrit University on one-year-age acacia seedlings during the growing season of 2023-2024 with the aim of studying the effect of adding humic acid at two levels (0،5 g. plant-1) and spraying salicylic acid at three concentrations (0, 250 and 500 mg. L-1). The effect of these treatments on a set of vegetative traits was evaluated according to the RCBD design with three replicates and an average of 3 shrubs in the experimental unit. The results showed the superiority of the bi- treatment treatment of adding humic and salicylic acid 500 mg.L-1 in all vegetative traits: leaf area (94.612 cm2), flower diameter (7.75 mm), flower weight (0.110 gm), number of flower branches (73.437branches. plant-1), and number of flower stalks (411.245flower stalks. plant-1(
Keywords : Humic acid, organic fertilizers, salicylic acid, cacia glauca

Introduction

Acacia is a perennial tree with single or alternate compound leaves (4) It contains indeterminate flowers that are sometimes reduced to a single yellow or golden shiny flower that is relatively small in size, carried on inflorescences distributed at the ends of almost every branch, and its fruits are in the form of pods, arranged alternately with every branch, and reach approximately 4-8 inflorescences, and each inflorescence contains 10-15 flowers that are 3-6 cm long (9). The leaves are dark green, compound, pinnate, and of equal length, containing 6-9 pairs of leaflets, and the length of the leaf stalks is approximately 1.5-3 cm, and the length of the leaf is approximately 18 cm. The upper surface is hairy and the lower surface is slightly rough. This shrub contains fruits that are long pods similar to peas, as the length of the pod is approximately 18 cm, and it contains 3 to 5 seeds that are green in color at first, and turn black once they ripen, and are formed shortly after the flowering process (6). Recently, interest in organic fertilizers has increased, either individually or in combination with chemical fertilizers, in agricultural production to reduce reliance on chemical fertilizers, including humic acid, which has a significant impact on soil development from an agricultural perspective. The role of humic acid is primarily to adjust the pH of the soil and transform it from basic to simple or neutral acidic soil, which in turn increases the availability of nutrients. In general, the amount of organic matter in Iraqi lands is small, not exceeding 1%, and is a

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source of nutrients for plants, including nitrogen, as its acidity increases positive cations, reduces the volatility of nitrogen in the form of ammonia gas, and increases the efficiency of ammonium metabolism. It is one of the main components of humic matter, which is a chemically complex organic substance in the form of a powder or liquid substance containing oxygen, nitrogen, carbon, and hydrogen in varying proportions (19). Growth regulators play a major role in their effects on vegetative and floral growth, including salicylic acid, which is considered a plant hormone that plays a role in plant growth (11). Many researchers have found that spraying the vegetative system of the plant with salicylic acid increases the activity of the vegetative system and increases plant growth in several plant species (17). Salicylic acid is a plant growth regulator that belongs to the group of phenolic compounds, consisting of a benzene ring with a carboxyl group and a hydroxyl group attached to it. It has an important role in regulating physiological processes such as photosynthesis, growth and flowering, and has a mitigating effect on biotic and abiotic stresses (11). Given the economic importance of the acacia shrub and the success of its cultivation on a wide area from north to south, the study aimed to improve its vegetative and floral traits by studying the response of the shrub to organic fertilization with humic acid and salicylic growth stimulant in the growth and development of the acacia tree.

Materials and methods

The study was conducted in the Department of Horticulture and Landscap at the College of Agriculture/Tikrit University during the agricultural season 2024, on one-year-old acacia seedlings, seedling height 130 cm, planted in the field on 3/1/2024 in holes prepared for planting filled with river soil. The experiment was conducted with two factors, the first factor is humic at two levels without addition and adding 5 g under the seedling with irrigation water, and the second factor is spraying with the growth regulator salicylic acid at three levels (0, 250 mg. L-1, 500 mg. L-1). The treatment was conducted before sunset and at a rate of twice a month after planting and repeated after two months. The experiment was conducted using a complete randomized block design (RCBD), and thus the experiment consists of 6 treatments resulting from the interaction of the above factors, with three replicates and an average of 3 seedlings per experimental unit. Measurements of vegetative and floral growth were taken on 11/25/2024, leaf area, the diameter and weight of the flower. s The results were statistically analyzed using the SAS program, and the averages were compared according to Duncan's multiple range test at a probability level of 5%.

Results and discussion

The results in Table (1) show that the addition of humic acid had a significant effect on the area of one leaf, as treatment H1 was significantly superior by giving the highest average leaf area of 87.271 cm2, while the control treatment H0 gave the lowest average of 62.506 cm2.

As for spraying with salicylic acid, treatment (S2) caused a significant increase as it gave the highest area per leaf (79.628 cm2) compared to the control treatment which gave the lowest area per leaf (71.014 cm2).As for the interaction between humic acid and

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salicylic acid, it gave a significant increase between the rates, where treatment H1S2 recorded the highest rate of area per leaf amounting to 94.612 cm2 and significantly excelled on all other treatments and control treatment H0S0 which gave the lowest rate amounting to 60.193 cm2 and which did not differ significantly from treatment H0S1 and treatment H0S2

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Table (1) Effect of humic acid and salicylic acid on leaf area (cm2) of Senna surattensis L

Salicylic acid	**Humic acid**		**Salicylic acid (mgL-1)**
	H1	H0	
b 71.014	b 81.836	c 60.193	**S0(0)**
b 74.023	b 85.366	c 62.680	**S1 (250)**
a 79.628	a 94.612	c 64.645	**S2(500)**
	a 87.271	b 62.506	**Humic acid**

. *The averages of each of the factors or their interactions followed by different letters indicate the presence of significant differences between them at a probability level of 5% according to Duncan's multiple range test.

Table (2) shows the significant effects of both humic acid and salicylic acid, as well as the interaction between them, on the studied trait. Treatment H1 recorded the highest values, as its average reached 7.59056 mm, indicating the positive effect of adding humic acid, unlike control treatment H0, which gave the lowest average of 5.68 mm, indicating that the absence of humic acid reduces efficiency. As for salicylic acid, it had a significant effect on flower diameter, as treatment S2 gave the highest value of 6.81083 mm, which outperformed the no-spray treatment S1, which gave the lowest content.

The bi- treatment between salicylic acid achieved significant differences, where the H1S2 treatment gave the highest value of 7.75667 mm, while control treatment H0S0 gave the lowest significant value

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Table (2) Effect of humic acid and salicylic acid on flower diameter (mm) of Senna surattensis L.

Salicylic acid	Humic acid		Salicylic acid (mgL-1)
	H1	H0	
c 6.48	c 7.44	f 5.52	S0(0)
b 6.61	b 7.57	e 5.65	S1 (250)
a 6.81	a 7.75	d 5.86	S2(500)
	a 7.59	b 5.68	Humic acid

*The averages of each of the factors or their interactions followed by different letters indicate the presence of significant differences between them at a probability level of 5% according to Duncan's multiple range test.

The results of Table (3) show that humic acid is significantly superior at the high level H1 in flower weight, as it gave the highest significant value of 0.091 g, while control treatment H0 gave the lowest significant value of 0.070 g. The results also indicate the superiority of salicylic acid in treatment S2 in the mentioned trait, which amounted to 0.097 g compared to control treatment S0, which gave the lowest value. The interaction treatments between humic acid and salicylic acid H1S2 recorded the highest value in flower weight, which amounted to 0.110 g compared to the no-added treatment H0S0, which gave the lowest value.

Table (3) Effect of humic acid and salicylic acid on flower weight (g) of Senna surattensis L.

Salicylic acid	Humic acid		Salicylic acid (mgL-1)
	H1	H0	
c 0.070	c 0.080	e 0.061	S0(0)
b 0.074	b 0.083	d 0.065	S1 (250)
a 0.097	a 0.110	d 0.085	S2(500)
	a 0.091	b 0.070	Humic acid

*The averages of each of the factors or their interactions followed by different letters indicate the presence of significant differences between them at a probability level of 5% according to Duncan's multiple range test.

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The results in Table (4) indicate the significant effect of humic acid on the number of floral branches of the acacia plant, as treatment H1 outperformed control treatment with a value of 71.2200 floral branches. Also, the salicylic spray treatments were significantly excelled in the number of floral branches, as treatment S2 gave significantly excelled on the rest of the treatments with a value of 63.2258floral branches compared to control treatment, which gave the lowest value of 59.9533 floral branches. As for the interaction treatments, treatment H1S2 was significantly excelled with a value of 73.437 floral branches compared to control treatment, which had the lowest value of 51.156 floral branches.

Table (4) Effect of humic acid and salicylic acid on the number of flower branches of Senna surattensis L.

Salicylic acid	Humic acid		Salicylic acid (mgL-1)
	H1	H0	
b 59.9533	b 68.751	c 51.156	S0(0)
a 61.8508	a 71.472	c 52.229	S1 (250)
a 63.2258	a 73.437	c 53.015	S2(500)
	a 71.2200	b 52.1333	Humic acid

*The averages of each of the factors or their interactions followed by different letters indicate the presence of significant differences between them at a probability level of 5% according to Duncan's multiple range test.

The results in Table (5) indicated that the humic acid H1 treatment was superior to control treatment in increasing the number of flower stalks, as it gave the highest value of 398.832 flower stalks compared to control treatment. As for the salicylic acid spraying treatments, the S2 treatment excelled on the rest of the treatments, as it gave the highest value of 354.065 flower stalks compared to control treatment S0, which gave the lowest value of 335.739 flower stalks. The humic and salicylic interaction treatment H1S2 had a significant effect on the mentioned trait, as it gave the highest value of 411.245 flower stalks compared to control treatment, which gave the lowest value of 286.473 flower stalks.

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Table (5) Effect of humic acid and salicylic acid on the number of flower stalks of Senna surattensis L.

Salicylic acid	Humic acid		Salicylic acid (mgL-1)
	H1	H0	
b 335.739	b 385.005	c 286.473	S0(0)
a 346.365	a 400.246	c 292.483	S1 (250)
a 354.065	a 411.245	c 296.884	S2(500)
	a 398.832	b 291.947	Humic acid

*The averages of each of the factors or their interactions followed by different letters indicate the presence of significant differences between them at a probability level of 5% according to Duncan's multiple range test .

Conclusion

We note that the addition of organic fertilizers caused a significant increase in the vegetative traits of the plant. This is attributed to the fact that organic fertilizers work to increase the activity of auxins and cytokinins, which in turn lead to increased cell division and elongation and increased protein synthesis, which allows the plant to grow quickly and works to accelerate the process of photosynthesis, which provides sufficient food for plant growth. Humic acid provides energy for microorganisms in the soil, and increases the availability of nutrients in the soil through its effect on the activity of microorganisms, which contributes to the release of more nutrients necessary for healthy growth.

In addition, humic acid was found to reduce the soil's ability to fix phosphate, improve soil nutrient retention, increase soil nutrient availability, enhance soil water retention, improve soil physical and chemical properties, and act as a source of nitrogen (N), phosphorus (P), and sulfur (S) for plants (12,7). Organic fertilizers increase nitrogen levels in plants, which increases chlorophyll in leaves and encourages growth, increases cell size, vegetative traits, and leaf area (5,3). As for the effect of humic, it is attributed to its containing oxygen, hydrogen, carbon, and nitrogen in varying proportions and with light molecular weights (1). When used for plants, it plays a fundamental role in plant nutrition, which is reflected in the photosynthesis process. Protein synthesis, other substances, and respiration [2]. In addition, humic substances contribute to raising the internal levels of plant hormones, such as auxins and gibberellins, by stimulating their formation or preventing their decomposition. The reason behind the increase in vegetative growth indicators and the chemical content of the plant may be that humic substances increase the proportion of solid compounds rich in oxygen in the cells [13] This is consistent with

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what (10) (when treating charisma trees) reached, as well as with (15). As for salicylic acid, it is a natural organic compound produced in plants and plays an important role in regulating physiological and vital processes. It is considered one of the most important compounds responsible for enhancing plant health and resistance to harmful environmental conditions. It works to enhance cell division and elongation, which contributes to increasing vegetative growth and stimulates reactions related to metabolism such as protein and carbohydrate synthesis and increases chlorophyll levels in the leaves, which improves the efficiency of photosynthesis and energy production. It contributes to improving gas exchange by regulating the opening and closing of stomata. It reduces the harmful effects of water shortage by regulating osmotic pressure and increasing drought resistance. It contributes to protecting plants from high temperatures by enhancing the antioxidant system. It enhances the movement of nutrients such as nitrogen, phosphorus, and potassium towards the aerial parts of the plant, which improves growth and productivity. It interacts with other plant hormones (such as auxins and gibberellins) to regulate vital processes (14) and this is consistent with both and (18) when treating cassia shrubs. It also agrees with what (18) reached when treating Myrtus communis plant

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