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RESPONSE OF MYRTLE VEGETATIVE GROWTH TO BA AND HUMIC ACID APPLICATION

Sudab Saadoon Rashid* and Mohammed Khazaal Hameed

Department of Horticulture and Gardens Engineering, College of Agriculture, University of Anbar, Iraq.
*e-mail : alani2005ms@yahoo.com

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ABSTRACT : This research was conducted in the glasshouse of the Department of Horticulture and Gardens Engineering at the College of Agriculture, Anbar University at the season 2018-2019, to study the effect of BA spraying and the addition of humic acid in some growth characteristics of *Myrtus communis* L. saplings at the age of one year. A factorial experiment was executed with two factors, the first one included BA spraying with three concentrates (0, 100, 200 mg L^{-1}) and given the symbols (B_0, B_1, B_2). The second factor included the addition of the humic acid with three concentrates (0, 3, 6 ml L^{-1}) which given the symbols (H_0, H_1, H_2). The experiment was applied according to the Complete Block Randomized Design (RCBD). The results were analyzed using the statistical program Genstat and the means were compared according to the least significant difference (LSD) at 5% probability level. The results can be summarized as follows: The spraying with BA affected in most vegetative and root growth characteristics. The concentration of 200 mg L^{-1} (B_2) was significantly superior in the number of branches (3.72 branch $sapling^{-1}$), stem diameter (4.88 mm), leaf number (250.23), leaf area (16.93 dcm^2) and thedry weight of the vegetative system (51.98 g). On the other hand, the treatment B_1 gavethe highermean of the increase in the length of branches (22.23 cm) which is not significantly differed with the treatment B_2, but significantly differed with the control treatment (B_0). Also, B_1 treatment was significantly superior in the mean increase of the sapling height (27.48 cm). The use of 6 ml L^{-1} concentration of humic acid (H_2) resulted in a significant increase in the increase of branch length (27.10 cm), sapling height (33.61 cm), number of leaves (187.83) in addition to, giving the highest leaf area (14.03 dcm^2) and the dry weight of vegetative system (52.47 g). While the results of the interaction between the two factors of the study according to F value test showed that there are no significant differences in the mean of increase in branch length, sapling height and leaves number. On the other hand, the treatment B_2H_2 gave the highest mean of increase in stem diameter (6.90 mm) and the dry weight of the vegetative system, which significantly differedwith most other interactions. The treatment B_2H_0 recorded the highest number of branches (4.43), which significantly differedwith most of the studied interactions.

Key words : Myrtle, *Myrtus communis* L., BA, humic acid.

INTRODUCTION

Myrtle (*Myrtus communis* L.), is an evergreen shrub belongs to the Myrtaceae family which includes approximately 90 genus and 2,800 species (Govaerts *et al*, 2008). Myrtle is one of the cutting and formation plants and its cultivation spreads in the temperate and warm zones. The leaves of this plant are small, oval or spherical, overlapping, smooth, glossy and with an aromatic smell. The flowers are white and the fruits are simple, soft, black and embodied shape which can be eaten fresh or dried to be a spice, while the seeds are white with a thick coat (Mouterde, 1983). This plant has great medical importance because it contains a pilot oil that is used as a disinfectant for germs, skin disease therapy, and in the preparation of some cosmetics (Bonjar, 2004; Hayder *et al*, 2004). The myrtle leaves, flowers and bark produce oil known as Angels Water, which has an aromatic refreshing aroma and has a role in the perfumery industry (Jimenez and Boelense, 1992) and this oil has analgesic properties of pain (Twaij and El-jalil, 2009). The leaves contain a disinfectant antioxidant materials (Gortzi, 2008) and the mature fruits are rich in vitamins, so they used in the food industry, and added to some foods to give a distinctive flavor (Akin *et al*, 2010).

Foliar spraying is an important method to provide the plant with the main and secondary nutrients as well as other chemicals such as growth regulators, and most plants have the ability to absorb these substances by leaves, which is more efficient and ensuring for the plant compared with the adding to the soil method, that cannot be absorbed by roots when the soil conditions are inappropriate (Kuepper, 2003; Murtic *et al*, 2012). Cytokinines are growth regulators that have a role in regulating the plant's biotic events and have an impact

on improving the growth and production of plants. cytokinines play a main role in stimulating the process of cell division and its specialization in conjunction with the auxins and delaying leaves senescence, in addition to inhibiting apical dominance. 6-benzyl amino purine (BA) is an industrial cytokine that plays a role in stimulating cell division and expansion, senescence delaying, inhibiting apical dominance and stimulating growth of lateral buds (Carey, 2008). BA is more effective than natural cytokines such as zeatine and kinetin because it has a benzene ring in the side chain associated with the double bond (George *et al*, 2008). On the other hand, cytokinine affect in the stimulation of RNA, which leads to increase the biological reactions in the cell and enhance chlorophyll and proteins synthesis that causing the delaying of leaf senescence (Werner, 2003).

The use of organic materials is one of the modern methods used in agriculture, which reduces the use of chemical fertilizers to reduce damage to human health and the environment, and has a role in increasing growth and production, improving quality, stimulating plant growth and improving the efficiency of photosynthesis (Mishra and Dadlich, 2010; Raja, 2013). The humic acid plays an important role in improving the soil properties through a number of influences that include improving the ventilation and stimulating the growth and activity of the microorganisms in the soil, especially the fungi that prefer the acidic medium, as well as improving the ability of the soil to retain in water, increase the nutrients availability and transfer (Katkat, 2009). Due to the medicinal and aesthetic importance of myrtle plant and because of its slow growth especially in the early stages, this research aims to study the effect of spraying the BA and the addition of humic acid in some growth characteristics of this plant under the conditions of the glasshouse.

MATERIALS AND METHODS

This research was carried out in the glasshouse of the Department of Horticulture and Gardens Engineering, College of Agriculture, Anbar University in the agricultural season 2018-2019, to study the effect of spraying with benzyl adenine and adding the humic acid in some growth characteristics of the *Myrtus communis* L. saplings. The plants were brought with a homogenous form as much as possible from one of the approved nurseries in Baghdad and transferred to 7-liter pots. The agricultural medium consist of sand and peat moss 2:1 ratio. The plants were irrigated by a drip irrigation system according to the need of the plant depending on the season, and they were fertilized with NPK fertilizer (20:20:20) according to the fertilizer program used by Laila *et al* (2012). A factorial experiment with two factors was carried out according to the Complete Randomized Block Design (CRBD) with three replicates. The first factorwas BA spraying with three concentrations (0, 100 and 200 mg L^{-1}) and given the symbols (B_0, B_1 and B_2) respectively, while the second factor included the addition of the humic acid to the soil in three levels (0, 3 and 6 ml L^{-1}) and given the symbols (H_0, H_1, H_2) and Table 1 shows the components of the humic acid used in this experiment. The number of treatments is 9 and the total experimental units are 27 units with 5 plants per each one.

The treatments were performed in four payments, two in autumn and the others in spring, the first spraying of BA was conducted on 25/10/2018 and after two days, the first addition of humic acid was done. A month after the first treatment, the second spraying and addition were done of the studied factors. On the other hand, the third spraying of BA was conducted on 25/2/2019, and two days later, the third addition of humic acid was done. A month later, the fourth treatment of the two studied factors was carried out. The data were collected and statistically analyzed using the statistical program Genstat and the means were compared according to the least significant difference (LSD) at the 5% probability level. The studied characteristics included :

1. The increase in the number of branches on the plant (branch $plant^{-1}$).
2. The increase in the length of the main branches (cm).
3. The increase in the main stem diameter (mm).
4. The increase in the plant height (cm).
5. The increase in the number of leaves (leaf $plant^{-1}$).
6. Leaves area (dcm^2).
7. The dry weight of the vegetative system (g).
8. The dry weight of the root system (g).

RESULTS AND DISCUSSION

The increase in the number of the main branches (branch plant[1])

Table 2 shows that spraying with BA has a significant effect on the mean of the increase in the number of main branches growing on the sapling. The spraying of 200 mg L^{-1} of BA (treatment B_2) recorded the highest value of the increase in the branches number (3.72 branch $plant^{-1}$), which differed significantly with treatment B_1 and the control treatment (B_0), that gave the lowest value (1.67 branch $plant^{-1}$). Also, the addition of humic acid significantly affected in this character, as the treatment H2 recorded the highest mean (3.16 branch $plant^{-1}$), which differed significantly with the other treatments and the lowest mean has been recorded by the treatment H_0 (2.30

Table 1 : The components of humic acid used in this study.

Component	K	K_2O	MgO	Orgnic matter	Fulvic acid	Fe	Fumic acid
Percentage (%)	16	2	0.035	12	5	0.05	10

plant branch^{-1}).

The interaction between the two factors, significantly affected in the increase of branches number, as the highest value (4.43 branch plant^{-1}) had been recorded by the treatment B_2H_0, which did not significantly differ with the treatments B_1H_2 and B_2H_2 but significantly differed with the other interactions and the control treatment gave the lowest mean (0.63 branch plant^{-1}).

The increase in the length of the main branches (cm)

The results in Table 3 shows that there are significant differences between the BA spraying treatments. The highest mean of the increase in the length of the main branches (22.23 cm) happens in treatment B_1, which did not significantly differ with the B_2 treatment but differed with B_0, which gave the lowest mean (14.73 cm). The addition of humic acid was significantly affected in the mean of the increase in the length of the main branches. The addition of 6 ml L^{-1}humic acid (H_2) recorded the highest increase mean (27.10 cm), which differed significantly with the treatments H_1 and H_0 (control treatment), which recorded the lowest mean of the increase in the length of the main branches (10.52 cm). While the interaction between the two factors did not significantly affect in this character according to calculated F value.

The increase in stem diameter (mm)

Table 4 shows that there are significant differences caused by the BA spray in the stem diameter and the highest value (4.88 mm) was recorded in treatment B_2, which differed significantly with the treatments B_1 and B_0, which recorded the lowest value (1.80 mm). As for the addition of hemic acid and its effect on the increase in stem diameter, the treatment H_2 gave the highest mean(4.65 mm), which significantly differed with the treatments H_1 and H_0, which recorded the lowest value (1.78 mm).

As for the interaction between the two factors, the B_2H_2 treatment showed the highest increase mean in the main stem diameter (6.90 mm), which differed significantly with the other interactions and the lowest mean (0.80 mm) was recorded in the control treatment (B_0H_0).

The increase in the sapling height (cm)

Table 5 shows that there are significant differences between the spray treatments of BA in the mean of the increase in the sapling height and the highest mean (27.48 cm) was recorded in the treatment B_1, which does not significantly differ with the treatment B_2, but differs with the control treatment (B_0) which, gave the lowest mean (18.36 cm). Also, the same table shows that there are significant differences in the same characteristic caused by the humic acid addition, the highest mean (33.61 cm) recoded by the treatment H_2, which significantly differed with the treatments H_1 and H_0, which gave the lowest mean (13.06 cm). On the other hand, the interaction between the two factors did not give a significant effect according to the F value test at the probability level of 0.05.

The increase in the leaves number (leaf plant^{-1})

The BA spraying significantly affected in the mean of the increase in the leaves number, as the treatment B_2 gave the highest mean (250.23 leaf plant^{-1}), which significantly differed with the treatments B_1 and B_0 (control treatment), that recorded the lowest increase (56.68 leaf plant^{-1}) (Table 6).

The addition of humic acid showed significant differences in the mean of the increase in the leaves number. The highest mean (187.87 leaf plant^{-1}) recorded by the treatment H_2, which did not significantly differ with the H_1 treatment but differed with the control treatment (H_0), which recorded the lowest mean (120.66 leaf plant^{-1}). While the interaction between the studied factors did not give significant differences in the mean of the increase of the leaves number.

Leaf area (dcm^2 plant^{-1})

The results in Table 7 shows that there are significant differences in the mean of the leaves area caused by the spraying with BA, as the highest mean of this character recorded by the treatment B_2 reached 16.93 dcm^2 plant^{-1}, which significantly differed with the treatments B_1 and B_0 (control treatment) that gave the lowest mean (7.59). Also, the addition of humic acid significantly affected in the mean of the leaves area, the highest mean (14.03 dcm^2 plant^{-1}) was recorded in the treatment H_2, which did not differ significantly with the H_1 treatment but differed with the treatment H_0, which gave the lowest mean (11.14 dcm^2 plant^{-1}). While the interaction between the two studied factors showed no significant differences in the leaves area.

The dry weight of the vegetative system (g)

The results showed that there are significant

differences in the dry weight mean of the vegetative system caused by the spraying with BA (Table 8). The highest mean recorded by the treatment B_2 (51.98 g), which significantly differed with B_1 and B_0 (control treatment), which recorded the lowest mean (36.64 g). As for the addition of humic acid, the treatment H_2 significantly affected in the dry weight of the vegetative system and gave the highest mean (52.47 g), which differed significantly with the treatments H_1 and H_0 (control treatment), which gave the lowest mean (40.53 g).

The interaction between the two factors of this study, it appears from Table (8) that the treatment B_2H_0 gave the highest dry weight of the vegetative system(56.76 g) which did not significantly differ with the means recorded in the treatments B_2H_2, B_1H_1, B_1H_2 and B_0H_2, but significantly differ with the other treatments, and the control treatment (B_0H_0) gave the lowest mean (22.62 g).

The dry weight of the root system (g)

The results in Table 9 indicate that there are significant differences obtained by the spraying of the BA. The highest dry weight of the root system recorded in treatment B_2 (41.50 g), which did not significantly differ with the treatment B_1 but significantly differed with the control treatment (B_0), which gave the lowest mean (28.83 g). While the addition of humic acid at the studied concentrations as well as the interaction between the studied factors did not cause significant differences in the dry weight of the root system according to the F value test (Table 9).

The characteristics of vegetative growth represented in the mean of the increase in the number of branches, stem diameter, plant height, number of leaves and leaf area, are significantly increased as a result of the spraying with BA as shown in tables (2, 4, 5, 6 and 7). This may be due to the effect of the cytokinine in the various physiological events of growth and development in the plant through its regulatory role in the cell division. It stimulates the division of meristematic tissue and the cambium through the formation of RNA, DNA, proteins, enzymes, in addition to its effect in the nutrient movement that leads to the cell division and promoting the growth of lateral buds by inhibiting the apical dominance. Cytokinine encourages the growth of dormant buds because it increases the passage of nutrients and other growth requirements to the lateral buds, which stimulates their growth, which is reflected in the increase of lateral branches (Sugiyama *et al*, 2015; Imamura and Higaki, 1988). The addition of cytokinines, also reduces the effect of auxins in the lateral buds (Asad, 2014). The increase in the means of the above characteristics is noted with increased concentration of BA, and this may be due to the enhancement effect of BA in the early growth of the buds, which increased the long period of growth as well as the role of BA in increasing cell division, which positively reflected in the increase of plant height (Fosket, 1998).

The increase in the number of branches (Table 2) and the height of the plant (Table 4) was positively reflected in the increase of leaves number due to the treatment with the BA which resulted in a greater number of leaves on the plant. The increase in the leaves number may be affected in the increase of the total leaf area. Van Staden and Crouch (1996) reported that spraying with cytokinines increases the leaves size due to the effect in the cell division and expansion, as well as the increase in the photosynthesis efficiency, which is reflected in the increase in the total leaf area. BA is one of the substances that play an essential role in the physiological events in the plant. It leads to the synthesis of amino acids and proteins in the leaves and increases photosynthesis and its products. The excess of the synthesized products is stored in plant parts, which increase the dry weight (Hedden and Thomes, 2006). This may explain the effect of BA in the concentration of 200 mg L^{-1} used in this study, which led to the increase of the vegetative system dry weight.

The results of this study showed that some vegetative characteristics were increased with the increase of humic acid concentration, such as the increase in branch length, the plant height and the dry weight of the vegetative system as shown in Tables 3, 5 and 8. Humic acid increases the efficiency of enzymes that decompose the complex compounds that lead to release the nutrient elements and increase their uptake, which increase the growth rates (Morgan, 2008; Holger and Bergstrom, 2008). Also, the humic acid contains some major and minor elements and organic acids (Table 1), which are applied to the plant, leading to increased cell division and expansion and increase the biological activities and synthesis processes in the plant (Osman *et al*, 2010). These activities reflect on the increase of the branches and plant height. On the other hand, the humic acid contains potassium element, which plays a main role in increasing metabolic activity, and it is necessary for the activation of the enzymes that manufacture amino acids and proteins and helps to manufacture the chlorophyll and the formation of sugars, proteins and ATP (energy compounds), which affect the increase of plant growth and size (Martin, 2012). Besides, potassium plays a main

Table 2 : Effect of BA and humic acid in the increase of the main branches number (branch plant^{-1}).

Treatments	B_0	B_1	B_2	Mean (H)
H_0	0.63	1.83	4.43	2.30
H_1	2.03	2.27	3.07	2.46
H_2	2.33	3.47	3.67	3.16
Mean (B)	1.67	2. 52	3.72	
LSD (0.05)	B	H	B×H	
	0.65	0.65	1.21	

Table 3 : Effect of BA and humic acid in the increase of the main branches length (cm).

Treatments	B_0	B_1	B_2	Mean (H)
H_0	7.41	11.88	12.27	10.52
H_1	13.31	28.72	20.01	20.68
H_2	23.47	26.08	31.76	27.10
Mean (B)	14.73	22.23	21.34	
LSD (0.05)	B	H	B×H	
	6.11	6.11	N. S.	

Table 4 : Effect of BA and humic acid in the increase of the main stem diameter (mm).

Treatments	B_0	B_1	B_2	Mean (H)
H_0	0.80	1.17	3.38	1.78
H_1	1.76	5.19	4.36	3.77
H_2	2.85	4.18	6.90	4.65
Mean (B)	1.80	3.51	4.88	
LSD (0.05)	B	H	B×H	
	0.89	0.89	1.55	

Table 5 : Effect of BA and humic acid in the increase of the sapling height (cm).

Treatments	B_0	B_1	B_2	Mean (H)
H_0	9.47	14.49	15.21	13.06
H_1	16.50	35.61	24.81	25.64
H_2	29.10	32.34	39.38	33.61
Mean (B)	18.36	27.48	26.47	
LSD (0.05)	B	H	B×H	
	7.61	7.61	N. S.	

Table 6 : Effect of BA and humic acid in the increase of leaves number (leaf plant^{-1}).

Treatments	B_0	B_1	B_2	Mean (H)
H_0	33.61	108.79	192.17	120.66
H_1	61.01	170.96	299.83	168.13
H_2	75.43	229.38	258.69	187.83
Mean (B)	56.68	169.71	250.23	
LSD (0.05)	B	H	B×H	
	35.40	35.40	N. S.	

Table 7 : Effect of BA and humic acid in the leaf area (dcm^2 plant^{-1}).

Treatments	B_0	B_1	B_2	Mean (H)
H_0	5.67	11.66	16.08	11.14
H_1	8.64	11.01	15.75	11.80
H_2	8.45	14.67	18.97	14.03
Mean (B)	7.59	12.45	16.93	
LSD (0.05)	B	H	B×H	
	2.26	2.26	N. S.	

Table 8 : Effect of BA and humic acid in the dry weight of the vegetative system (gm).

Treatments	B_0	B_1	B_2	Mean (H)
H_0	22.62	42.22	56.76	40.53
H_1	36.72	49.06	44.47	43.42
H_2	50.57	52.11	54.71	52.47
Mean (B)	36.64	47.80	51.98	
LSD (0.05)	B	H	B×H	
	3.32	5.33	9.28	

Table 9 : Effect of BA and humic acid in the dry weight of the root system (gm).

Treatments	B_0	B_1	B_2	Mean (H)
H_0	19.80	38.72	38.40	32.30
H_1	32.31	42.20	44.71	39.74
H_2	34.39	40.33	41.40	38.70
Mean (B)	28.83	40.42	41.50	
LSD (0.05)	B	H	B×H	
	6.6	N. S.	N. S.	

role in the movement of water and nutrients, and increasing the accumulation of auxins and improving its function, which leads to increase the cell division and elongation. This may explain the increase in plant height and branch length obtained in this study. The micro-elements have a fundamental role, especially iron, because its balanced existence, according to plant needs, stimulates important enzymes in the production of plant hormones that lead to cell division and elongation, which increases plant height Iron is one of the components of the nucleic membrane's lipids, chloroplast and mitochondria, in addition to its role in the chlorophyll synthesis and the formation of proteins for cell walls as well as the process of cell division (Taiz and Zeiger, 2010). Humic acid stimulates root initiation and growth, in addition, to improve the absorption of essential nutrients such as Mn, P, K, Ca from the soil and also helps to retain the water. It also improves the chemical, physical and biological properties

of the soil, increasing the exchange capacity and the readiness of some nutrients to absorb. By roots (Turkmen *et al*, 2004).

CONCLUSION

The results of this study showed that some vegetative characteristics were increased with the increase of BA and humic acid concentration.

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