Effect of Mycorrhizae and some root stimulators on cuttings of Myrtle (Myrtus communis Linn.)

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Abstract
The field experiment was conducted in Baquba Nursery, Diyala Agriculture Directorate, Iraq, for the period from 1/3/2022 to 1/11/2022 to evaluate the effect of some stimulating materials such as Aloe vera gel (100%), mycorrhizae inoculum (125 g/m2), gibberellin (10%), and the stimulator (rootex) (4.5%) on the rooting of myrtle plant cuttings with a length of 15 cm and a diameter of 1 cm and approximately 12–16 buds per cutting. A factorial experiment with two factors was carried out within a randomized complete block design (RCBD). There were eight treatments, with three replicates per treatment. Thus, the number of experimental units was 24, with 5 pots per replicate. The results showed that inoculation of soil with mycorrhizae led to an increase in percentage of nitrogen and phosphorous in leaves, rooting of cuttings, plant length, root length, and dry root weight, which amounted to 2.17%, 0.165%, 68.25%, 52.83 cm, 26.16 cm, and 3.69 g, respectively, while Aloe vera gel recorded an increase in nitrogen, phosphorous, potassium, rooting of cuttings, plant length, root length, and dry root weight, which reached 2.40%, 0.180%, 3.10%, 75.50%, 54.50 cm, 29.00 cm, and 4.26 g, respectively. Aloe vera gel with mycorrhizae was superior in recording the highest rates of nitrogen, phosphorous, rooting of cuttings, plant length, root length, and dry root weight, which amounted to 2.92%, 0.188%, 85.33%, 57.66 cm, 31.33 cm, and 5.06 g, respectively.

Keywords: Myrtle, Aloe vera gel, Mycorrhizae, and root stimulators

Introduction

Myrtle (Myrtus communis Linn.) is an aromatic perennial shrub or small tree belonging to the Myrtaceae family. It is native to West Asia, North Africa, and Southern Europe; it is distributed in the Mediterranean region, South America, the North Western Himalaya, and Australia [12,14]. In addition, it is grown in gardens throughout Iraq. There are two factors in the success of cutting rooting: the physiological stage of the mother plant and the time at which the cutting was taken [5,6]. Aloe vera gel is one of the natural alternatives that could be used to stimulate the rooting of cuttings. Aloe vera is a significant medicinal plant that belongs to the Asphodelaceae family. It is a succulent herb that grows all over the world [16]. Its large leaves consist of three layers: an inner layer of clear gel, a middle layer of latex, and an outside layer that is thick. The inner clear gel consists of 99% water and some sterols, vitamins, amino acids, and glucomannans. Middle parenchymatic cells contain yellow latex liquid, a bitter sap, which is rich in lignin, micronutrients, macronutrients, vitamins, salicylic acid, gibberellins, essential amino acids, and mono- and polysaccharides [20]. An outer, thick layer consisting of

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proteins and synthesized carbohydrates [17]. Aloe vera gel extract can be used as a source of natural hormones in place of synthetic growth regulators or purified natural hormones to induce cutting rooting because it contains plant hormones like auxins and gibberellin as well as plant root growth promoters like salicylic acid [20]. Mycorrhizae are symbiotic relationships between some soil fungi and plant roots that can increase plant output [4]. Mycorrhizae may increase a plant's ability to absorb nutrients and water [1]. Despite the commercially produced inoculum of VAMF being easily available to farmers, few of these investigations were carried out in nurseries. The gibberellin mainly promotes cell proliferation. cell elongation and become finally differentiated in the elongation zone [21]. Propagators search for strategies to improve propagation and shorten the time required for rooting when they need to rapidly produce large quantities of rooted cuttings [2]. The initiated roots numbers can impact the quality of rooted cuttings produced and the length of a production cycle. The aim of this study was to determine whether the addition of Aloe vera gel, Mycorrhizae inoculum, gibberellin, and the stimulator (rootex) to the rooting substrate during cutting propagation increases rooting of Myrtle plants under nursery conditions.

Materials and methods

A field experiment was conducted in Baquba Nursery, Diyala Agriculture Directorate, for the period from 1/3/2022 to 1/11/2023 to find out the effect of some stimulating materials on the rooting of myrtle plant cuttings, such as Aloe vera gel, mycorrhizae inoculum, gibberellin, and the stimulator (rootex). A factorial experiment design was carried out with three replicates of each treatment that involved two factors: the first factor included adding mycorrhizae inoculum and without mycorrhizae inoculum; the second factor included adding Aloe vera gel, gibberellin, and the stimulator (rootex), while the control was without adding anything .

Study requirement collection

The cuttings were manually taken from the old myrtle plants in Baquba Nursery. Terminal cuttings were trimmed to an average length of 15 cm and a diameter of 1 cm, resulting in approximately 12–16 buds per cutting. . Mycorrhiza fungus was obtained from Neudorff, a company of German origin, and loaded on organic material, whose components are mentioned in Table 1, at a dose of 125 g/m2. Gibberellin is 10%, at a rate of 10 x 10 g per tab. The stimulator (rootex) with the active substance alphanaphthyl acetic acid (4.5%) produced by the Jordanian Agricultural Veterinary Pharmaceutical Factories Company, in addition to Aloe vera gel (100%), was obtained from the peeling of Aloe vera plants

Table 1. Mycorrhizal components

Measurements	Value	Unit of measurement
Organic matter	94	%
NPK	6	%
Mycorrhizae	0.69×10^{6}	CFU/g

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Field experiment

The experiment soil was a sandy mixture transported from the beach of the Tigris river, free of salts. Soil samples with a depth of 0–15 cm were taken to record the physical and chemical properties (Table 2). The soil was placed in plots of 1 x 2 m. The soil was divided into two parts: the first was inoculated and mixed with mycorrhizae at a depth of 10–15 cm at a rate of 125 g/m2, and the second without mycorrhizae. Two cm from the bottom of the cuttings were moistened with water, then they were dipped separately in the root-stimulating treatments, and then the cuttings were planted in the soil at a depth of 10–15 cm at a rate of 20 cuttings per replication. The treatments were covered with a plastic cover to reduce evaporation and protect the cuttings from the cold weather in the first days of March and during the night, then they were irrigated as needed until the age of 60 days. The growing and rooted cuttings were calculated and transferred on 1/5/2022 in plastic bags with a diameter of 10 cm and a height of 20 cm, as one cutting for each bag and in the same soil, then the seedlings were transferred to the wooden canopy to avoid the temperature during the summer months, and the seedlings were fertilized with a balanced fertilizer, NPK, by spraying on the leaves.

Table 2. The physical and chemical properties of soil

Measurements	Value	Unit of measurement
Texture of soil	Sandy loam	-
Clay	76	g. kg^{-1}
Silt	332	g. kg^{-1}
Sand	592	g. kg^{-1}
Ph	7.4	-
EC	1.96	$ds.m^{-1}$
N	61	mg. kg^{-1} or ppm
P	9.8	mg. kg^{-1} or ppm
K	303	mg. kg^{-1} or ppm
B	3.91	mg. kg-1 or ppm
Organic matter	1.7	%

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Studied traits

At the end of the experiment, after 240 days, the following traits were calculated: plant length, root length, rooting of cuttings%, dry root weight, and the percentage of their content of the elements N, P, and K.

Statistical analysis

The data were analyzed by one-way analysis of variance (ANOVA) [9.[

Results and discussion

The results in Table 3 showed that inoculation of soil with mycorrhizae was significantly superior in percentage of nitrogen and phosphorous in leaves, rooting of cuttings, plant length, root length, and dry root weight, which amounted to 2.17%, 0.165%, 68.25%, 52.83 cm, 26.16 cm, and 3.69 g, respectively, as compared with non-inoculated soil, which reached 1.78%, 0.151%, 57.50%, 47.25 cm, 21.75 cm, and 2.70 g, respectively, with no significant differences in percentage of potassium. The gibberellin, rootex, and Aloe vera recorded increases in all previous traits as compared with control, as the Aloe vera gel was significantly superior in recording the highest mean in nitrogen (2.40%), phosphorous (0.180%), potassium (3.10%), rooting of cuttings (75.50%), plant length (54.50 cm), root length (29.00 cm), and dry root weight (4.26 g). As for the interaction between the treatments, the Aloe vera gel with mycorrhizae recorded the highest rates of nitrogen (2.92%), phosphorous (0.188%), rooting of cuttings (85.33%), plant length (57.66 cm), root length (31.33 cm), and dry root weight (5.06 g.(

The findings of the present study indicate that the addition of mycorrhizae and the root-stimulators, such as gibberellin, rootex, and Aloe vera gel, and the combination between them were significant on all measured traits. Currently, a lot of farmers use fresh Aloe vera gel to induce the rooting of stem cuttings. Because of its antibacterial qualities or a composition that contains compounds that promote rooting, such as growth regulators or hormones, cuttings may root more easily. The plant growth regulators (PGR) can be replaced with Aloe vera gel as an alternative root induction agent for semi-hard wood cuttings of Citrus aurantifolia after three months of establishment [13]. Aloe vera leaf extract led to enhanced growth of Populus trees in terms of fresh weight, number of leaves, plant height, root length, root multiplication, and contents of leaves from major nutrients such as nitrogen, phosphorus, and potassium [8]. [11] reported that the root growth of Lemna minor was regulated by endogenous gibberellin. The gibberellin manages the elongation growth of the root by regulating cell elongation [10]. [22] discovered that inoculating arrow-wood cuttings increased the number of root initials emerging from stem cuttings after five weeks of sticking, but they found that this effect only happened once the fungus had colonized the plant. According to [3,15], the advantages of root colonization by vesicular-arbuscular mycorrhizae fungal (VAMF) are believed to be greatest when colonization takes place as early as possible during plant growth. This means that the presence of inoculum during adventitious root formation will maximize the effects of VAMF colonization in plant propagation from cuttings. Different plants' rooting can be increased by adding mycorrhizal fungi to the rooting substrate during cutting propagation [22,23,7,18,19 .[

Conclusion

Our results indicate that adding Mycorrhizae to the soil and treating the roots of Myrtle (Myrtus communis Linn.) with Aloe vera gel,

gibberellin, and rootex resulted in an increase in all growth characteristics compared with control

Table 3. Effect of Mycorrhizae, gibberellin and root stimulators on growth traits of Myrtle cuttings

Nitrogen % in leaves					
A	B				
	Gibberellin	Rootex	*Aloe vera*	Control	Mean
Without Mico.	1.50	2.16	1.88	1.60	1.78
Mycorrhizae	1.78	2.20	2.92	1.77	2.17
Mean	1.64	2.18	2.40	1.68	
CD 5%	A= 0.01, B= 0.02, A x B = 0.03				
Phosphorous % in leaves					
Without Mico.	0.142	0.142	0.171	0.148	0.151
Mycorrhizae	0.165	0.151	0.188	0.156	0.165
Mean	0.154	0.146	0.180	0.152	
CD 5%	A= 0.002, B= 0.002, A x B = 0.004				
Potassium % in leaves					
Without Mico.	2.86	2.82	3.11	2.77	2.89
Mycorrhizae	3.10	2.69	3.10	2.80	2.92
Mean	2.98	2.76	3.10	2.78	
CD 5%	A= 0.03, B= 0.04, A x B = 0.06				
Rooting of cuttings %					
Without Mico.	53.00	62.33	65.66	49.00	57.50
Mycorrhizae	58.33	64.33	85.33	65.00	68.25
Mean	55.66	63.33	75.50	57.00	
CD 5%	A= 0.95 , B= 1.34 , A x B = 1.90				
Plant length after 180 days of planting (cm)					
Without Mico.	46.33	48.00	51.33	43.33	47.25
Mycorrhizae	54.66	51.33	57.66	47.66	52.83
Mean	50.50	49.66	54.50	45.50	
CD 5%	A= 0.57, B= 0.81, A x B = 1.15				
Root length after 180 days of planting (cm)					
Without Mico.	22.66	23.33	26.66	14.33	21.75
Mycorrhizae	23.33	27.66	31.33	22.33	26.16
Mean	23.00	25.50	29.00	18.33	
CD 5%	A= 0.58, B= 0.82, A x B = 1.17				
Dry roots weigh after 180 days (g)					
Without Mico.	2.48	2.63	3.45	2.23	2.70
Mycorrhiza	3.63	3.17	5.06	2.91	3.69
Mean	3.05	2.90	4.26	2.57	
CD 5%	A= 0.02, B= 0.04, A x B = 0.05				

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