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Article

Effect of shading and fertilization with iron and sulfur on some vegetative growth and leaves mineral content of Gardenia jasminoides Ellis.

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ABSTRACT

This study was conducted in a glass house, Dept of Hort. and Landscape, College of Agriculture, Univ. Anbar, during the 2021-2022 growing season, to investigate the influence of shading and fertilization on the growth and leaf mineral content of gardenia plants. This study included two factors: two levels of shading at 0 (S_0), shading 50 % (S_1) and four treatments of fertilizations, control (F_0), chelated iron spray at 2 ml.L^{-1} (F_1), addition of magnesium sulfate to pots at 7 gm.$plant^{-1}$ (F_2) and chelated iron spray at 2 ml.L^{-1} + addition of magnesium sulfate to pots at 7 gm.$plant^{-1}$ (F_3) and their interaction. Treatments were replicated three times at Split plots design (Shading is the main plot) in an RCBD. The number of plants used was 36 plants. The results showed that interaction treatment (S_1F_3) significantly increased the plant height by 6.517 cm, the highest increase in shoot length of 11.267 cm, and the number of 94.107 leaves.$plant^{-1}$, highest leaf area of 9437.463 cm^2, highest leaf nitrogen content of 1.877 % and highest leaf potassium content of 0.561 %, while lower values of these traits were in interaction treatment (S_0F_0).

Keywords: iron, sulfur, vegetative growth, Gardenia jasminoides Ellis

INTRODUCTION

Gardenia jasminoides Ellis belongs to the Rubiaceae family, and its English name is Gardenia floridn. The name of Gardenia goes back to Alexander Garden (1791-1730), a botanist from South Carolina who used the last name Garden in naming this plant. A common name for the plant is Cape Jasmine. The plant is characterized by its aromatic white flowers used for picking. The tropical and semi-tropical regions, i.e., hot regions, are considered the original home of this plant [3]. There are several problems facing Gardenia in its production process, the most important of which are yellowing of leaves, infection with nematodes, lack of flower bud formation, fall of flower buds and short flowering life. Therefore, we find it challenging to raise a gardenia bush, even for professional breeders, as it needs indirect lighting, balanced fertilization, moist soil, and keeping it from

being exposed to drought. The development of product quality is shown by providing the ideal weather conditions for vegetative growth, reaching an appropriate size, and then pushing the plant to flower; at this stage, all nutrients suitable for growth must be provided. [4].

Lighting is a significant and essential factor in plant growth and development. It has an influential role in many vital processes within the plant. It affects the plant in several directions, including lighting type, lighting duration and lighting intensity, which is the number of visible light photons falling on leaves, specifically chlorophyll pigment per unit area. Plant exposure to high degrees of light intensity causes a decrease in the level of photosynthesis, and this can be avoided by protected cultivation and the use of wooden canopy or materials that reduce solar radiation energy and reduce temperature, which is reflected in an increase in the practical efficiency of photosynthesis [6]. Light is one of the most critical environmental factors for plants' growth and development, and it is the main factor for photosynthesis, which is photons particles, which increase with increasing light intensity until saturation and affect transpiration and external shape of leaves [11]. Light is one of the most critical factors affecting many of the vital processes that occur in plants, directly through the effect that occurs in the activity of some enzymes and light reactions in photosynthesis. However, increasing light intensity beyond required limits has many harmful effects on plants; when light intensity increases more than the required limit, it damages plant tissues and thus destroys chlorophyll and reduces the photosynthesis process; in contrast, a decrease in light intensity than the required limit leads to a decrease of growth and plant development [10].

Suitable soil for gardenia cultivation is acidic soil pH (5-5.5), well aerated and rich in organic matter, and problems appear when planting in alkaline soils, which are iron deficient, which the plant greatly needs [13]. Producers work to improve plant growth and flower production in reasonable quantities and qualities by studying all agricultural processes that affect the plant's characteristics in terms of vegetative and floral terms, quantity and type of essential oil, most important of which is plant nutrient with nutrients such as iron, which has a significant and influential role in many vital processes within plant, through its direct participation as a synthetic part of plant materials or acting as an activator in enzymatic processes inside plant, yellowing of leaves that results from iron deficiency reflects its importance Physiological in chlorophyll formation process in plants, where iron enters as a catalyst and activator in reactions of green pigments formation and passing through a series of compounds that ends with chlorophyll molecule formation [12]. [16] confirmed in his experiment that spraying with iron led to a significant increase in most vegetative growth characteristics of Gardenia, spraying with iron every 30 days outperformed the other treatments and gave the highest plant height of 68.04 cm and stem diameter of 9.98 mm and gave a significant increase in leaves carbohydrates and chlorophyll content.

Sulfur also affects the growth of Gardenia. Sulfur is found in soil organically or inorganically, and organic sulfur represents the most significant part of it. Adding mineral sulfur to soil affects the readiness of nutrients, and this is by reducing soil reaction (pH) or through its effect on ionic relations when sulfate is formed by oxidation SO_4 [5], due to few similar studies in Iraq.

MATERIALS AND METHODS

This study was conducted in a glass house, Dept of Hort. and Landscape, College of Agriculture, Univ. Anbar, during the 2021-2022 growing season, to investigate the influence of shading and fertilization on the growth and leaf mineral content of gardenia plants. This study included two factors: two levels of shading at 0

(S_0), shading 50 % (S_1) and four treatments of fertilizations, control (F_0), chelated iron spray at 2 $ml.L^{-1}$ (F_1), addition of magnesium sulfate to pots at 7 $gm.plant^{-1}$ (F_2) and chelated iron spray at 2 $ml.L^{-1}$ + addition of magnesium sulfate to pots at 7 $gm.plant^{-1}$ (F_3) and their interaction. Treatments were replicated three times at Split plots design (Shading is the main plot) in an RCBD. The number of plants used was 36 plants. The following parameters were determined:

Increase in plant height (cm): was measured by metric tape measure at the beginning and end of the experiment, according to the difference between them and such an increase in plant height.

Increased Shoot length (cm): Taking four shoots of each experimental unit at the beginning and measuring annual shoots formed during the season in each unit empirical metric tape measure and mined average branch length.

Leaves number and area: by estimated leaves number and area (cm^2). Five leaves were taken from the middle position of the shoot randomly, and leaf area (cm2) was measured using a Digimizer program Windows 7 operating system. Then leaves area = leaves number x leaf area.

Leaves mineral content: 10 Leaves samples were collected for chemical analysis. Leaves were washed with tap water, rinsed with distilled water, and then dried at 70 c^o until constant weight, ground and digested according [to 7]. Nitrogen was estimated by the micro-Kjeldahl method of [1]. Potassium was determined using an atomic absorption spectrophotometer "Perkin Elmer 1100B" after samples were digested according to [8].

The obtained results were subjected to analysis of variance according to (Elsahookie and Wuhaib, 1990) using LSD 0.05 for comparing differences between various treatment means.

RESULTS

Effects of Shading and Fertilization Treatment on Increase in plant height, Increased in Shoot Length, Leaves Number and Leaves Area: Data concerning the effect of treatments on an increase in plant height, increase in shoot length, leaves number and leaves area are listed in Table (1). The data showed that interaction treatment (S_1F_3) significantly increased the plant height by 6.517 cm, with the highest increase in shoot length of 11.267 cm, leaves a number of 94.107 $leaves.plant^{-1}$ and highest leaves area of 9437.463 cm^2, while lower values of these traits were in interaction treatment (S_0F_0).

Effects of Shading and Fertilization Treatment on Leaves Nitrogen and Potassium Content:

Data concerning the effect of treatments on leaves' nitrogen and potassium content is listed in Table (2). The data showed that the interactions between shading and fertilization significantly affected leaves nitrogen and potassium content, especially the interaction treatment (S_1F_3), as it gave the highest leaf nitrogen content of 1.877 % and the highest leaf potassium content of 0.561 %, while lower values of these traits were in interaction treatment (S_0F_0).

Increase in plant height (cm)				Increase in Shoot length (cm)		
F	S			S		
	S0	S1	Mean	S0	S1	mean
F_0	2.513	3.660	**3.087**	5.833	6.367	6.100
F_1	4.333	5.660	**4.997**	6.800	8.767	7.783
F_2	3.390	4.340	**3.865**	7.633	8.633	8.133
F_3	5.557	6.517	**6.037**	10.467	11.267	10.867
mean	**3.948**	**5.044**		**7.683**	**8.758**	
LSD 5%	S	F	Int.	S	F	Int.
	0.122	0.128	0.181	1.034	0.490	0.693
Leaves number				leaves are (cm^2)		
F_0	69.663	71.107	**70.385**	3843.420	4424.100	**4133.760**
F_1	77.773	84.107	**80.940**	5505.757	6844.070	**6174.913**
F_2	74.883	82.217	**78.550**	5366.517	8715.743	**7041.130**
F_3	90.550	94.107	**92.328**	6955.547	9437.463	**8196.505**
mean	**78.218**	**82.884**		**5417.810**	**7355.344**	
LSD 5%	S	F	Int.	S	F	Int.
	2.709	1.932	2.732	802.340	440.075	622.361

Table 1. Effects of Shading and Fertilizations Treatment on Increase in plant height, Shoot length, Leaves number and Leaves area of Gardenia plants.

Leaves nitrogen content (%)				Leaves potassium content (%)		
F	S			S		
	S0	S1	Mean	S0	S1	mean
F_0	1.176	1.160	**1.168**	0.355	0.365	**0.360**
F_1	1.704	1.700	**1.702**	0.446	0.433	**0.439**
F_2	1.173	1.451	**1.312**	0.433	0.403	**0.418**
F_3	1.676	1.877	**1.777**	0.466	0.561	**0.514**
mean	**1.432**	**1.547**		0.425	0.440	
LSD 5%	S	F	Int.	S	F	Int.
	0.093	0.101	0.142	NS	0.042	0.059

Table 2. Effects of Shading and Fertilizations Treatment on Leaves Nitrogen and Potassium Content of Gardenia Plants.

DISCUSSION

The reason for the increase in vegetative traits is the result of iron spray, which is necessary for plants, as it enters the composition of basic components of the cell and contributes to building chlorophyll and the activity of many enzymes, as foliar nutrients provide an opportunity to consume energy needed for the transfer of element ions within the plant, which means availability of energy needed for cell division and elongation, and thus increase growth [2]. This increase in vegetative growth characteristics may be due to adding sulfur, Where [15] explained that sulfur plays an important role in photosynthesis, which is

positively reflected in vegetative growth characteristics. This increase may also be attributed to shading. The percentage of shading leads to an improvement in photosynthesis efficiency, which led to an increase in the studied vegetative characteristics [17].

Moreover, the increase in leaf nitrogen and potassium content due to the addition or spraying of mineral elements is attributed to its role in increasing the proportion of organic matter in the soil, then improving soil composition and increasing the number of available elements of the plants that absorb and increase its concentration in it [14].

CONCLUSIONS

This study concludes by determining the effect of shading and comparing it with no shading and fertilization with iron and sulfur on the growth and leaf mineral content of gardenia plants.

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