Effect of Shading and Spraying with Chitosan on the Vegetative and Flowering Growth of Polianthes Tuberosa L.

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Abstract. The experiment was conducted in Horticultural Facilities Unit of the Department of Horticulture and Landscape - College of Agriculture - Tikrit University, Iraq for the period from 3/15/2020 to 1/15/2021. The experiment was designed as a randomized complete block design (RCBD). The experiment included two factors: first shading with two levels without shading (open field) and lath house (net 33%). second spraying with chitosan in three concentrations 0, 500, 1000 mg. L⁻¹. Results showed that shading treatments exceeded in length and width leaves gave 52.08 cm and 17.8 mm, open field gave highest Diameter of the basal florets 34.32 mm , foliar with chitosan 1000 mg.L⁻¹ gave highest leaves number 19.12 . Length and diameter of syphilitic Peduncle recorder in interaction between lath house and foliar chitosan 1000 mg.L⁻¹ was 109.02 cm and 9.21mm respectively.

1. Introduction

Polianthes tuberosa L. grows in tropical and subtropical regions [1], belongs to family (Amaryllidaceae). Genus Polianthes which contains 15 species are found in Mexico. [2]. Tuberose for its multiple uses, as it is used as a commercial picking flower for its high aromatic aroma and the duration of the flowering for a long time in decorating bouquets [3] as well as the use of flowers in perfumery, as it is considered an essential source of essential oils that It is used in the production of cosmetics and perfumes [4]. Light basic factor in growth and morphology, shading which reduces the temperature of vegetative growth, which is reflected in the increase efficiency of photosynthesis process [5]. Chitosan is a natural polymer and it is one of the alternatives to traditional fertilizers and has been used in many physiological studies to determine its effect on the growth of plants. It is determined through three criteria: morphological composition, the degree of tissue removal, and the molecular weight [6]. Chitosan increases nutrient absorption and chlorophyll content and increases the rate of photosynthesis, which is reflected in plant growth by increasing essential nutrients, water absorption, and increasing enzyme activity [7]. Plant tolerance to drought can be increased by maintaining plant water balance and photosynthesis activity. This study aimed to know effect of shading and spraying with chitosan on the growth and flowering of tuberous under the conditions of Salah al-Din Governorate.

2. Material and Methods

The experiment was conducted in Horticultural Facilities Unit of the Department of Horticulture and Landscape - College of Agriculture - Tikrit University, Iraq for the period from 15/3/2020 to 15/1/2021, tuberosa variety (Double) with white flowers from Syria. The bulbs were separated, cleaned, and selected bulbs with a diameter of 1.6 - 2 cm used pots 19 cm, bulbs were planted 5-8 cm in depth on 3/15/2020 in mixture soil : peat moss : perlite (2: 2: 1) six pots in experimental unit.

2.1 Experiment design
The experiment designed as a randomized complete block design (RCBD). The experiment included two factors: first shading with two levels without shading (open field) and lath house (net 33%). second spraying with chitosan in three concentrations: 0, 500, 1000 mg L⁻¹, plants were sprayed four times, the first after 2 months of planting, second, third after 15 days, while the fourth when flowering began.

2.2 Characteristics of vegetative growth: length of the leaf (cm), leaf width (mm). Number of leaves, fresh leaf weight (g) Dry leaf weight (g). Leaves area (cm² plant⁻¹).

2.3 Characteristics of flowering growth: duration to flower (day). The length of the floral Peduncle (cm). The diameter of the syphilitic Peduncle (mm). Number of florets (florest floret⁻¹). Basal florets diameter (mm). Florets dry weight (g). Dry florets weight (g). vase life (day), data were analyzed statistically using [8].

3. Results and Discussion

Table (1) Effect of shading and spraying with chitosan on vegetative growth of Polianthes tuberosa L.

| Shading          | duration to flower (day) | leaf width (mm) | Number of Leaves | Florets wet weight (g) | Dry Florets weight (g) | Leaves area (cm² plant⁻¹) |
|------------------|-------------------------|----------------|-----------------|----------------------|-----------------------|--------------------------|
| Open field       | 34.61 b                 | 15.69 b        | 16.79 b         | 1.90 b               | 0.303 b               | 444.69 b                 |
| Lath house       | 52.08 a                 | 17.78 a        | 17.92 a         | 3.42 a               | 0.412 a               | 786.86 a                 |
| Chitosan mg L⁻¹  |                         |                |                 |                      |                       |                          |
| 0                | 39.90 b                 | 15.13 c        | 14.91 c         | 2.23 c               | 0.293 c               | 496.24 c                 |
| 500              | 44.47 a                 | 17.22 b        | 18.04 b         | 2.73 b               | 0.360 b               | 652.13 b                 |
| 1000             | 45.47 a                 | 17.85 a        | 19.12 a         | 3.01 a               | 0.420 a               | 698.97 a                 |
| Interaction      |                         |                |                 |                      |                       |                          |
| Open field       |                         |                |                 |                      |                       |                          |
| 500              | 36.17 c                 | 16.13 c        | 17.53 c         | 1.98 d               | 0.315 c               | 469.17 e                 |
| 1000             | 36.91 c                 | 17.07 b        | 18.84 a         | 2.08 d               | 0.337 c               | 513.58 d                 |
| 0                | 49.06 b                 | 16.39 c        | 15.83 d         | 2.84 c               | 0.330 c               | 641.15 c                 |
| Lath house       | 53.15 a                 | 18.31 a        | 18.55 b         | 3.49 b               | 0.405 b               | 835.09 b                 |
| 500              | 54.03 a                 | 18.63 a        | 19.40 a         | 3.93 a               | 0.502 a               | 884.35 a                 |

The means per column with similar letters are not significant at 0.05 (Duncan’s multiple range tests).

The results in Table (1) indicated the superiority of the shading treatment in leaf length, leaf width, number of leaves, wet and dry leaf weight, and the total area of the plant was 52.08 cm, 17.78 ml, 17.92 leaves. Plant⁻¹, 3.42 gm, 0.412 gm, 786.86 cm². Plant⁻¹, respectively, compared to the non-shading treatment (compare field). The spray treatment with chitosan 1000 mg. L⁻¹ was superior in the characteristics of leaf width, number of leaves, wet and dry leaf weight and leaf area was 17.85 mm, 19.12 leaf, 3.01 gm, 0.420 gm, 698.97 cm², respectively, while the spray treatment with Chitosan 500 and 1000 mg. L⁻¹ was superior in leaf length and area of one leaf 44.47, 45.47 cm, 35.63, 36.29 cm², respectively, compared with the other of the treatments. As for the bilateral interaction, the treatment of spraying with chitosan 1000 mg. L⁻¹ increased the number of leaves, wet and dry leaf weight, and leaf area was 19.40 leaf, 3.93 gm, 0.502 gm, 884.35 cm², while the spray treatment with chitosan 500 and 1000 MG. L⁻¹ and shading in leaf length exceeded the leaf 53.15, 54.03 cm, 18.31, 18.63 mm, compared with the other treatments.

Table (2) Effect of shading and spraying with chitosan on syphilitic growth of Polianthes tuberosa L.

| Shading          | duration to flower | The length of the floral Peduncle (cm). | The diameter of the syphilitic Peduncle (mm). | Number of florets (florest floret⁻¹). | Basal florets diameter (mm). | Florets wet weight (g) | Dry Florets weight (g) | Flowering time (day) |
|------------------|--------------------|----------------------------------------|---------------------------------------------|--------------------------------------|------------------------------|-----------------------|-----------------------|----------------------|
| Open field       | 149.25 a           | 63.19 b                                | 7.59 a                                      | 26.96 a                              | 34.32 a                      | 0.655 a               | 0.171 a               | 38.66 a              |
| Lath house       | 131.00 b           | 103.13 a                               | 8.63 a                                      | 25.62 a                              | 28.92 b                      | 0.586 a               | 0.155 a               | 38.77 a              |
| Chitosan mg L⁻¹  |                    |                                        |                                            |                                      |                              |                       |                       |                      |
| 0                | 146.88 a           | 74.50 b                                | 7.43 b                                      | 23.55 b                              | 28.06 c                      | 0.454 c               | 0.136 b               | 37.38 b              |
| 500              | 136.38 b           | 86.27 a                                | 8.32 a                                      | 27.33 a                              | 32.10 b                      | 0.651 b               | 0.173 a               | 39.38 a              |
| 1000             | 137.11 b           | 88.71 a                                | 8.57 a                                      | 28.00 a                              | 34.70 b                      | 0.756 a               | 0.180 a               | 39.38 a              |

The results in Table (2) indicated that spraying the syphilitic growth with chitosan increased the flowering time, the diameter of the syphilitic Peduncle exceeded the leaf 0.651, 0.756, 0.835 cm, while the spray treatment with chitosan 500 and 1000 MG. L⁻¹ increased the flowering time and diameter of the syphilitic Peduncle. The means per column with similar letters are not significant at 0.05 (Duncan’s multiple range tests).
The results presented in Table (2) indicate the superiority of the shading treatment on the characteristics of the duration of flowering and the length of the syphilitic Peduncle, which reached 131.00 days, 103.13 cm, respectively. The spray treatment with chitosan 1000 mg. L⁻¹ was significant increase in the characteristics of flowering duration, the diameter of the basal florets, and it reached 137.11 days, 34.70 mm. The treatment of spraying with chitosan was superior to 500 and 1000 mg. L⁻¹ in the length of the floret, the diameter of the Peduncle, the number of florets, the weight of the wet and dry florets and the flowering period 86.27, 88.71 cm, 8.32, 8.57 mm, 27.33, 28.00 floret, 0.173, 0.180 gm, 39.38, 39.38 days compared to the comparison treatment. The treatment of shading and spraying with chitosan 500 and 1000 mg. L⁻¹ was significant increase duration of flowering, the length and diameter of the syphilitic Peduncle 127.66, 127.88 days, 105.80, 109.26 cm, 8.84 and 9.21 mm, respectively, compared to the other interactions. The treatment of non-shading and spraying with chitosan 500 mg. Liter -¹ , shading and spraying with chitosan 1000 mg. Liter -¹ were significant increase and gave the lowest flowering time 39.66 days, 39.77 days, respectively, compared to the other of the interactions.

Indicates improvement of vegetative growth as a result of spraying with chitosan, which increased the length and width of the leaf and the number of leaves, which was reflected in the increase in the leaf area and the increase in fresh and dry weight and thus increased vegetative growth [9]. In addition to its role as an antioxidant that improves vegetative growth as a result of improving photosynthesis [10] and increasing carbohydrates that increase the strength of plant growth. As it increased dissolution of sugars as an energy source within the plant, which increases the organic matter, which was reflected in the increase in vegetative growth, length and width of the leaf and leaf area, thus increasing the dry and fresh weight of the plant [11], [12], as well as its role in increasing auxin a result of its role in the accumulation of metabolites of photosynthesis [13]. In addition to its role in regulating the closing of stomata, which causes an increase in carbon dioxide inside [14]. Shading improved flowering reason is due to its role in improving the vegetative growth and increasing photosynthesis process and thus increasing carbohydrates, vitamins and amino acids, [15], [16].

4. Conclusion
In conclusion, it can be recommended treatment of shading and spraying with chitosan 1000 mg.L⁻¹ caused a significant increase in most of the vegetative and flowering characteristics.

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