The Effect of Foliar Thiamine and Roselle Extract on NPK Content and Some Chemical Parameters inof Mathiola Plant

Raeed S. H. Al-Sultani and Ameer A. H. ALFahham

1Urban Planning, Environmental Planning, Iraq.
2Department of Horticulture and Landscape, Faculty of Agriculture, University of Kufa, Iraq.

Abstract

The experiment was conducted in the Directorate of Agriculture in Najaf during the agricultural season 2020-2021 to know the effect of Foliar application of thiamine and Roselle extract on the chemical parameters of the Mathiola plant (Matthiola incana L). The experiment included two factors, the first is thiamine at four concentrations (90,60,30,0) mg.L⁻¹. The second is Roselle extract at four concentrations (0,2,4,6) g.L⁻¹, a factorial experiment was conducted consisting of three replicates, the experiment was conducted based on the Randomized Complete Block Design (R.C.B.D) 4×4×3 = 48. The results can be summarized that thiamine at a concentration of 90 mg.L⁻¹ with Roselle extract at a concentration of 6.4 g.L⁻¹ when sprayed on the plant led to a significant increase in the study parameters as the leaves content of total chlorophyll and nitrogen phosphorous potassium, boron and the total soluble carbohydrate content of the leaves and the anthocyanin content of the flowers were increased reached to 57.27 mg.100 g⁻¹ and 2.45% and 0.29% and 2.96% and 13.72 mg.kg⁻¹ and 18.10 mg.g⁻¹ respectively.

Keywords: Thiamine, Mathiola, Roselle, Brassicaceae.

1.Introduction

Mathiola plant (Matthiola incana L.) is a plant of the family Brassicaceae. It is one of the winter annual plants, its leaves are alternate, spear-shaped, with a few fluffs, of a silvery green color. The flowers are borne on a stalk and are clustered and have multiple colors, including white, red, pink, purple, violet and blue. Seeds can be obtained from single flowers because the applied flowers usually do not give seeds [1]. The reason for the variation in flower colors from light to dark violet in Mathiola plant is due to the concentration of the main anthocyanin pigment derived from pelargonidine or cyanidin [2]. It is a widespread plant in the areas of the Mediterranean basin and the Canary Islands, which is its origin country [3,4]. It prefers the soil that tends to the basal and does not grow in the shade and needs direct sunlight to a large extent [5]. The use of biostimulants is one of the most important trends in the recent study, as vitamins, hormones and microorganisms are used to encourage plant growth and improve cellular metabolism [6-10]. The organic stimulants reduce the need for fertilizers, improve plant growth and increase productivity [11-17].

Thiamine, also known as vitamin B1, is a water-soluble vitamin, and TPP acts as an essential coenzyme for enzymes involved in chloroplastic photosynthesis, and in the synthesis of ATP for its participation in the oxidative decarboxylation of pyruvate and in the carboxylic acid cycle in central mitochondrial metabolism, as well as in the pentose phosphate pathway and alcoholic fermentation [18] and [19]. This vitamin is formed in the leaves in the presence of light and then transmitted to the roots [20]. It was confirmed by [21] that spraying thiamine on zinnia plants led to a significant increase in vegetative and flowering growth parameters. Plant extracts have an important role in stimulating the germination process and improving plant growth in addition to reducing the need to add fertilizers [22,23], and reducing soil pollution [24]. Also, plant extracts have an important role in the germination, growth and nutrition of most plant species [25]. Among those extracts is the extract of Roselle Hibiscus Sabdariffa L., which is an important source of some vitamins, nutrients, compounds and amino acids [26]. This was confirmed by [20] that spraying Roselle extract on the Mathiola plant led to a significant increase in the parameters of vegetative and flowering growth.
2. Materials and Methods

The experiment was conducted in the Najaf Agriculture Directorate - Horticulture and Forestry Nursery during the agricultural season 2020-2021. To know the effect of spraying thiamine and Roselle extract on the chemical parameters of Mathiola plant (*Matthiola incana* L). Where the seedlings were prepared and then transported in plastic pots with a diameter of 25 cm and a height of 22 cm containing river soil and peatmoss as shown in the table below.

| Traits | Units | Values |
|--------|-------|--------|
| N      | mg.kg⁻¹ | 5.00   |
| P      | mg.kg⁻¹ | 2.00   |
| K      | mg.kg⁻¹ | 32.00  |

The experiment included the effect of spraying two factors:

The first factor: Thiamine in four concentrations (90, 60, 30.0) mg.L⁻¹

The second factor: Roselle extract with four concentrations (6, 4, 2, 0) g.L⁻¹. It was sprayed twice for the factor and the second time after 21 days from the first spraying and the plants were fertilized with compound fertilizer (K.P.N) granular at an average of (1 g). The treatments were distributed in a factorial experiment with two factors, each factor with four concentrations and three replicates. The experiment was applied using the Randomized Complete Block Design (R.C.B.D) [8]. ANOVA was performed and the mean was compared according to the least significant difference (L.S.D) test and at the probability level (0.05) using GenStat Release 12.1 program.

Studied traits

1. Determination of the total chlorophyll content of leaves (mg. 100 g⁻¹), Estimation according to the method [16]
2. Determination of the leaves content of nutrients N.P.K (%), Estimation was conducted according to the method [9].
3. Determination of the leaves' content of total soluble carbohydrates (mg.g⁻¹), Estimation was conducted according to the method [15].
4. Determination of the flower content of anthocyanin dye (mg. 100 g⁻¹), Estimation conducted according to the method [1].

3. Results and Discussion

Results that thiamine at a concentration of 90 mg.L⁻¹ with Roselle extract at a concentration of 6.4 g.L⁻¹ when sprayed on the plant led to a significant increase in the study parameters. The content of the leaves of total chlorophyll, nitrogen, phosphorous potassium, boron, the content of leaves of total soluble carbohydrates and the content of flowers of anthocyanin pigment increased, reaching 57.27 mg. 100 g⁻¹, 2.45%, 0.29%, 2.96%, and 13.72 mg kg⁻¹, and 18.10 mg.g⁻¹. Compared with the treatment of spraying with water only, which amounted to 20.81 mg.100 g⁻¹, 1.12%, 0.12%, 1.21%, 9.14 mg kg⁻¹ and 16.02 mg.g⁻¹, respectively. It was found that there was a significant increase in the chemical traits of the plant when spraying with thiamine compared to the control treatment that gave the lowest average. This may be due to the role of thiamine in increasing the efficiency of the photosynthesis process and the absorption of nutrients and increasing the levels of both cytokinins and gibberellins [25]. Roselle extract also participates in encouraging vegetative growth by containing many other substances such as water, protein, fat, fiber, calcium, phosphorous and iron in addition to carotene, thiamine, riboflavin, niacin, Ascorbic acid, vitamin B2 and D, anthocyanins, flavonoids and polyphenols have important and effective roles in carbohydrate metabolism and synthesis and regulating cell division and increasing the expansion of plant cells, which leads to an increase in the rate of plant growth in general and a significant increase in vegetative and flowering traits [26].
Table 2. The interaction effect of thiamine spraying and Roselle extract on chemical parameters.

| Interaction between thiamine mg.L⁻¹ with Roselle extract g.L⁻¹ | Total chlorophyll mg.100 g⁻¹ | Total soluble carbohydrates mg.g⁻¹ | N % | P % | K % | Anthocyanin’s pigment mg.100g⁻¹ |
|---------------------------------------------------------------|----------------------------|----------------------------------|-----|-----|-----|--------------------------------|
| B1. 0                                                         |                            |                                  |     |     |     |                                |
| 0                                                             | 20.81                      | 9.14                             | 1.12| 0.12| 1.21| 16.02                          |
| 2                                                             | 43.10                      | 10.09                            | 1.95| 0.13| 2.43| 16.12                          |
| 4                                                             | 24.42                      | 11.34                            | 2.02| 0.14| 1.83| 17.06                          |
| 6                                                             | 34.69                      | 11.10                            | 2.22| 0.16| 2.81| 18.10                          |
| 0                                                             | 30.15                      | 10.68                            | 1.25| 0.20| 2.33| 16.66                          |
| B1 .30                                                        |                            |                                  |     |     |     |                                |
| 2                                                             | 35.69                      | 10.08                            | 1.86| 0.21| 1.52| 18.18                          |
| 4                                                             | 35.45                      | 10.09                            | 2.32| 0.29| 2.54| 17.48                          |
| 6                                                             | 42.23                      | 12.07                            | 2.06| 0.19| 2.50| 16.33                          |
| 0                                                             | 23.66                      | 12.08                            | 1.94| 0.21| 2.09| 16.42                          |
| B1 .60                                                        |                            |                                  |     |     |     |                                |
| 2                                                             | 30.31                      | 11.04                            | 2.37| 0.24| 2.53| 17.12                          |
| 4                                                             | 27.66                      | 12.11                            | 2.21| 0.28| 2.30| 17.12                          |
| 6                                                             | 45.43                      | 12.09                            | 2.37| 0.22| 2.20| 18.02                          |
| 0                                                             | 51.09                      | 12.15                            | 2.41| 0.19| 2.02| 17.27                          |
| B1 .90                                                        |                            |                                  |     |     |     |                                |
| 2                                                             | 52.57                      | 12.88                            | 2.11| 0.21| 2.38| 18.08                          |
| 4                                                             | 48.70                      | 12.20                            | 2.41| 0.29| 2.96| 18.10                          |
| 6                                                             | 57.27                      | 13.72                            | 2.45| 0.20| 2.66| 16.57                          |
| L.S.D.(P≤0.05)                                                | 2.404                     | 0.189                            | 0.267| 0.002| 0.025| 0.240                          |

References

[1] Abbas, M. F. and M. J. Abbas. 1992. Practical fruit and vegetable care and storage. faculty of Agriculture. Albasrah university. Ministry of Higher Education and Scientific Research. Iraq.
[2] Abdel-Aziz, N. G., A. A. Mazherand M. H. Mahgoub. 2011. Influence of using Fertilizer on Vegetative Growth, Flowering and Chemical Constituents of Mathiola incana Plant growth under saline water irrigation. World J. of Agric. Scin. 7(1) : 47-54. 2011.
[3] Alaa, G. and A.G. AL_hashimi. 2012. Antioxidant and antibacterial activities of Roselle sabdariffa L. extracts. African Journal of Food Science, 6(21):506 – 511.
[4] Al-Abbas, A.M.A.S.; J.A. Abbass and Al-Taey. 2020. A study on the effect of glutamic acid and benzyl adenine application up on growth, yield parameters and active ingredients of Matricaria chamomilla L. Ph.D. Thesis, College of Agriculture, University of Baghdad. The Republic of Iraq.
[5] Alrawi, khashie Mahmoud and Abdel Aziz Khalaf Allah. 2000. Design and analysis of agricultural experiments. Dar Al-Kutub for Printing and Publishing, University of Mosul, Ministry of Higher Education and Scientific Research. Iraq.
[6] Al-Sahaf, F. H.1989. Applied plant nutrition. Baghdad University. Ministry of Higher Education and Scientific Research. Iraq.
[7] Al-Taey, D. K. A. (2017). Alleviation of Salinity Effects by Poultry Manure and Gibberellin Application on growth and Peroxidase activity in pepper. International Journal of Environment, Agriculture and Biotechnology; 2(4) 1851-1862 http://dx.doi.org/10.22161/ijeab/2.4.49
[8] Al-Taey, D.K.A., M.J.H. Al-Shareefi , A.K. Mijwel, A. RZ. Al-Tawaha, A. RM. Al-Tawaha.(2019). The beneficial effects of bio-fertilizers combinations and humic acid on growth, yield parameters and nitrogen content of broccoli grown under drip irrigation system. Bulgarian Journal of Agricultural Science, 25 (5), 959–966.
[9] Bocobza, S.E., Aharoni, A. Switching the light on plant riboswitches. Trends Plant Sci. 2008, 13, 526–533.
[10] Dirmenci, T.; F. Satil and G. Tumen . 2006 . A new species of matthiola R.Br. (Brassicaceae) from Turkey. Botanical Journal of the Linnean Society, Vol.151 (3) : 431–435.
[11] Dole JM, Wilkins HF (2005) Matthiola. Floriculture priples and species. Pearson Prentice Hall, New Jersey, pp 682–687.
[12] Shakir, A.A., Salman, E.F., Shakir, A.J., Mohammed, M.A., Abdurridha, W.M., Almayahi, B.A ., (2019) . Optical properties of polyvinyl alcohol membrane with h-HAp for bio-medical applications. Prensa Medica Argentina, 105 (11), pp. 836-841.
[13] Goodwin, T.W. 1976. Chemistry and biochemistry of Plant Pigments. 2nd ed. Academic Press, N.Y.U.S.A. p. 373.
[14] Hamza O.M. and D. K. A. AL-Taey. 2020. A study on the effect of glutamic acid and benzyl adenine application up on growth and yield parameters and active components of two Broccoli hybrids. Int. J. Agricult. Stat. Sci., 16, Supplement 1: 1163-1167. DocID: https://connectjournals.com/03899.2020.16.1163
[18] Hasan, A.M., T.J.Mohamed Ali .,D.K.A.Al-Taey (2019). Effects of Winter Foliar Fertilizing and Plant Growth Promoters on Element and Carbohydrate Contents on the Shoot of Navel Orange Sapling. International Journal of Fruit Science., 19(1) 1-10. https://doi.org/10.1080/15538362.2019.1668331

[19] Jasman A.K., Slomy , A.K., Sahib, M.R., AL-Taey, D.K.A. and Abd Ali, A. 2019. Evaluation of Mirabilis jalapa and Conocarpus erectus Extracts against Bemisia tabaci and Myzus persicae on Solanum melongena Plants under Laboratory and Field Conditions. Biopestic.Int.15(1):39-44.

[20] Manea, A.I., AL-Bayati, H.J. and AL-Taey, D.K.A . 2019. Impact of yeast extract, zinc sulphate and organic fertilizers spraying on potato growth and yield. Res. on Crops 20 (1) :95-100. DOI : 10.31830/2348-7542.2019.013

[21] Martinis, J.; E. Gas-Pascual.; N. Szydlowski.; M. Crèvecoeur.; A. Gisler.; L. Bürkle and Fitzpatrick, TB. 2016. Long-distance transport of thiamine (vitamin B1) is concomitant with that of polyamines. Plant Physio, 171: 542–553.

[22] Muhammad, B. T. 1995 . Effect of Cuscuta spp. extracts. In the germination and growth of some plant species. Master Thesis. College of Science . University of Babylon .

[23] Tatsuzawa F, Saito N, Toki K, Shinoda K, Honda T (2012) Flower colors and their anthocyanins in Matthiola incana cultivars (Brassicaceae). J Jpn Soc Hort Sci 81:91–100.

[24] Tylicki, A.; Z. Lotowski.; M. Siemieniuk and Ratkiewicz, A. 2018. Thiamine and selected thiamine antivitamins—Biological activity and methods of synthesis. Biosci. Rep, 38(1):1-23.

[25] Youssef, A.A. and I.M. Talaat. 2003. Physiological response of rosmary plant to some vitamins. Egypt pharm.J.,1:81-93.

[26] Zuraida, Z.; E. Yerizel and Anas, E. 2015. Pengaruh pemberian ekstrak rosela (Roselle sordariaff Linn) terhadap kadar malondialdehyd dan aktivitas katalase tikus yang terpapar karbon tetraklorida. Andalas J. Health ,4: 795-802.