Effect of Foliar Spray of Seaweed (Alga300) and Licorice Extracts on Growth, Yield and Fruit Quality of Pomegranate Trees *Punica Granatum* L. Cv.Salimi

S. A. Hussein¹, A. M. Noori¹, M. A. Lateef¹ and Ch. Ra. Ismael²

¹Department of Horticulture and Landscape Design, College of Agriculture, University of Kirkuk, Iraq
²Office of Examination and Certification of Seeds, Ministry of Agriculture-Iraq

Abstract: This study was conducted in a private-orchard in the Kumptler village of Kirkuk / Iraq during the growing season of (2019), to study the effect of foliar spraying with seaweed extract (Alga300) in three concentrations (0, 5, 10) mg.L⁻¹ and licorice extract in three concentrations (0, 5, 10) g.L⁻¹ in some growth traits and yield for pomegranate trees, cv.Salimi. The factorial experiment within randomize complete block design was used. The results obtained can be summarized to the fact that foliar spraying pomegranate trees with a concentration of 10 mg.L⁻¹ of seaweed extract represented by Alga300 led to a significant increase in most of the study characteristics (average length of vegetative growth, leaf area, average size and weight of fruit, average number of fruits, TSS% and total yield/tree) while the spray was superior to the concentration of 5 mg.L⁻¹ of Alga300 in the relative chlorophyll content and leaf dry matter which reached (45.91 CCI, 64.10 %) Respectively. The foliar spray with a concentration of 10g.L⁻¹ of licorice extract was significantly higher in all studied parameters (average length of vegetative growth, leaf area, chlorophyll content in leaves, percentage of dry matter in leaves, average fruit size and weight, average number of fruits and TSS% and total yield/tree) which reached (25.57 cm, 7.01 cm², 44.57 CCI, 62.93%, 202.33 cm³, 396.55 g, 112.79 62 fruit.tree⁻¹, 14.34%, 16.37 km.tree⁻¹). Respectively.

1. Introduction:
The pomegranate tree, *Punica granatum* L., belongs to the Punicaceae family, and it is one of the oldest types of deciduous fruits whose fruits are eaten. Pomegranate has a great economic importance, as it gives a crop that can be available in the market from late summer (often in October) until mid-winter due to the thick leather cover of its fruits that provides protection for the fruit, as well as the use of the fruiting coating in tanning leather because it contains tannin by 20-30% of the fruit juice contains proteins, fats, carbohydrates, dyes, acids, fibers, vitamin C and a number of nutrients, the most important of which are potassium, iron and copper [1].

Seaweed extracts are considered one of the organic sources used, as more than 15 million tons of them are used annually in the agricultural field in various parts of the world [2]. In this regard, [3], when spraying the seaweed extract Chlorella vulgaris on 5-year-old grape trees, resulted in an increase in the length of branches, number of leaves, leaf area and leaf content of nitrogen, phosphorus and potassium. In a study [4] on the effect of spraying with marine plant extracts on some vegetative growth traits of olives, it was found that spraying with Soluamine extract at a concentration of 2 ml.L⁻¹ led to a significant increase in some vegetative growth characteristics (length of branches, leaf area
and leaf content of chlorophyll) compared with a comparison treatment. [5] when spraying pomegranate seedlings with marine algae extract, that spraying with a concentration of 4 mL⁻¹ of marinervert extract 012/0 led to a significant increase in the seedling height, average main stem diameter and leaf area. Studies have shown that the use of some plant extracts such as licorice extract has a similar effect to growth regulators in improving the root and vegetative growth characteristics of plants as well as containing a wide range of nutrients and nutrients [6]. [7] confirmed that the licorice plant contains high concentrations of amino acids, carbohydrates and other important elements, which gives it great importance in nutritional uses, and given the content of licorice extract of various compounds that may have an effect on plant growth and development, many studies have been conducted to find out the effect of this extract on plant growth and production. [8] showed that spraying with a concentration of 10 g.L⁻¹ of licorice resulted in a significant increase in leaf area, number of leaves, dry weight of the shoot and root system, and the content of pomegranate seedlings Wonderful class of nutrients NPK, which reached (5.61 cm², 344.11 leaves.plant⁻¹, 30.18 gm, 15.98 gm, 2.20%, 1.02%, 1.41%), respectively, as compared to the control treatment. [9] concluded that spraying with a concentration of 8 g.L⁻¹ of licorice extract in the growth of olive seedlings led to a significant increase in the number of branches, number of leaves, stem diameter, area of one leaf, leaf content of chlorophyll and the ratio of NPK in leaves compared with the rest of the treatments. The aim of this research is to improve some of the vegetative characteristics, yield and fruit quality of young pomegranate trees by spraying with seaweed extracts and licorice.

2. Materials and Methods:
This study was conducted in a private orchard in Kumptler village in Kirkuk / Iraq during the growing season of 2019 on the pomegranate trees of a 6-year-old planted with dimensions of 4 x 4 m. Cultivation and irrigation during the trial period. The trees were sprayed with Alga300 marine algae extract (containing 1% nitrogen, 5% phosphorous and 10% potassium, in addition to seaweed, vitamins, amino acids, methionine and lysine at 4%) in three concentrations (0, 5, 10) mg.L⁻¹ and extract of sweat. Licorice (prepared by soaking each concentration separately in a liter of 50 °C distilled water for 24 hours and then filtering the solution through a damp cloth) in three concentrations (0, 5, 10) g.L⁻¹ in the early morning till run off and three sprays during the growing season using a manual sprinkler, where the first spray was carried out in February, the second spray was carried out at the full decade of trees, and the third spray was a month after the first spray. So, the number of trees in one replicator was 18 and the number of trees in the total experiment was 54 trees. The data were analyzed statistically according to the ANOVA TABLE using the (2001 SAS, V 9.0) system for analyzing agricultural experiments and the averages were compared using Duncan's Multiple Range test under a probability level of 0.05, as mentioned [10].

3. Study characteristics: All measurements were taken at the end of the experiment, 15 / October / 2019.
1- Average length of shoots (cm):
2- Leaf area (cm²):
3- Chlorophyll Content (Chlorophyll Content Index CCI):
4- Leaves dry matter (%):
5- Average fruit size (cm³):
6- Average number of fruits (fruit. tree⁻¹):
7- Average fruit weight (g):
8- TSS percentage (%):
9- Yield per tree (kg.tree⁻¹):

4. Results and Discussion:
1. Vegetative growth Characteristics:
The results shown in table 1 showed that spraying pomegranate trees with Alga300 seaweed extract at a concentration of 10 mg.L⁻¹ led to a significant increase in the average length of vegetative growth and leaf area by an increase of (22.90 and 17.55)%, respectively, according to the treatment. The comparison, while the spray at a concentration of 5 mg. L⁻¹ significantly outperformed the comparison
treatment in relative chlorophyll and the percentage of dry matter in the leaves, with an increase of (9.49 and 16.04) %, respectively. The spray with a concentration of 10 g.L\(^{-1}\) of licorice extract was significantly superior in all the studied vegetative growth characteristics (average length of vegetative growth, leaf area and relative chlorophyll in leaves and percentage of dry matter in leaves) by an increase over the comparison treatment, which amounted to (8.16, 9.53, 2.74 and 5.87\%), respectively.

As for the interaction between the concentrations of Alga300 and licorice, the spray with a concentration of 10 mg. L\(^{-1}\) of Alga300 with 5 g. L\(^{-1}\) of licorice was superior to the control of the treatments in the average length of vegetative growth and leaf area, which reached (27.14 cm, 7.61 cm\(^2\)). Respectively, the concentration of 5 mg.L\(^{-1}\) of Alga300 with 5 g.L\(^{-1}\) of licorice was superior to the control of the treatments in the relative chlorophyll characteristic in the leaves, which reached 46.15 CCI, which did not differ significantly with a concentration of 5 mg.L\(^{-1}\) of Alga300. With 10 g.L\(^{-1}\) of licorice, which reached 45.96 CCI, and in the percentage of dry matter in the leaves, the interaction of two concentrations of 10 mg. L\(^{-1}\) of Alga300 and 10 g.L\(^{-1}\) of licorice was significantly higher than the control of the treatments, as it reached 67.13%.

Table (1) Effect of foliar spraying with seaweed (Alga300) and licorice extracts on vegetative growth

| Alga300 mg.L\(^{-1}\) | licorice g.L\(^{-1}\) | Pomegranate trees Punica granatum L. cv. salimi | Growth characteristics |
|---------------------|------------------|-----------------------------------------------|------------------------|
|                     | Average length of shoots (cm) | Leaf area (Cm\(^2\)) | Chlorophyll content (CCI) | Leaves dry matter (%) |
| 0                   | 20.13 g          | 5.68 f                          | 40.74 g                | 55.29 h               |
| 5                   | 22.27 f          | 6.12 e                          | 42.14 f                | 54.22 i               |
| 10                  | 23.48 e          | 6.84 c                          | 42.89 e                | 56.20 f               |
| 0                   | 24.29 d          | 6.40 d                          | 45.62 b                | 63.19 f               |
| 5                   | 25.77 c          | 6.18 df                         | 46.15 a                | 63.65 c               |
| 10                  | 25.90 c          | 7.02 bc                         | 45.96 a                | 65.46 b               |
| 0                   | 26.52 b          | 7.13 b                          | 43.78 d                | 59.84 e               |
| 5                   | 27.14 a          | 7.61 a                          | 45.08 c                | 55.94 g               |
| 10                  | 27.33 a          | 7.17 b                          | 44.86 c                | 67.13 a               |
| Alga300 mg.L\(^{-1}\) | 0                | 21.96 c                          | 6.21 c                  | 41.93 c               |
|                     | 25.32 b          | 6.53 b                          | 45.91 a                | 64.10 a               |
|                     | 26.99 a          | 7.30 a                          | 44.57 c                | 60.97 b               |
| licorice g.L\(^{-1}\) | 0                | 23.64 c                          | 6.40 c                  | 43.38 b               |
|                     | 25.06 b          | 6.64 b                          | 44.46 a                | 57.94 c               |
|                     | 25.57 a          | 7.01 a                          | 44.57 a                | 62.93 a               |

The values with similar letters for each factor or their interactions individually did not differ significantly according to Duncan's test at a probability level of 0.05.

2. Yield characteristics:
The results shown in table 2 showed that spraying pomegranate trees at a concentration of 10 mg.L\(^{-1}\) of Alga300 extract and 10 g.L\(^{-1}\) of licorice extract separately led to a significant increase in all the yield characteristics (average size, weight, average number of fruit, percentage of total soluble solids, and yield per tree) compared to treatment with an increase of (12.19, 14.05, 9.14, 16.78, 22.22\%) respectively for Alga300 extract, while the percentage increase over the treatment was (3.57, 2.73, 2.82, 3.76 and 10.53\%), respectively, for licorice extract.

The concentration of 10 mg.L\(^{-1}\) of Alga300 extract interfering with a concentration of 10 g.L\(^{-1}\) of licorice extract significantly exceeded the rest of the treatments in the average size and weight of the fruit, the average number of fruits and the percentage of total dissolved solids, reaching (210.88 cm\(^3\), 421.35 g, 118.62 fruit.tree\(^{-1}\), 15.09 \%), while the interaction of the concentration of 10 mg.L\(^{-1}\) of Alga300 extract with two concentrations of 5 and 10 g. L\(^{-1}\) of licorice extract in the yield of one tree was significantly higher than the control of the treatments. It amounted to (17.06, 17.14) kg.tree\(^{-1}\) respectively.
Table (2) Effect of foliar spraying with seaweed (Alga300) and licorice extracts on some fruit characteristics of Pomegranate trees *Punica granatum* L. cv. salimi

| Alga300 mg.L⁻¹ | licorice g.L⁻¹ | Growth characteristics |         |         |         |         |
|---------------|---------------|------------------------|---------|---------|---------|---------|
|               |               | Average fruit size (cm³) | Average number of fruits (fruit. tree⁻¹) | Average fruit weight (g) | TSS (%) | Yield per tree (kg. tree⁻¹) |
| 0             | 0             | 182.16 i               | 106.05 h | 361.24 i | 12.56 h | 12.73 h |
| 5             | 5             | 184.45 h               | 106.13 h | 367.31 h | 12.98 g | 13.92 g |
| 10            | 0             | 191.53 g               | 109.22 e | 370.56 g | 13.07 f | 15.20 d |
| 5             | 10            | 197.34 f               | 107.35 g | 383.17 f | 13.94 e | 14.74 f |
| 10            | 0             | 204.59 d               | 110.54 d | 397.73 d | 14.85 c | 16.77 c |
| 10            | 5             | 206.57 c               | 115.71 c | 413.66 c | 14.97 b | 16.96 c |
| 10            | 10            | 210.88 a               | 118.62 a | 421.35 a | 15.09 a | 17.14 a |
| Alga300 mg.L⁻¹ |               |                        |         |         |         |         |
| 0             | 5             | 186.05 c               | 107.13 c | 366.37 c | 12.87 c | 13.95 c |
| 5             | 5             | 200.53 b               | 108.73 b | 390.46 b | 14.29 b | 15.49 b |
| 10            | 0             | 209.84 a               | 116.92 a | 417.85 a | 15.03 a | 17.06 a |
| 10            | 5             | 205.36 c               | 109.70 c | 386.02 c | 13.82 c | 14.81 c |
| 10            | 10            | 202.33 a               | 112.79 a | 396.55 a | 14.34 a | 16.37 a |

The values with similar letters for each factor or their interactions individually did not differ significantly according to Duncan's test at a probability level of 0.05.

The results obtained can be explained by the increase in the vegetative growth characteristics when spraying with seaweed extract to the fact that it contains growth-promoting substances such as vitamins, organic and amino acids in addition to plant hormones such as auxins, cytokinins and some other nutrients that have a role in increasing the vegetative growth of the plant [11,12], in addition to containing substances that act as inhibitors of oxidation processes and thus work to prevent the degradation of chlorophyll, which increases the chlorophyll content of leaves [13]. The ability of plants to grow and absorb nutrients and thus increase vegetative growth improves the nutritional status of trees [14]. These results are consistent with [4,5].

The spray with licorice extract can be explained by its containment of most of the micro and macro nutrients in addition to Mevalonic acid, which has a positive role in building gibberellin biosynthesis, which leads to an increase in the internal level of gibberellin, which improves the stimulation of the plant towards flowering, and its containment of carbohydrates and salts, which leads to an increase in the rate of vegetative and root growth, thus increasing the absorption of water and nutrients from the soil, which are transferred to fruits and improve the yield characteristics [15,16]. These results are in agreement with [8,9].

5. Conclusion:

It was concluded from this study that the spraying of pomegranate trees ‘Salimi cultivar’ at 6 years with Alga300 extract with 5 and 10 mg.L⁻¹ concentrations and licorice extract at 10 g.L⁻¹ concentration led to a clear significant increase in all the vegetative growth and yield characteristics, which was obtained alone or in combination.

References:
[1] Hassan, N A, Abeer,A, El-Halwagi, and Sayed,H A 2012, Phytochemicals, Antioxidant and Chemical Properties of 32 Pomegranate accession growing in egypt. *World Applied Sciences Journal. 16*(8), 1065-1073.
[2] FAO 2006, Food and agriculture organisationof the united nations , *Rome yearbook of fishery statistics*98(1-2),
[3] Abd El Moniem, E A, and Abd-Allah,A S E 2008, Effect of green alga cells extract as foliar spray on vegetative growth yield and berries quality of superior grapevines american-eurasian *J.Agric.and Environ. Sci.*,4(4), 427-433.
[4] Abboud, R L, Zuhair, E D, and Mona, H Sh 2010, The effect of spraying with natural growth regulators (marine plant extracts) on some vegetative and fruiting characteristics of Bashyki olives. The Iraqi Journal of Desert Studies, Special Issue of the First Scientific Conference, 9(1), 7801-1994.

[5] Athbib, I G, Falah, H R, Al-Mayahi, and Al-Badri, L T 2018, The effect of spraying with seaweed extract on some vegetative and chemical characteristics of pomegranate seedlings under salt stress punica granatum L., Wonderful variety. Dhi Qar University Journal of Agricultural Research, Volume 7(2), 1-14.

[6] Musa, T N, Abdul-Jabbar, W, Abd al-Hadithi, and Abdul-Majid, N A 2002, Study of some components of local licorice root powder, Glyrrhiza glabra L. Journal of Agricultural Sciences. 34(4), 30-38.

[7] Al-Ajili, T A Z 2005, The effect of gibberellin GA3 and some nutrients on the production of glycerine and some other ingredients in the licorice plant. PhD thesis, Faculty of Agriculture, University of Baghdad. The Republic of Iraq.

[8] Abu Al-Mikh, M T 2017, The effect of biological fertilization and spraying with plant extracts on some growth indicators and leaf nutrients content of Wonderful pomegranate seedlings. Al-Kufa Journal of Agricultural Sciences. 9(3), 42.59.

[9] Zangana, A G 2019, The effect of foliar spraying with licorice extract and fenugreek seeds on the growth of seedlings of two varieties of olive (Olea europaea L): Arctic and green. Master Thesis, College of Agriculture, University of Kirkuk.

[10] Roger Mead, R N C, and Hasted, A M 2003, Statistical methods in agriclture and experimental biology champan. Hall, CRC, A CRC Press Co., Washington, D.C.

[11] Travena, R G 2007, Seaweed fertilizer for the organic farmer biobauer. BioMagic. Priory gardens, Derby, DE 214Tg.

[12] Zodape, S T, Gupta, A, and Bhandari, S C, Rawat, S, Chaudhary, D R, Eswaran, K and Chikara, J 2011, "Foliar application of seaweed sap as biostimulant for enhancement of yield and quality of tomato (Lycopersicon esculentum Mill.)." NISCAIR-CSIR. JSIR India 70(3), 215-219.

[13] Kuwada, K L, S, Wamocho, M U, Matsushita, I and Ishii, T 2006, Effect of red and green algal extracts on hyphal growth of arbuscular fungi and on mycorrhizal development and growth of Papaya and Passionfruit. Agron. J. 98, 1340-1344.

[14] Jensen, E 2004, Seaweed: Fact or fancy. from the organic broadcaster, published by moses the midwest organic and sustainable eductation. From the Broadcaster: 12(3), 164-170.

[15] Francisco, J P and omez, M G 2000. Possible role of soluble invertase in the gibberellic acid berriesizing effect in Sultana grape. Plant Growth Regulation. 30, 111-116.

[16] Casanova, L A, Moret and Agusti, M 2009. The application of gibberellic acid increases berry size of ‘Imperatriz’ seedless grape. Spanish Journal of Agricultural Research. 7(4), 919-927.