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EFFECT OF FOLIAR SPRAY WITH POTASSIUM HUMATE AND GREEN TEA EXTRACT ON SOME OF THE VEGETATIVE CHARACTERISTICS OF GUAVA (*PSIDIUM GUAJAVA* L. CV. LOCAL) SEEDLINGS

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Abstract

The results showed that foliar spray of guava seedlings with Potassium humate concentration at 4 ml.L^{-1} recorded a significant increase in the means of the seedling height, the diameter of the main stem, the number of lateral shoots, the number of leaves for each seedling, the leaf area, the percentage of dry matter, protein, total chlorophyll, nitrogen, phosphorus and potassium content of leaf compared to other treatment. The results showed that foliar spray with green tea extract also showed a significant increase in all of the above-mentioned characteristics when compared with other treatments except for the treatment at4 ml.L^{-1} potassium humate. While the control treatment gave the lowest values in the means of seedlings height, the diameter of the main stem, the number of lateral shoots, the number of leaves for each seedling, the leaf area, dry matter, protein, total chlorophyll, nitrogen, phosphorus and potassium content of the leaf. Also, the results indicate that the control treatment recorded the highest significant increase in the percentage of water content in the guava leaves compared with the other treatments. While the Potassium humate at 4 ml.L^{-1} recorded the lowest percentage of water content in the guava leaves.

Key words **:** Leaf area; nitrogen; protein content; total chlorophyll.

Introduction

Guava (*P. guajava* L.) plant is an evergreen fruit tree that is cultivated in tropical and subtropical regions. This plant belongs to the family Myrtaceae, which includes *Psidium*, which contains about 150 species of plants, the most important of which is the guava plant (Soares *et al*., 2007). The height of the tree of this plant is 30 feet above the surface of the soil. The leaves of tree arranged in pairs along the branches. Guava fruit trees are economically important plants because their fruits have nutritional value because they contain carbohydrates, proteins, fiber, minerals and vitamins. It has a high content of vitamin C (Bashir, 2003; Salazar *et al*., 2006). The fruits of guava are eaten fresh, cooked or preserved as slices in sugar solutions, juices or jams, so it is called the Asian apple. Plant parts of the tree, such as bark, phloem, leaves, flowers and roots, are used in the manufacture of medicines and medical preparations (Mossler and Nesheim, 2002). Guava trees grow in different clay, sandy, alkaline and acid soils as they grow in a wide range of soil pH ranging from 4.5 - 9.4. It also tolerates salinity and saturated with the moisture of the soil that most fruit trees cannot tolerate (Sharif *et al*., 2011). Nutrients to the plant can be made available by the soil fertilization as well as by the foliar application. The foliar feeding of the plant has gained much importance in recent years, as the addition of nutrients to the soil is not a good method because some nutrients leached and become unavailable to the plant. The foliar application depends on the fact that the nutrients are quickly absorbed by the leaves and transported to different parts of the plant (Shukla, 2011). The important nutrients like nitrogen, phosphorus, potassium, iron, zinc, copper, molybdenum etc. have a great effect in promoting the plant growth, development and yield (Khamis and Bakry, 2007). Aml *et al*. (2011) indicated that treatment of humic acid, amino acids, macro elements and trace elements were caused an increase in plant height, the number of branches and leaves and leaf area compared with control when they study on Chemlali olive (*Olea europea* L.) seedlings. Mustafa and El-Shazly (2013) found that the soil application of potassium humate at 20 g.tree^{-1} led to increase in tree height, leaf area, fresh and dry weight of leaf when they study on the effect of potassium humate at a different concentration (0, 10 and 20 g.tree^{-1}) in some vegetative parameters of navel orange (*Citrus sinensis*) trees. Ennab (2016) noticed that the addition of humic acid to the soil at a concentration of 30 g.tree^{-1} resulted in a significant increase in the shoot length, the number of leaves. branch^{-1} and leaf area compared with other treatments. When he was studying on the effect of different concentrations (0, 10, 20 and 30 g.tree^{-1}) of humic acid on some vegetative growth characteristics of the lime (*C. aurantifolia* Swingle) trees. Green tea extract contains different tannins, vitamins, antioxidants and minerals (Parakash and Majeed, 2003). The foliar application by plant extracts was found by many researchers to promote plant growth and development (Abd El- Rahman and El- Masry, 2012; Mohamed and

Mohamed, 2013). Ahmed *et al*. (2014) noticed that the foliar spray of mango (*Mangifera indica* L.) trees by green tea extract at 0.1% led to significant increase in shoot length, the number of leaves.shoot^{-1} and leaf area compared with control treatment. Abada (2014) found that the foliar spray by green tea extract at 250 or 500 mg.L^{-1} concentration led to significant increase in leaf area, chlorophyll and carotenoid pigments of grapevines (*Vitis vinifera* L.) leaves compared with control treatment. The present study was conducted to determine the effect of foliar spraying with different concentrations of potassium humate or green tea extract in the vegetative growth of guava (*P. guajava* L.) seedlings.

Materials and Methods

The experiment was carried out in the lethal house of the Department of Horticulture and Landscape Design, College of Agriculture, University of Basrah, Basrah, Iraq during the growing season 2017. Forty-five guava (*P. guajava* L. cv. Local) seedlings of a two years age were cultured in plastic pods of 10 kg. The potassium humate solution was prepared with concentrations of 0, 2 and 4 ml per one liter of distilling water and adding 1 ml. L^{-1} of Tween 20 (Polysorbate 20). The plant water extract of green tea was prepared by taking 20 g of dried green tea powder and placed in a 500 ml flask. Then add 200 ml of distilled water. After two hours of time, the green tea extract was filtered. The green tea extract was prepared with concentrations of 0, 50 and 75 ml per one liter of distilling water and adding of 1 ml.L^{-1} of Tween 20. Experimental treatments were as follows:-

1. Control treatment: seedlings sprayed with distilled water.
2. Seedlings were sprayed by potassium humate at 2 ml.L^{-1} concentration.
3. Seedlings were sprayed by potassium humate at 4 ml.L^{-1} concentration.
4. Seedlings were sprayed by green tea extract at50 ml.L^{-1} concentration.
5. Seedlings were sprayed with green tea extract at 75 ml.L^{-1} concentration.

The vegetative growths of seedlings were sprayed four times by the treatments which that mentioned above, by using 5 L sprayer at one sprayed per week. Each experimental treatment was repeated nine times. The following data were recorded for the studied traits after two months after the last spraying:

1. Seedling height (cm).
2. Stem diameter of seedling (mm): It was measured by the Vernier instrument at a height of 5 cm above the soil surface.
3. The number of leaves per seedling.
4. The number of lateral branches per seedling.
5. Leaf area (cm^2): It was measured by a Portable laser leaf area meter device.
6. Percentage of water content and dry matter of leaves.
7. Protein content in a dry matter of leaf: % of Protein content = % of Nitrogen × 6.25.
8. Total chlorophyll content in leaves: Total chlorophyll was estimated in mg.g^{-1}fresh weight of leaf tissue as described in Goodwin (1976).
9. The leaves content of nitrogen, phosphorus and potassium: The dry samples of the leaves of the shoots were digested according to the method described by Cresser and Parsons (1979). Total nitrogen concentration in leaves (%) was estimated using Micro Kjeldahl. The content of the phosphorus in leaves of the shoot was estimated at the percentage (%). The amount of potassium in the leaves of the shoots was estimated in the percentage (%) according to the methods described by Page et al. (1982).

Experimental Design and Statistical Analysis

Randomized complete blocks design was used with nine replicates. The data were subjected to the analysis of variance and mean values were compared using revised-LSD as described by Snedecor & Cochran (1980).

Results and Discussion

Table 1 show that vegetative spraying of guava seedlings with Potassium humate at 4 ml.L^{-1} concentration recorded a significant increase in all vegetative characteristics when compared with other treatments. This treatment gave the highest increase in the means of the seedling height, the diameter of the main stem, the number of lateral shoots, the number of leaves for each seedling and the leaf area at 129.11 cm, 6.91 mm, 5.33 lateral shoots per seedling, 31.33 leaves per seedling and 39.33 cm^2, respectively. The foliar spraying of guava seedlings helped to accelerate the uptake of potassium humate by leaves and thus transferred to all parts of the plant, which improved the vegetative properties (Shukla, 2011).The results of the present study are in agreement with the results of other studies in the role of Potassium humate in improving the vegetative properties of other plants (Mustafa and El-Shazly, 2013; Abou-Sreea *et al*., 2017).

The treatment of foliar spray of guava seedling with green tea extract at 75 ml.L^{-1} concentration showed a significant increase in all vegetable characteristics when compared with the other treatments, except for treatment of 4 ml.L^{-1} of Potassium humate. The reason for the significant increase in the vegetative characteristics of guava seedlings treated with green tea extract compared to the control treatment was that the green tea extract contains mineral elements, vitamins and antioxidants, which have an important role in improving the vegetative properties of the plant (Parakash and Majeed, 2003).The results of the present study were agreed with the results of other studies on other plants in the role of green tea extract in improving vegetative growth characteristics (Abada, 2014; Ahmed *et al*., 2014).

While the control treatment gave the lowest values in the means of seedlings height, the diameter of the main stem, the number of lateral shoots, the number of leaves for each seedling and the leaf area at 85.33 cm, 2.99 mm, 2.33 lateral shoots per seedling, 21.33 leaves per seedling and 25.33 cm^2, respectively. The reason for the low values in the vegetative characteristics studied is that the guava seedlings are not sprayed with Potassium humate or green tea extracts (Table 1).

Table 1 : Effect of the foliar spray of Potassium humate or green tea extract on some vegetative characteristics of guava (*P. guajava* L.) seedlings.

Treatment (ml.L^{-1})	Seedling height (cm)	Stem diameter (mm)	No. of lateral shoots	No. of leaves per seedling	Leaf area (cm^2)
Control	85.33	2.99	2.33	21.33	25.33
2 Potassium humate	108.66	4.33	4.11	25.00	30.00
4 Potassium humate	129.11	6.91	5.33	31.33	39.33
50 Green tea extract	104.33	3.66	3.11	22.33	31.33
75 Green tea extract	122.99	4.99	4.66	29.00	34.00
R-L.S.D (P≤0.05)	4.08	0.54	0.15	1.95	1.61

The results from Table 2 indicate significant differences between treatments in the all studied chemical characteristics of guava leaves. The treatment of foliar spray of guava seedling with Potassium humate at 4 ml.L^{-1} concentration showed a significant increase in all the studied chemical characteristics except water content in the leaves compared to other treatments. This treatment recorded the highest values in the percentage of dry matter, protein, total chlorophyll, nitrogen, phosphorus and potassium content in the guava leaves of41.87%, 9.42%, 1.22 mg.g^{-1} fresh weight, 1.51%, 0.45% and 1.58%, respectively. This is because potassium has an important role in many metabolic processes, such as carbohydrate synthesis and meristematic tissue development, as well as regulating water uptake and transpiration and its effective role in cellular protein metabolism (Khamis and Bakry, 2007).The reason for the significant increase in the vegetative characteristics of guava seedlings that were treated with Potassium humate was attributed to its role in increasing plant growth and chlorophyll content and promoting cell division, respiration and photosynthesis (Yang et al., 2004; Ulukan, 2008; Hassanpanah, 2009; Carrubba, 2014; Abou-Sreea *et al*., 2017).

The treatment of foliar spray of guava seedlings with green tea extract at 75 ml.L^{-1} concentration showed a significant increase in all studied chemical characteristics except water content in the leaves when compared with other treatments, which reached 40.44% dry matter, 9.00% protein, 1.09 mg.g^{-1} fresh weight of leaf tissue (Total chlorophyll), 1.44% nitrogen, 0.42% phosphorus and 1.53% potassium content, respectively. The reason for the significant increase in the chemical properties of leaves of guava seedlings treated with green tea extract compared to control treatment is because it contains the mineral elements, vitamins and antioxidants that have been absorbed and accumulated in the leaves (Parakash and Majeed, 2003; Abada, 2014; Ahmed *et al*., 2014).The high content of green tea extract from gallic acid, catechin; theogallin, gallocatechin, epicatechin; pigalla catechin; vitamins A, C and E, flavonoids, theanine, caffeine, tannins, volatile oils and zinc encouraged the bioactivities that occur in the plant cells, which contributed to the accumulation of mineral elements and the synthesis of proteins, carbohydrates, vitamins and plant pigments, which led to the accumulation and increase the chemical and dry matters in the leaves (Grohar, 1992; Abada, 2014).

While the control treatment gave the lowest values in the means of dry matter, protein, total chlorophyll, nitrogen, phosphorus and potassium content in guava leaves at 36.37%, 7.83%, 0.72 mg.g^{-1} fresh weight of leaf tissue, 1.25% Nitrogen, 0.36% Phosphorus and 1.09% Potassium, respectively (Table 2). Also, the results in Table 2 indicate that the control treatment recorded the highest significant increase in the

percentage of water content in the guava leaves compared with the other treatments reached63.63%. While the Potassium humate concentration at 4 ml.L^{-1} recorded the lowest percentage of water content in the guava leaves reached58.13%.The reason for the high water content in the guava seedlings that was sprayed with the control treatment and the reduction in the treatment of Potassium humate is due to the inverse relationship with the accumulation of dry matter in the leaves (Table 2).

Conclusion

The treatment of foliar spray with the bio-stimulator of potassium humate at a concentration of 4 ml. L^{-1} or green tea extract at 75 ml. L^{-1} lead to improved vegetative growth and chemical properties of guava seedlings cv. Local.

Table 2 : Effect of the foliar spray of Potassium humate or green tea extract on some chemical characteristics of guava (*P. guajava* L.) leaves.

Treatment (ml.L^{-1})	Water content (%)	Dry weight (%)	Protein (%)	Total chlorophyll mg.g^{-1}	N (%)	P (%)	K (%)
Control	63.63	36.37	7.83	0.72	1.25	0.36	1.09
2 Potassium humate	60.00	40.00	8.69	0.93	1.39	0.40	1.50
4 Potassium humate	58.13	41.87	9.42	1.22	1.51	0.45	1.58
50 Green tea extract	60.90	39.10	8.29	0.96	1.33	0.39	1.49
75 Green tea extract	59.56	40.44	9.00	1.09	1.44	0.42	1.53
R-L.S.D (P≤0.05)	0.39	0.39	0.21	0.04	0.04	0.01	0.02

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