Nat. Volatiles & Essent. Oils, 2021; 8(4): 5454-5475

Influence Of Humic Acid And Boron Foliar application on growth And Fruit Characteristics Of Pomegranate Tree (Punica Granatum L.) Cv.Smaqulli grown in Erbil -Iraq

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ABSTRACT

This study was carried out on a local pomegranate variety in the Smaqulli region of Northern Iraq's Arbil region in 2019-2020. The effects of foliar application of 0, 3, and 6 g. L^{-1} humic acid 0 and 2 g. L^{-1} boron, separately or in combination on growth and fruit quality of pomegranate tree. Three rates of HA with two levels of B were applied before and after the blooming stage. The experiment was arranged in (RCBD), with 3 replications. Trees were sampled at the harvesting stage and analyzed for morphology characteristics, chemical composition, and yield production. Data were analyzed by (SPSS) using variance (ANOVA) at a 5% level. Results showed that application of (HA) with a foliar application (B) significantly increased most of the parameters of pomegranate trees such as (number of fruit per tree, yield, leaf dry weight, chlorophyll content, the weight of 100 seed, boron cortex, boron leaf, P, pH, Anthocyanin. was negatively affected by foliar fertilizers in this study. Combining foliar fertilizers was given the highest results on the growth and yield of a pomegranate tree. Pomegranate production is a significant contributor to the agricultural economy in Iraq and a significant source of income for farmers and rural communities of many provinces.

Keywords: Boron, Humic acid, foliarapplication, growing fruit, Pomegranate, fruit characteristics, Yield, Chlorophyll, Ph, Anthocyanin, The Randomized Complete Block Design (RCBD), Statistical Package for Social science (SPSS).

1. INTRODUCTION

The pomegranate of the family Punicaceae (Punica granatum L.) is one of the most desirable fruits in tropical and subtropical areas. It is primarily grown in Bijapur, Bagalkot, Tumkur, Kolar, Belgium, Dharwad, and Bangalore in Karnataka (Sheikh and Manjula 2012).and is one of the oldest recognized edible fruits, produced mostly in Mediterranean countries in several subtropical countries and also commonly produced both in Iran, India, Pakistan, Afghanistan and in sub-tropical regions of South America (Ramezanian et al. 2009). India, Iran, the United States, Turkey, Syria, and Iraq are the major Pomegranate (Punica granatum L.) producing countries (Davarpanah et al. 2018). Pomegranate is considered a non-climate fruit without the involvement of ethylene in the preparation process.

Pomegranate fruit in Iraq starts maturity from the end of July to the end of November that relies on climate, cultivar, cultivating fields, and service processes such as pruning, fertilization,and irrigation (Davarpanah et al. 2018). In Iraq, output in 2006 amounted to 104 − 12 * 104tons, 3% of global production (Hamad 2012). In 2011, pomegranate production in Iraq was projected to be 132,994 tons as opposed to 124,340 tones, with an average yield per tree of approximately 26.1 kg in 2011 (Statistical of Agriculture 2011), but, production in 2010 was approximately 24.8 kg (Davarpanah et al 2018). The fruit is abundant in many nutrients, including sugars (Al-Maiman, and Ahmad 2002). Because of the high content of polyphenols, for example, gallic acid, ellagitannins,gallotannins, chlorogenic acid, caffeic acid, ferulic acid, coumaric acid, catechin, and two anthocyanin glucosides (delphinidin and cyanidin) (Seeram et al 2005). Organic acids (malic, citric, tartaric, succinic, oxalic, and fumaric acid) and vitamin C contents of fruits of pomegranate genotypes grown in the Çukurca (Hakkari) district were determined. Oxalic acid, malic acid, citric acid, succinic acid, fumaric acid, and tartaric acid contents of pomegranate fruit juices were determined to range from 0.02 to 0.59 g L^{-1} from 1.01 to 2.84 g L^{-1}, from 1.92 to 7.84 g L^{-1}, from 0.06 to 0.28 g L^{-1}, 0.13 to 0.68 g L^{-1}, 0.03 to 0.10 g L^{-1}, respectively (Singh, Shukla, and Meghwal 2020). In the study, the 30HAK02 genotype (30.84 mg L^{-1}) was found to contain higher vitamin C than other genotypes. (Çelik et al. 2019). Pomegranate juice contains 3 sugars, namely sucrose, glucose, and fructose, among which the most fructose (63.85 g / L). In the juice of this fruit, the soluble solids are 13.3-16.9%, the pH is 0.93-4.6 and the titratable acidity is between 0.25-3.17percent (Şimşek2017).

Pomegranate (Punica granatum L.) is one of the oldest known edible fruits, which is native of Iran and is currently cultivated in many countries, including Spain, Morocco, Egypt, Afghanistan, Burma, China, Japan, USA, Russia, Bulgaria, and Italy (Korkmaz, and Aşkın 2013). Pomegranate is mainly consumed as fresh fruit and is also used in form of jams, juices, wines, vinegar, and jellies (Heber et al. 2006; Kingsly and Singh 2007; Sheikh and Manjula 2012; Gumienna et al. 2016). Pomegranates' economic value occurs over a broader span that reflects on the market from the beginning of fruit maturation in the late summer until the middle of winter when other varieties of leafy fruit have been removed (Khattab et al. 2012). Pomegranate is mainly consumed as fresh fruit and also used in form of jams, juices, wines, vinegar, and jellies (Heber et al. 2006; About 82,000 ha of Iranian lands, which are mainly located in the borders of the desert and are not suitable for commercial production of other crops, are devoted to the pomegranate cultivation and 941,000ton pomegranate are annually produced in this country (Olyaie et al. 2017). in its native regions, the pomegranate is the symbol of fertility and has been consumed traditionally as a medicinal fruit for its valuable nutritional values (Moradinezhad et al.2020). Although pomegranate is considered as a low expectation fruit species and is relatively tolerant to various unfavorable conditions s as hot and dry climate, salty soil as well as water deficit, however, various physiological disorders, as well as biotic/abiotic stresses, can impede fruit production and significantly reduce the fruit yield, quality, and commercial acceptance (Ghanbarpour, Rezaei, and Lawson 2019). Fruit skin sunburn and fruit cracking are among the main physiological disorders that cause serious economic losses to the pomegranate growers all around the world and may account for losses of up to 40-50%ofthetotalharvestindifferentpomegranateproductionareas(YaziciandErcişli 2017).

Sunburnt peel damages are appeared in the form of large brown to black spots on the fruit skin and reduce fruit marketability as well as juiciness of the arils resident in that region. However, proper horticultural practices can result in healthier plants with a high-density canopy that can remarkably reduce the direct exposure of the fruits to the sunlight and their subsequent damages (Olyaie et al.2017).

Cracking or breaking of the fruit is another restricting issue that adversely affects fruit quality and quantity in most pomegranate plants. This physiological condition not only decreases the marketability and approval of the customer but also gives fruit exposure to insects and fungi and renders fruits more vulnerable to certain environmental stresses (Maity et al.2021). Sunburn lowers fruit surface moisture and its flexibility, which contributes to a greater sensibility to the fluctuation of temperature and water and eventually to the splitting of fruit (Hosein-Beigi et al.2019).

Aim:

1. Toincrease theproductivityofpomegranates
2. Tostudytheeffectofhumicacid, and boron,onPomegranate’sgrowthandyield

and itscomponents.

3. Toincrease theMorphologicalandBiochemicalofPomegranatesbyusingfoliarsprayapplicationssuchashumicacid, and boron.
4. Toincreasetheadsorptionofsomeleafplantnutrition

2. MATERIALS AND METHODS

2.1. Materials

2.1.1. Location

The study was carried out at a private orchard of pomegranate which was established for more than 10 years in Smaqulli village (36°10'16.1"N 44°33'06.9"E) (ASL735), koisnjaq district, 50 km from Erbil city center.

Figure 2.1.The location of the orchard.

2.1.2. Soil properties

The soil of the field was sandy clay. Soil tests were conducted at the soil laboratory, Soil Department, Directorate of research in Erbil. Soil samples were randomly collected from two depths of 0-30 cm and

30-60 cm, then the samples were thoroughly mixed, air-dried, and sieved using a 2 mm mesh sieve and some chemical properties and texture of the soil taken from different locations of the field depending on (Estefan et al.2013)are described in (Table 2.1and 2.2). Climate data were obtained from the General Directorate of agriculture, Erbil. Average temperatures, the relative moisture, and rain rate in the growing season are shown in (Table2.3).

Table 2.1. Soil chemical compounds

No.	EC ds/m	PH	N%	P ppm	%Ca	B PPM	K ppm	O.M %
(0-30) cm	0.3	7.60	1.1133	10.4	3.25	0.457	360	1.46
(30-60) cm	0.2	7.42	1.052	8.6	2.58	0.310	294	1.32

Table 2.2. Soil texture

NO	Sand	Silt	Clay	Soil texture USDA
(0-30) cm	58.7	15.9	25.4	Sand Clay L
(30-60) cm	53.7	18.4	27.9	Sand Clay L

Table 2.3. Climate information

Month/year	Average Air Temperature °C	Average Air Humidity RH°	Average Rain Rate mm
January	7.6	68.7	150
February	8.8	67.6	118.5
March	10.4	72.9	206.4
April	14.6	63.6	166.8
May	25.3	32.4	11.6
June	33.2	15.1	0
July	34.1	13.1	0
August	35.4	14.3	0
September	23.0	30.3	0
October	24.3	31.2	31.8

November	15.8	33.0	16.8
December	10.9	63.7	55.5

2.1.3. Selection of pomegranate cultivar

Smaqulli cultivar has been selected to be tested in this study which is described below: This cultivar is a local cultivar; it has an average of height 2-4 m, strong shoot part, depth root system and high resistance for disease, fruit cracking, and good for weak soil. The cultivar is characterized by its medium-sized fruits, rounded shape, and the arils is pink in color, and sour-sweet taste as it progresses fruit maturity increases the sweetness and less acidity. This cultivar's shelf life is relatively high.

Figure 2.2. Some flowers of the Smaqulli CV. Pomegranate.

2.1.4. Treatments

Each pomegranate tree was sprayed with Boron and Humic acid, the spraying was done at different times per growing season. Tween-20, as a wetting agent at 0.1% was added to all spraying solutions of Boron and humic acid, spraying was carried out till runoff in the evening. two different fertilizers were sprayed at different growth stages.

2.1.4.1. Boron 8%

Two concentrations were applied (0 and 2 $g.L^{-1}$) concentrations will be applied on two periods; at full blossoming (June 21st, 2019), and one-month post full blossoming (July 19th, 2019).

2.1.4.2. Humic acid 85%

Three concentrations will be applied (0, 3, 6 g. L^{-1}) in three periods; at full blossoming (June 22nd, 2019), two weeks after (July 5th, 2019), and four weeks after blossoming (July 20th, 2019).

2.1.5. Experimental design and statistical analysis

The experiment consists of eighteen treatments (two concentrations of boron, three concentrations of humic acid with three replications) and the experimental unit consists of 18 trees (2x3x3) (table 3.4), in Factorial Randomized Complete Block Design (RCBD) with one individual tree for each experimental unit. Data were entered into Excel spreadsheets and analyzed by Analysis of Variance (ANOVA) using SPSS 20th version statistical package for windows, and treatment means were compared using Tukey's range test at 5% level, calculated from standard errors of the difference of the means using appropriate degrees of freedom when ANOVA indicated significant differences. (Field2009;Weinberg, and Abramowitz2008).

Table 2.4. Treatments included in the experiment

REPLICATION	H1	H2	H3
B1	H1B1	H2B1	H3B1
	H1B1	H2B1	H3B1
	H1B1	H2B1	H3B1
B2	H1B2	H2B2	H3B2
	H1B2	H2B2	H3B2
	H1B2	H2B2	H3B2

H1, B1 =0 , H2=3 g.L^{-1}, H3 = 6 g. L^{-1}, B2= 2 g.L^{-1}

2.2. Methods

The analyzed samples data were taken from every 10 random fruits or leaves from the top, middle, and bottom. The chemical analyses were conducted from the same 10 selected fruits, cortex, or leaves.

2.2.1. Pomegranate vegetative growth properties

2.2.1.2. Total leaf chlorophyll content (%)

The chlorophyll content is fully expanded of 10 leaves collected randomly from the top, middle, and bottom of the tree canopy was measured non-destructively using a portable chlorophyll meter device (at LEAF CHL PLUS, Wilmington, DE, USA).

2.2.1.3. Leaf dry weight (g)

It will be determined by oven drying of 10 leaves at 70°C until a constant weight will be obtained

2.2.1.4. Mineral determination

All plant samples were ground and 0.5g were weighted using a sensitive electronic balance (0.00 g). 0.5 ml ethanol was added to the plant sample in a porcelain dish, and then the ethanol was removed by burning using a flamed piece of cotton. The samples were placed in a muffle for 2 or 6 hours at 500-550 ^{0}C. The burning process ended when the plant sample color was changed to grey then left to cool down at room temperature. 2-4 drops of distilled water were added to the surface of the ash, and 4 ml of 3NHCl was added slowly, and then placed on a hotplate carefully. The samples were left to cool down for 10-15 minutes, and then the mixture was drained into a 50 ml volumetric flask using a filter paper (Kacar, and İnal 2010). Using spectrophotometer system (Table 2.5), cortex boron content (ppm), leaf boron content (ppm), and leaf phosphor content (ppm).

Table 2.5. Mineral determination devices and wavelength (nm)

Element	Device name	Wavelength nm
Phosphor	Spectrophotometer	177.495
Boron	Spectrophotometer	249.77

Figure 2.3. Measuring elements using Spectrophotometer.

2.2.2. Pomegranate fruit yield properties

2.2.2.2. Total number of fruits per tree

Sum of fruits per tree at each harvesting.

2.2.2.3. Yield per Tree (kg.tree^{-1})

The weight of fruits per tree at each harvesting was recorded and the total yield per tree was calculated.

2.2.2.4. Weight of 100 seeds (g)

Weight of 100 seeds (g) 10 fruits was weighted.

Figure 2.4. Pomegranate Arils - Smaqulli CV.

2.2.3. Chemical properties of pomegranate cv. smaqulli

2.2.3.1. Fruit juice pH value

In this calculation, we eliminated pH, the rate for all types are different concentrations by pH-meter.

Figure 2.5. pH-meter device.

2.2.3.4. Anthocyanin (mg. 100g^{-1} fresh weight)

Anthocyanin in fruit arils was determined by taking (2.5g) of fruit arils, then added 50 ml mixture of 85% Alcohol (95%) + 15% HCl (1.5 N), and left for 24 hours at 4°C, then filtered through filter paper (0.1N) then it estimated by using Spectrophotometer at a wavelength of 535nm. (Spayed and Morris, 1978). **(Ranganna1995).**

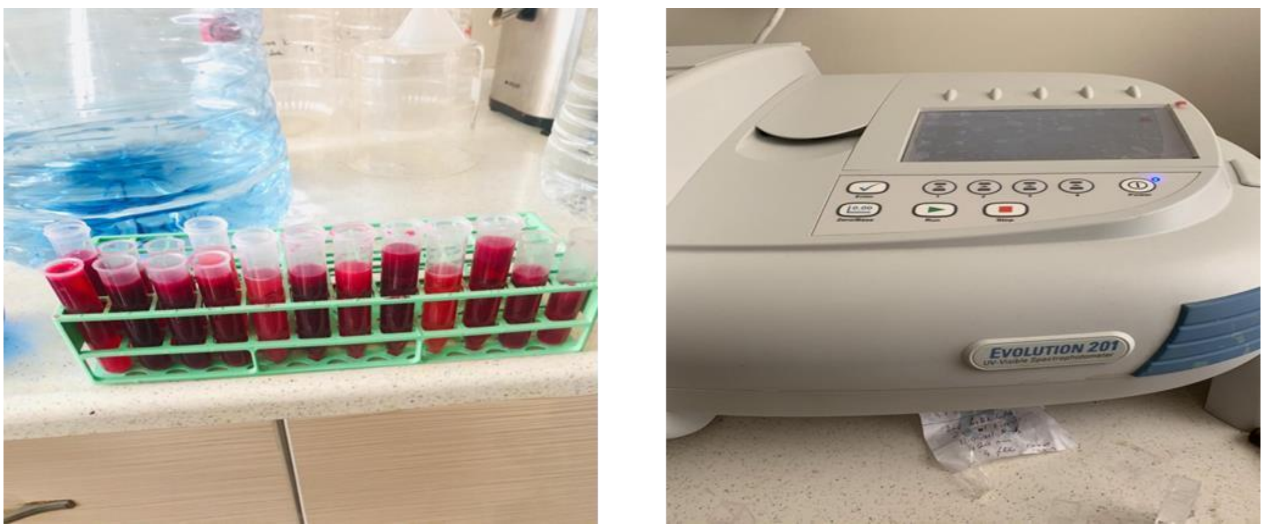

Figure 2.6.Sample preparation and measuring for anthocyanin

3.RESULT AND DISCUSSION

3.1 : RESULT

Table 3.1. Effects of interaction boron and humic acid, application on leaf chlorophyll content of pomegranate tree CV. Smaqulli

Humic acid g.L^{-1}	Humic acid g. L^{-1}	Boron g. L^{-1}	Humic acid Average

×		0	2 g. L^{-1}	
Boron g.L^{-1}	0	52.68 c	54.18 c	53.43 c
	3 g. L^{-1}	62.82 b	62.82 b	62.82 b
	6 g. L^{-1}	66.79 a	66.67 a	66.73 a
Boron Average		60.76 a	61.22 a	

Means within a column, row, and their interactions followed with the same letters are not significantly different from each other according to Tukey's range test at the significant level of 5%.

6 g. L^{-1} HA + 0 + 2 grams. Treatment with L^{-1} B demonstrated dominance in this issue. Nevertheless, the interaction between the two nutrient factors revealed that the HA interaction with B increased the chlorophyll content of the leaf relative to the regulation. The maximum content (66.79) was found at 6 g. L^{-1} HA and first concentration of B, in conversely the lowest value (52.68) was recorded at control.

The obtained results that the addition of HA alone was positively affected by leaf chlorophyll content. The highest value (66.73) was observed at 6 g. L^{-1}, as compared to the lowest value (53.43) was registered at the control level of HA.

indicates that under B application induced a positive impact on leaf chlorophyll content in both concentrations of B, but there was no significant effect of B on leaf chlorophyll of pomegranate tree. A higher score (61.22) was shown at the second concentration, while the lowest value (60.76) was observed at the control

Figure 3.1. Effect humic acid on the leave of pomegranate. Dark color: high chlorophyll, bright color: low chlorophyll

Table 3.2. Effects of interaction boron and humic acid, application on leaf Dry weight (g) of pomegranate tree CV. Smaqulli

Humic acid g.L^{-1} × Boron g.L^{-1}	Humic acid g. L^{-1}	Boron g. L^{-1}		Humic acid Average
		0	2 g. L^{-1}	
	0	0.1112 b	0.1133 a	0.1123 a
	3 g. L^{-1}	0.1083 c	0.1073 c	0.1078 b
	6 g. L^{-1}	0.1078 c	0.1083 c	0.1081 b
Boron Average		0.1091 b	0.1097 a	

Means within a column, row, and their interactions followed with the same letters are not significantly different from each other according to Tukey's range test at the significant level of 5%.

Results showed that the interaction of HA and B at (0 HA + 2 g. L^{-1} B) was significantly increased leaf dry weight compared to other treatments. The control showed that there were no more changes in leaf dry weight during the interaction study. A higher value is recorded (0.1133 g) but a lower weight is showed (0.1073 g) at 3 g. L^{-1} HA + 2 g. L^{-1} B

The effect of humic acid, and boron, application on leaf dry weight of pomegranate tree. Humic acid was not effectively enhanced leaf dry weight on the pomegranate tree at (3 + 6 g. L^{-1}). The control treatment was more effective than both levels of HA application in this respect. A higher value is (0.1123 g), while the lowest value is (0.1078 g).

The addition of Boron (B) at (2 g. L^{-1}) showed significantly superior over control treatment, amount (0.1097 g) of leaf dry weight, whereas the minimum score (0.1091 g) was shown at control.

Table 3.3. Effects of interaction boron and humic acid, application on phosphorus leaf (ppm) of pomegranate tree CV. Smaqulli

Humic acid g.L^{-1} × Boron g.L^{-1}	Humic acid g. L^{-1}	Boron g. L^{-1}		Humic acid Average
		0	2 g. L^{-1}	
	0	4.31 cd	4.01 d	4.16 c
	3 g. L^{-1}	5.25 b	5.64 a	5.45 a
	6 g. L^{-1}	4.39 c	5.64 a	5.02 b
Boron Average		4.65 b	5.10 a	

Means within a column, row, and their interactions followed with the same letters are not significantly different from each other according to Tukey's range test at the significant level of 5%.

The interactions between HA and B affected significantly the phosphorus level in leaf at both concentrations (3 + 6 g.L^{-1} HA + 2g.L^{-1} B). The highest value is (5.64 ppm). while the lowest score (4.01 ppm) is shown at control.

Effects of humic acid, and boronnutrients on the phosphorus leaf of the pomegranate tree. Spraying HA on pomegranate trees was found a significant increase in phosphorus leaf.The maximum value (5.45 ppm) was obtained from (3 g.L^{-1}) that it was different as compared to control (4.16 ppm).

It is apparent from the same table that there was a significant impact of B on the phosphorus leaf, especially at the second concentration, which had a significant effect (5.10 ppm) relative to the first concentration (4.65 ppm) regulation

Table 3.4. Effects of interaction boron and humic acid, application on boron leaf (ppm) of pomegranate tree CV. Smaqulli

Humic acid g.L^{-1} × Boron g.L^{-1}	Humic acid g. L^{-1}	Boron g. L^{-1}		Humic acid Average
		0	2 g. L^{-1}	
	0	0.11 c	0.14 b	0.12 b
	3 g. L^{-1}	0.12 c	0.15 ab	0.14 a
	6 g. L^{-1}	0.12 c	0.16 a	0.14 a
Boron Average		0.12 b	0.15 a	

Means within a column, row, and their interactions followed with the same letters are not significantly different from each other according to Tukey's range test at the significant level of 5%.

Foliar application of HA and B were responded to very differently on B. leaf content of pomegranate tree. The highest value (0.16 ppm) was given at (6 g. L^{-1} HA + 2 g. L^{-1} B),

The addition of humic acid and boronnutrients on B. leaf ppm of the pomegranate tree is shown in (Table3.4). All treatments of HA increased markedly than the untreated control. Both rates 3 g. L^{-1} + 6 g. L^{-1} of HA was positively improved B. leaf compared to non-application. The maximum value (0.14 ppm) was recorded at the first and second concentrations, while the minimum value (0.12 ppm) was found at control.

Effect of Boron on Boron Content in Leaf (ppm) was represented The presence of a very large gap was seen as a result of (2 g. L^{-1})B (0.15 ppm) while the minimum value was obtained from the nonapplication of B (0.12ppm).

Table 3.5. Effects of interaction boron and humic acid, application on boron cortex (ppm) of pomegranate tree CV. Smaqulli

Humic acid $g.L^{-1}$ × Boron $g.L^{-1}$	Humic acid g. L^{-1}	Boron g. L^{-1}		Humic acid Average
		0	2 g. L^{-1}	
	0	0.54 d	0.77 bc	0.65 b
	3 g. L^{-1}	0.47 d	0.61 cd	0.54 c
	6 g. L^{-1}	0.79 b	1.04 a	0.91 a
Boron Average		0.60 b	0.81 a	

Means within a column, row, and their interactions followed with the same letters are not significantly different from each other according to Tukey's range test at the significant level of 5%.

Cortex weight was significantly affected by the application of all treatments of HA and B elements. The higher weight of the B. cortex between HA and B treatment was significantly observed at (6 g. L^{-1}, 2 g. L^{-1}) which is recorded (1.04 ppm), While 6 g. L^{-1} and a second concentration of boron were recorded the lowest value (0.47 ppm).

The effects of humic acid and boron application on the boron cortex (ppm) of the pomegranate tree are shown in (Table 3.5). Among HA treatments, a high weight (0.91 ppm) was observed at (6 $g.L^{-1}$ HA), while the lowest weight (0.54 ppm) was shown at control. It means HA showed significance on the B. Cortex of the pomegranate tree. The addition of born element at (2 g. L^{-1}) recorded the highest weight (0.81 ppm) of the B. cortex and it is significantly recorded compared to control (0 g. L^{-1}).

Table 3.6. Effects of interaction boron and humic acid, application on number fruits per tree of pomegranate tree CV. Smaqulli

Humic acid $g.L^{-1}$ × Boron $g.L^{-1}$	Humic acid g. L^{-1}	Boron g. L^{-1}		Humic acid Average
		0	2 g. L^{-1}	
	0	58.56 d	64.22 b	61.39 b
	3 g. L^{-1}	61.56 c	72.00 a	66.78 a
	6 g. L^{-1}	62.11 c	72.00 a	67.06 a
Boron Average		60.74 b	69.41 a	

Means within a column, row, and their interactions followed with the same letters are not significantly different from each other according to Tukey's range test at the significant level of 5%.

The effects of three different fertilizers as a foliar application on the number of the pomegranate fruit. According to data analysis, both rates (3 g. L^{-1} + 6 g. L^{-1}) of HA were given the highest (66.78) value and the same letter (a), while the lowest number (61.39) was observed at the un-amended treatment of HA.

Application of B on the growth of pomegranate significantly increased the number of fruit per tree. The maximum number (69.41) was recorded at 2 g. L^{-1} but the minimum (60.74) was shown at the control level.

Among HA interaction treatments with B, a higher value (72.00 g) was recorded at (3 + 6 g. L^{-1} HA + 2 g. L^{-1} B), while the lowest value (61.56) was observed at (3 g. L^{-1} + 0). There was no significant difference between both concentrations of HA and the second rate of B element on the number of fruit per pomegranate tree.

Table 3.7. Effects of interaction boron and humic acid, application on yield per tree (kg) of pomegranate tree CV. Smaqulli

Humic acid g.L^{-1} × Boron g.L^{-1}	Humic acid g. L^{-1}	Boron g. L^{-1}		Humic acid Average
		0	2 g. L^{-1}	
	0	17.68 f	20.73 d	19.20 b
	3 g. L^{-1}	20.20 e	26.05 a	23.13 a
	6 g. L^{-1}	21.18 c	25.3 b	23.24 a
Boron Average		19.69 b	24.03 a	

Means within a column, row, and their interactions followed with the same letters are not significantly different from each other according to Tukey's range test at the significant level of 5%.

There was a significant interaction between (HA and B at (3 g. L^{-1} HA + 2 g. L^{-1} B) on the yield of pomegranate. The best value (26.05 kg) was recorded at (3 g. L^{-1} + 2 g. L^{-1}) and the lowest value (17.68 kg) were shown at control.

The effects of three different fertilizers (humic acid, boron) application on the yield of the pomegranate tree. Application of HA alone at (3 g. L^{-1} + 6 g.L^{-1}) on the yield of pomegranate tree was significantly

effective but both values (23.13 + 23.24 kg) respectively. All weight of HA treatments was higher than the lowest value (19.20 kg) of control treatment.

The addition of B element led to significant improvement in higher yield (28.08 kg) of pomegranate tree at (2 g. L^{-1}), whereas the un-amended treatment was given the lowest yield (16.52 kg) of a pomegranate tree.

Table3.8. Effects of interaction boron and humic acid, application on the weight of 100 seed (g) of pomegranate tree CV. Smaqulli

Humic acid $g.L^{-1}$ × Boron $g.L^{-1}$	Humic acid g. L^{-1}	Boron g. L^{-1}		Humic acid Average
		0	2 g. L^{-1}	
	0	23.83 cd	22.75 d	23.29 c
	3 g. L^{-1}	24.43 c	25.04 bc	24.73 b
	6 g. L^{-1}	25.80 ab	26.43 a	26.11 a
Boron Average		24.68 a	24.74 a	

Means within a column, row, and their interactions followed with the same letters are not significantly different from each other according to Tukey's range test at the significant level of 5%.

Applying HA and B to pomegranate trees can bring additional benefits to the weight of 100 seeds. The most effective HA and B rate of the plant was found at (6 g. L^{-1} HA + 2 g. L^{-1} Ca).

The application of humic acid, and boronnutrients on the weight of 100 seeds of the pomegranate tree.The application of HA significantly improved the weight of 100 seeds, compared to the control. The maximum value (26.11 g) is observed at 6 g. L^{-1}, while the lowest weight (23.29 g) was found at 0 concentration (control).

Plants applied with B at all concentrations showed no significant effect on the weight of 100 seeds of a pomegranate tree. Higher weight (24.74 g) was found at the second concentration, while the lowest value (24.68 g) was recorded at control.

There was no significant difference between both concentrations of B on the weight of 100 seeds.

Table3.9. Effects of interaction boron and humic acid, application on pH of pomegranate tree CV. Smaqulli

Humic acid $g.L^{-1}$ × Boron $g.L^{-1}$	Humic acid g. L^{-1}	Boron g. L^{-1}		Humic acid Average
		0	2 g. L^{-1}	
	0	3.80 bc	3.76 c	3.78 b
	3 g. L^{-1}	3.85 bc	4.00 a	3.93 a
	6 g. L^{-1}	4.01 a	3.91 ab	3.96 a
Boron Average		3.89 a	3.89 a	

Means within a column, row, and their interactions followed with the same letters are not significantly different from each other according to Tukey's range test at the significant level of 5%.

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The application of interaction between HA and B was given a positive result on fruit pH. Higher results (4.01) were shown at (6 g. L^{-1} HA + 0 B), while the lowest value (3.76) was obtained from (0 HA + 2 g. L^{-1} B).

The results of humic acid, and boron, application on fruit (pH) of pomegranate tree are shown in(Table 3.9). The results of this study demonstrate that the addition of humic acid is positively achieved at both levels of HA on fruit (pH) compared to control. The higher result (3.93 + 3.96) was recorded at (3 g. L^{-1}+ 6 g. L^{-1}), while the lowest value (3.78) was always showed at control. There was no significant effect between 3 g. L^{-1} and 6 g. L^{-1} HA according to data analyzing system.

Table 3.10. Effects of interaction boron and humic acid, application on Anthocyanin of pomegranate tree CV. Smaqulli

Humic acid g.L^{-1} × Boron g.L^{-1}	Humic acid g. L^{-1}	Boron g. L^{-1}		Humic acid Average
		0	2 g. L^{-1}	
	0	43.46 e	48.53 d	46.00 c
	3 g. L^{-1}	36.77 f	64.62 b	50.70 b
	6 g. L^{-1}	53.72 c	67.10 a	60.41 a
Boron Average		44.65 b	60.09 a	

Means within a column, row, and their interactions followed with the same letters are not significantly different from each other according to Tukey's range test at the significant level of 5%.

Regarding the combination of HA and B fertilizers, the results showed that the addition of interaction at 6 g. L^{-1} HA + 2 g. L^{-1} B gave the highest and significant value (67.10) of the Anthocyanin parameter. Whereas, the interaction study at 3 g. L^{-1} HA + 0 g. L^{-1} B demonstrated the lowest level (36.77).

The effects of different fertilizer rates of humic acid, and boronon the Anthocyanin of the pomegranate tree.Our Research observed an exponential increase in Anthocyanin with an increasing HA fertilizer application rate in pomegranate trees. A higher value (60.41) was shown at 6 g. L^{-1}, while a lower result (46.00) was obtained from control.

The effects of different rates of boron significantly affected Anthocyanin at the second concentration. The minimum score (44.65) was found in a non-application study, while the maximum value (60.09) was showed at 2 g. L^{-1}. According to the data analyzing system.

3.2 : DISCUSSION

The production of pomegranate trees (Punica granatum L.) is an important role in Iraq and the Northern Iraq agricultural economy and a significant contributor to income for many farmers and rural communities in several provinces. Cultivation of pomegranate is one of the primary physiological issues, especially on immoderate fruit cracking. Spraying foliar fertilizer chemical composition such as boron and humic acid as organic fertilizer to determine some parameters of pomegranate were evaluated in this work.

The main purpose of this research was to record the impact of HA, and Bfertilizers on growth, with quality and quantity of yield production in the pomegranate treeand it was conducted in Smaqulli, Iraq between 2019 and 2020. This research wasapplied and designed to evaluate treatments were three levels of foliar applicationconcentration (0, 3, and 6 g. L-1) HA, and (0 and 2 g. L-1) Bseparately and in combination.

However, Smaqulli region is challenging in weather and soil quality, and it is known for low-rate annual precipitation, dry, warm condition throughout the growing season, and limited soil improvement. The uses of bio-stimulants and chemical fertilizers such as Humic acid substances, and Boron may significantly increase plant growth and yield production of plants.

CONCLUSION

This research was conducted to examine the impacts of humic acid and, boron, as foliar applicants on pomegranate fruit. Fruit improvement in the The pomegranate tree examined in this research was revealed to be reliant on a nutritional a deficiency that those healthy plants may not be caught to biotic and abiotic factors. Our data designated that the irrigation period, in combination with warmer temperatures, and spraying of organic and chemical fertilizers resulted in increased stress and then larger percentages of growth and increasing pomegranate fruit. The application of (0 + 3 + 6 g. L^{-1} HA, and 0 + 2 g. L^{-1} B) reduced cracking in pomegranate throughout water-stressed and non-stressed periods. Uses of nutrients separately and in combination were also shown to positively affect the growth and production of the tree due to decrease fruit skin temperature via reducing sunlight and progress the internal water balance within the fruit. All treatments in most cases were showed the high improvement of pomegranate tree; on the other hand, non-application treatment was almost given the lack of significance on all parameters of this study. Lower rates of the foliar application was much better than the high amount of nutrient combination in this respect.

Further analysis is required to assess the magnitude of these benefits. The foliar application of boron often restricted plant stress impacts due to its biostimulator properties. While none of the macronutrients and several of themicronutrients used in this analysis have been shown to offer 100% defense against cracking of fruit, some of these combinations have been revealed to substantially reduce the percentage of cracking in pomegranate fruit under abiotic stress circumstances.

ACKNOWLEDGMENT

I would like to thanks Allah for granting me the wisdom, health, and strength to undertake this research task and enabling me to its completion. I would like to express my sincere gratitude to my supervisor, Assist. Prof. Dr. Adnan YAVİÇ and my Co-supervisor, Prof. Dr. Shler Mahmood Taha for their continuous support, their patience, motivation, and immense knowledge. Also, I would like to thank my friends and allthemembersofthe VanYüzüncü Yıl Universitygroupwhohelpedme foraroundTwoyears andlab member in the faculty of the agriculture department of horticulture. Also, I would like to thanks the friend Ministry of Agriculture and water resources and especially the general directorate of agriculture in Erbil. However, I will be thankful to Dr. Krmanj Yousif at Salahddin University who helped me in my research thesis. Finally, I would like to thanks my parents, brothers, and anyone supporting me for writing research in one word.

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