The response of Brahimi apple's Cultivar to Foliar Application of Glycyrrhizin Extract (GLE) and Humic Acid (HA)

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Abstract

The research team had conducted this work at a private orchard in Saqlawiya – Falluja district in 2019 to investigate the influence of foliar application of liquorice (glycyrrhizin) extract (GLE) and humic acid (HA) on some vegetative growth traits and yield of Al-Ibrahimi apple cultivar. The factorial experiment consisted of 2 factors; the first one was GLE which consisted of 3 levels (L0, L1, L2) of (0, 3, and 6 $g.L^{-1}$) respectively; while the second one was HA with 4 levels (0, 2, 4, and 6 $g.L^{-1}$) had symbols of (H0, H1, H2, and H3) successively. Thus, the total number of treatments was 12 of 3 replications. Every apple tree considered as an experimental unit. The HA treatments were applied 7 times to soil every 20 days starting from 20th February 2019 while the foliar applications of GLE were 5 times starting from the 1st April in the same year.

A significant improvement in vegetative growth, quantity, and quality of yield due to GLE and HA applications has been shown in increasing individual leaf area (LA), length of branches (LOB), number of leaves (NOL), total chlorophyll content in leaves (TCL) , and total carbohydrates content in leaves (TCCL), average weight of fruits (AWF), and number of fruits per tree (NFT) that reflected positively on increasing yield per individual tree (YPT), total percentage of soluble solids (PSS), vitamin C content in fruits (CC) , and decreasing acidity of fruits (TPA). The interaction between factors had significant influence in most of studied traits. Thus the L1H3, L2H2, and L2H3 treatment had the best results.

Keywords: *Liquorice; Humic acid; Foliar application; Fruits; Apple; toxicity*

Introduction

The apple (Malus pumila L.) is one of Rosaceae family which is the most worldwide spread type of deciduous fruit trees in temperate regions in the globe, the global production of apples is estimated at 83139326 tons, and Iraq's production of apples is estimated at 626,470 tons[(1)]. Many scientific manuscripts had indicated that the foliar spraying of many herbal extracts had a great effect in improving the vegetative and flowering growth and yield of many plants[(2)]. Among these plant extracts is the extract of licorice plant roots, Glycyrrhiza glabrag, which has been proven in many studies to enhance the productivity of many plants [(3)], [(4)] and [(5)]. Found that in spraying of pear seedlings with licorice root extract, had significant increase in plant height, stem diameter, dry weight of leaves and leaf content of chlorophyll. Found that spraying of pear seedlings with licorice root extract has led to significant increase in the leaf area and its total chlorophyll content. [(6)] Stated an increase in the yield of pomegranate trees when spraying leaves with licorice root extract. The use of organic products has received a lot of attention in the recent period, furthermore, this new system of agricultural production that contain Humic acid has become one of the most important organic compounds used in this field, if it is found that the addition of humic acid to soil leads to increase the cation exchange capacity of soil and increases its pH and thus increases the availability of nutrients and increases

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the growth of roots and their branches [7]. [8] found in their study on Anna cultivar apples that the addition of humic acid to soil by 30 $cm^3.tree^{-1}$ has led to significant increase in the number of leaves per $branch^{-1}$ and the area of the leaf increased with an increase in yield by 25.6% in addition to an increase in the average weight of the fruit and the percentage of total soluble solids, [9] also obtained similar results when studying Anna-cultivar apple trees, and [10] stated an increase in tree yield, fruit count per tree, and average of fruit weight of pear (Leconte cultivar) when adding 100 ml per tree of humate-NPK combination (10% humate ratio) to the soil. [11] Had gained the same results on apricot trees (Canino cultivar).

Materials and Methods

The effect of foliar spraying with glycyrrhizin root extract (GLE) and the addition of humic acid (HA) to the soil has been studied on some of the vegetative growth characteristics and yield of apple trees (Brahimi cultivar). The factorial experiment of randomized completely block design (RCBD) has been conducted where the GLE was the 1st factor with levels of 0, 3, 6 $g.L^{-1}$ have symbols of L0, L1, and L2 respectively, whereas the 2nd factor were HA levels of 0, 2, 4, 6 g. L^{-1} have the symbols of H0, H1, H2, H3 for the Humibest product from Meristem Spanish company (have 55% Humic acid, 5% Fulvic acid, and 7% K_2O) as a humic source. The required quantity of HA was dissolved in 15 liters of water and added circularly around each tree on 50 cm distance and 20 cm depth from main stem, then the HA was applied to soil starting from 20th February for every 20 days at 7 times. The trees were sprayed with GLE five times every 20 days starting from 1st April 2019, the results were analyzed using GenStat and then, averages were compared using the least significant difference test (L.S.D) at a probability level of 5%. The following traits have been studied:

1- Individual leaf area (cm^2) LA: the average LA of completely widen leaf was computed from the middle of modern branches from separate locations of tree after harvesting by using dry weight based weighted method.

2- Increasing average of branch's length (cm) LOB: 4 main approximately equal branches has been selected from different sides of tree. The lengths of new buds formed on branches were measured in the 3rd week of March at the end season in 1st October 2019.

3- Increasing of number of leaves per branch NOL: the average of NOL has been calculated in the branches of measured lengths.

4- Total content of chlorophyll in leaves (mg.100 g^{-1} fresh weight) TCL: TCL has been measured in 20 mature leaves from different parts of tree according to [12] by using spectrophotometer device at wavelength of 663 to 645 Nm (nanometer).

5- Total carbohydrates content in leaves (TCCL): TCCL had been estimated in 15th October, 2019 using [13] by sampling of mature leaves from the middle branches.

6- Percentage of falling fruits (PFF): 4 branches were selected from different parts of the tree and the number of formed fruits was calculated on 1st April, 2019 and the remaining fruits were counted at the harvest.

Results and Discussion

1. Individual leaf area (cm^2) (LA):

The results of table 1. Showed that the individual LA had significantly affected by the increased levels of foliar sprayed GLE. The highest LA average was 21.23 cm^2 for L2 level compared to 19.47 cm^2 in control treatment. The same table revealed that H3 level of HA led to significant increase in individual LA, where it was 21.02 cm^2 compared to insignificant difference of H1 and H2 levels that reached 20.35 and 20.05 cm^2 respectively as well as that H0 had less value of 19.40 cm^2. On other hand, the interaction between GLE and HA had insignificant effect on individual LA.

Table 1. The effect of foliar GLE, soil applied HA , and their interaction on individual LA (cm^2) for Brahimi apple in spring season of 2019

HA / GLE	H0	H1	H2	H3	Average GLE
L0	18.62	19.15	19.71	20.38	19.47
L1	19.43	19.86	20.06	20.36	19.93
L2	20.14	21.15	21.29	22.33	21.23
Average of HA	19.40	20.05	20.35	21.02	
L.S.D %5	HA		GLE		interaction
	1.13		0.98		insignificant

2. Increase average of branch length (LOB) (cm):

Table 2 had shown a significant increase in average LOB for every single increase in foliar GLE levels. The highest LOB value of 30.98 cm was found in L2 compared to 24.04 cm in control treatment.

The same table had revealed significant differences among HA levels that affected LOB average. The highest LOB value was 30.33 cm found in H3 compared to 24.22 cm in control treatment H0 which was the least.

The interactions between GLE and HA treatments were significant in increasing LOB values where the highest averages of 33.33, 30.5, 31.33, and 32.42 cm were found in L1H3, L2H1, L2H2, and L2H3 interactions respectively compared to 19.25 cm in control treatment

Table 2. The effect of foliar GLE, soil applied HA , and their interaction on LOB (cm) for Brahimi apple in spring season of 2019.

HA / GLE	H0	H1	H2	H3	Average of GLE
L0	19.25	24.25	27.42	25.25	24.04
L1	23.75	27.08	27.33	33.33	27.88
L2	29.67	30.5	31.33	32.42	30.98
Average of HA	24.22	27.28	28.69	30.33	
L.S.D %5	HA		GLE		interactions
	1.85		1.61		3.21

3. Increase average of number of leaves per branch NOL (leaf per branch LPB):

The results of table 3 revealed significant differences among levels of foliar GLE in increasing average NOL. The second level L2 had the highest NOL of 22.51 LPB and insignificant NOL difference of 21.50 LPB in L1 compared to control treatment which had the least average of 16.16 LPB. The results of the same table showed that NOL was significantly increased with HA levels where the highest was 25.28 LPB in H3 compared to the least NOL in H0 which was 15.56LPB.

There was a significant effect of interactions between GLE and HA on increasing NOL values where the highest of them found in L1H3, L2H2, and L2H3 treatments of (30.17, 28.63, and 25.92 LPB) respectively with insignificant differences among them compared to the least of 14.25 LPB in control treatment.

Table 3. The effect of foliar GLE, soil applied HA , and their interaction on NOL (LPB) for Brahimi apple in spring season of 2019.

HA / GLE	H0	H1	H2	H3	Average of GLE
L0	14.25	17.22	13.42	19.75	16.16
L1	15.50	19.08	21.25	30.17	21.50
L2	16.92	18.58	28.63	25.92	22.51
Average of HA	15.56	18.29	21.10	25.28	
L.S.D %5	HA		GLE		interaction
	2.47		2.14		4.28

The increase in vegetative growth traits, consisting of LA, LOB, and NOL when spraying with GLE may be due to the fact that this extract contains a good amount of nutrients necessary for plant growth such as potassium, phosphorus, calcium, other elements, various amino acids, salts and carbohydrates (appendix 1) which are included in the synthesis of many enzymes, especially in the enzymes contained in photosynthesis, as well as the providing of nitrogen plant directly at the spraying [14]. The role of GL extract in improving the growth of the plant may be due to its role similar to the work of gibberellin, since it contains mevalonic acid, the bio-initiator of the formation of gibberellin. It is known that the gibberellins work to increase the softness of the cellular walls of the top and sub-top symbiotic, which increases from its permeability and allowing the entry of larger amounts of water and nutrients, which increases the growth and expansion of cells and this is reflected in the elongation of plant branches and increase the leaf area and the gibberellins also work to stimulate the production of auxins and reduce their degradation [15].

[16] Got a significant increase on branches' length, leaves number, and leaf area of Canino cultivar apricot trees.

4. Total content of chlorophyll in leaves (mg.100 g^{-1} fresh weight) TCL:

The results of table 4 referred to significant increase of TCL with increasing levels of foliar GLE. The second level L2 has the highest value of 114.0 mg.100 g^{-1} fresh weight in comparison with least value of 107.6 mg.100 g^{-1} fresh weight in control treatment. A significant increase of TCL noticed from the same table as a result of increasing HA levels in soil where the highest value of 118.6 mg.100 g^{-1} fresh weight was shown in H3 treatment compared to control treatment which had the least TCL of 104.7 mg.100 g^{-1} fresh weight. The interaction between GLE and HA treatments had a powerful effect in increasing TCL where the treatment

L2H3 had the highest value of 122.7 mg.100 g^{-1} fresh and the lowest value of 102.3 mg.100 g^{-1} fresh weight was recorded in L0H0 treatment.

Table 4. The effect of foliar GLE, soil applied HA , and their interaction on TCL (mg.100 g^{-1} fresh weight) for Brahimi apple in spring season of 2019.

HA / GLE	H0	H1	H2	H3	Average of GLE
L0	102.3	104.0	109.0	115.0	107.6
L1	105.0	105.3	110.3	118.0	109.7
L2	106.7	107.3	119.3	122.7	114.0
Average of HA	104.7	105.6	112.9	118.6	
L.S.D %5	HA		GLE		interaction
	1.1		0.9		1.8

The increase in TCL leaves when spraying leaves with GLE may be due to the growth stimulators like macro and micro nutrients that this extract contains, especially nitrogen, which is included in the porphyrin ring, which is the basis for the synthesis of chlorophyll, since 70% of the leaf nitrogen, is included in the formulation of this formula.

Conclusions

1- The 6 of GLE and the addition of HA to the soil with levels of 4 and 6 gram per liter had a significant effect in most of the studied traits.

2- The interaction between the two study factors had a significant effect on most of the studied traits, and the best results were in the L2H2 and L2H3 interaction treatments.

Ethical Clearance: The Research Ethical Committee at scientific research by ethical approval of both MOH and MOHSER in Iraq

Conflict of Interest: None

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