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EFFECT OF FOLIAR SPRAYOF GIBBERELLINS, KELATEX (Ca), AND AMINOPLASMAL ON VEGETATIVE GRWOTH AND LEAF NUTRIENT OF POMEGRANATE TREES (*Punica granatum* L.) CV. MAHDAWI

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ABSTRACT

This study was conducted during growing season of 2022 in a private orchard of pomegranate (*Punica granatum* L.) cv. Mahdawi which is located at Dulib village, Duhok Governorate, Kurdistan region to evaluate the efficacy of foliar spray of, Gibberellins (GA3) Kelatex (Ca) and Aminoplasmal (A). The experiment designed as a factorial experiment in a randomized complete block (RCBD) with three replications, for each treatment and each replicate was represented by one tree.

There were three concentrations of Gibberellins (0,50 and 100mg. L^{-1}); three concentration of Ca (0, 200, and 400mg. L^{-1}) and three concentrations of Aminoplasmal (0, 100 and 200ml.L^{-1}) in the study. The results showed that GA3 at 100mg. L^{-1} had a significant effect on leaf area, leaf dry weight, leaf chlorophyll content, leaf nitrogen content and leaf calcium content when compared to control. On the other hand, that Ca at 400 mg. l^{-1} had significant effect on leaf dry weight, leaf chlorophyll and leaf calcium content when compared to control, in addition to Aminoplasmal at 200 mg. L^{-1} had significantly affected leaf area, leaf dry weight, chlorophyll content, nitrogen content, and calcium content. Furthermore, the interaction between (GA3, Ca and A) had significant effect on leaf chlorophyll, leaf calcium content, leaf nitrogen content, and leaf area at concentrations of (100, 400, and 200 mg. L^{-1}) respectively. However, the leaf dry weight was significantly affected at concentrations of (100,200 and 200 mg. L^{-1}) respectively.

KEYWORD: Gibberellins, Kelatex, Aminoplasmal and Pomegranate cv. 'Mahdawi'**.**

INTRODUCTION

The pomegranate (*Punica granatum* L.), a fruit tree that is classified as a berry and a member of the Pinaceae family, is primarily grown in tropical and subtropical climates (Adsule and Patil, 1995; Naik and Chand, 2011). One of the most popular table fruits, pomegranates are nourishing and full of proteins, vitamins, and minerals. The fresh fruits can be used to make processed goods like juice, syrup, squash, etc. in addition to the fact that it can be used for table use (Legua *et al*., 2012). According to a growing amount of evidence, this fruit tree has been originated in Iran and several neighboring locations, while it is currently grown in Mediterranean area, Spain, Morocco, Egypt, Iran, Afghanistan, and Baluchistan (Olyaie Torshiz *et al.*, 2017). Pomegranate production has increased significantly in the Kurdistan region of Iraq, particularly in Duhok governorate, since the first decade of the twenty-first century, this is due to a number of factors, including the favorable climate and soil fertility that provide the best conditions for the best pomegranate production. After 150 to 180 days from blooming to fruit maturity, pomegranate harvesting begins. Genetic makeup, environmental conditions, agricultural services, and the growing location all have a role in this (Davarpanah *et al*., 2018). Pomegranate fruits may experience to serious biological illnesses including sunscald and cracking for a variety of causes, in addition to being infected by several diseases and insects, and to combat them, certain agricultural procedures must be followed, and chemical agents as calcium, amino acids, and gibberellic acid may have been used. According to previews published researches, Gibberellic acid was utilized often in a variety of horticultural crops to enhance fruit set, fruit weight, and fruit dimensions (Khalil and Aly, 2013; Merwad *et al*., 2016). Additionally, calcium is crucial for preserving fruit firmness and the quality of vegetables and fruits (Shukla, 2011). Additionally, amino acids can have a

direct or indirect impact on the physiological processes involved in plant growth and development. For example, exogenous amino acid administration has been shown to affect plant growth (Shiraishi *et al*., 2010). Because they result in losses of around 50% and 30% of the fruit's market value, respectively, biological illnesses including cracking and sunburn are among the severe issues in pomegranate orchards (Racsko'I and Schrader, 2012). This study will examine the effects of calcium, amino acids, and gibberellic acid on the cracking and sunburning of pomegranate fruits.

The Aim of study: - To study the effects of gibberellins, Kelatex, and Aminoplasmal on vegetative growth, leaf nutrients of pomegranate tress cv. 'Mahdawi' under the environmental conditions of Kurdistan region.

MATERIALS AND METHODS

This study was conducted during spring season of 2022 in a private pomegranate orchard which is located at Dulib village, Duhok Governorate, Kurdistan region, (42°89'83.9"N 36°83'82.8"E), at an elevation of (423) m above the sea level. The orchard has been cultivated with Al Mahdawi cultivar of pomegranate trees which are reaching the sixth year. The cultivation distance between trees is (3 * 3) m, and the normal watering system used is the surface irrigation.

Throughout the study, eighty-one healthy trees, consistency in shape and size, having the same horticultural practices were selected to be a part of the study. Factorial experiment with three factors has been applied. Gibberellins at three various concentrations (0, 50 and100 mg. L^{-1}), Kelatex (Cosmocel) with concentrations (0,200 and 400mg.L^{-1}) and Aminoplasmal (0,100 and 200mg.L-^{1}) were used. The experimental applied was randomized complete block design (RCBD) with three replicates for each treatment and each replicate was represented by one tree.

The first foliar spray was done in 22 of April 2022 and had been repeated in the 22 of May during the same year. Meanwhile, the control trees were sprayed with just tap water. Drops of Tween-20 was added at 0.1% as a surfactant to spray solution including the control "tap water". Spraying of all treatments were carried out by using compression sprayers during the first application of treatments.

The parameters were studied: -

1- The Leaf area of 15 leaves (at middle of shoot) was measured by the image J program (Schneider 2012) in each replication.

2- Leaf dry weight was taken after the fresh leaves being weighted (Gobara, 1998).

3- Leaf chlorophyll content of the fresh leaves was measured by using portable Chlorophyll Meter, **(**SPAD-TYS-B**)**.

4- Nitrogen content was also determined by the Microkyeldahl Method of (Jackson 1967).

5- Titration against versenate solution (Na-EDTA) a method which is described by (Chapman and Pratt 1961) was determined to measure the Calcium content.

RESULT

The results of table (1) demonstrated that the pomegranate 'Mahdawi' cultivar treated with GA3 concentration had significantly increased the leaf area at (100 mg. L^{-1}) which presented (11.66 $cm^{2)}$ comparing to the other concentrations. Moreover, Kelatex at concentration (400 mg. L^{-1}) resulted in the highest value of leaf area, but there are not any significant differences between them. Where, the Aminoplasmal concentrations was meaningfully increased the leaf area at (200 mg. L^{-1}) concentrations which noted (11.44 $cm^{2)}$ likened to the other concentrations. The results refer that there is a significant difference between the interaction of Gibberellins (GA3), Kelatex (Ca), and Aminoplasmal (A) and the concentrations of (100,400 and 200 mg. L^{-1}) respectively got the highest value of leaf area when compared with other treatments and the value was (13.51 cm2).

Table (1): Effect of foliar spray of Gibberellins, Kelatex, Aminoplasmal, and their interactions on single leaf area (cm^2) of 'Mahdawi' cv. pomegranate.

GA3 mg`. L^{-1}	Ca mg. L^{-1}	Aminoplasmal mg. L^{-1}			GA3* Ca	Mean effect of GA3
		0	100	200		
0	0	8.94 c	9.72 bc	10.13 abc	9.60 c	9.70 b
	200	9.19 bc	9.70 bc	10.45 abc	9.78 c	
	400	9.48 bc	9.58 bc	10.10 abc	9.72 bc	
50	0	7.30 c	9.26 bc	11.11 ab	9.23 c	10.06 b
	200	9.38 bc	10.40 abc	11.54 ab	10.44 c	
	400	10.29abc	10.53 abc	10.68 abc	10.50 bc	
100	0	11.54 ab	12.55 ab	13.44 a	12.51 a	11.66 a
	200	9.10 bc	10.71 abc	11.98 ab	10.59 bc	
	400	10.91 abc	11.21ab	13.51 a	11.88 ab	
Mean effect of A		9.57 b	10.40 b	11.44 a	**Mean effect of Ca**	
GA3*Amino	0	9.20 d	9.67 cd	10.23 bcd		
	50	9.00 d	10.06 bcd	11.11 bc		
	100	10.52 bcd	11.49 ab	12.97 a		
Ca*Amino	0	9.27 b	10.51 ab	11.56 a	10.45 a	
	200	9.22 b	10.27 ab	11.32 a	10.27 a	
	400	10.23 ab	10.44 ab	11.43 a	10.70 a	

Based on Duncan multiple at the 0.05 level, the mean with a column, row, and their interaction with the same latter are not significantly different.

The results of table (2) demonstrated that the pomegranate 'Mahdawi' cultivar treated with GA3 concentrations had significantly increased the Chlorophyll particularly at (100 mg. L^{-1}) which presented (54.52) comparing to the other concentrations. Moreover, Kelatex at concentration (400 mg. L^{-1}) give the highest value of Chlorophyll when compared to the control. Where, the Aminoplasmal concentrations was increased the Chlorophyll at (200 mg. L^{-1}) concentration which noted (54.78) likened to the other concentrations. The results refer that there is a significant difference between the interaction of Gibberellins (GA3), Kelatex (Ca), and Aminoplasmal (A) and the concentrations of (100,400 and 100 mg. L^{-1}) respectively got the highest value of Chlorophyll when compared with the other treatments which recorded (58.35).

Table (2) : Effect of foliar spray of Gibberellins, Kelatex, Aminoplasmal, and their interactions on Chlorophyll of 'Mahdawi' cv. pomegranate.

GA3 mg`. L^{-1}	Ca mg. L^{-1}	Aminoplasmal mg. L^{-1}			GA3* Ca	Mean effect of GA3
		0	100	200		
0	0	49.83 h	50.84 fgh	51.47e-h	50.71 e	52.98 b
	200	51.22 fgh	53.02 c-h	54.32	52.85 cde	
	400	53.19 c-f	55.85 a-d	57.07 abc	55.37 ab	
50	0	50.79 fgh	52.60 d-h	56.17 a-d	53.19 bcd	53.42 ab
	200	50.60 gh	51.89 d-h	53.33 b-h	51.94 de	
	400	54.15 b-g	53.71 b-h	57.55 ab	55.13 ab	
100	0	55.38 a-e	55.01 a-f	52.47 d-h	54.29 bc	54.52 a
	200	50.16 gh	54.29 a-g	52.50 d-f	52.32 cde	
	400	54.29 a-g	58.35 a	58.19 a	56.94 a	
Mean effect of A		52.18 b	53.95 a	54.78a	**Mean effect of Ca**	
GA3*Amino	0	51.41 c	53.24	54.28 ab		
	50	51.85c	52.73bc	55.68 a		
	100	53.28 bc	55.88 a	54.39 ab		
Ca*Amino	0	52.00 bc	52.82b	52.729 b	52.729 b	
	200	50.66 c	53.07 b	52.371 b	52.371 b	
	400	53.88 b	55.97 a	55.815 a	55.815 a	

Based on Duncan multiple at the 0.05 level, the mean with a column, row, and their interaction with the same latter are not significantly different.

Table (3) : Effect of foliar spray of Gibberellins, Kelatex, Aminoplasmal, and their interactions on leaf Nitrogen ratio of 'Mahdawi' cv. pomegranate.

GA3 mg`. L^{-1}	Ca mg. L^{-1}	Aminoplasmal mg. L^{-1}			GA3* Ca	Mean effect of GA3
		0	100	200		
0	0	0.96 efg	1.05 efg	1.09 d-g	1.03 b	1.11 b
	200	1.08 d-g	1.11 c-g	1.22 b-f	1.14 b	
	400	1.10 d-g	1.14 c-g	1.20 b-f	1.15 b	
50	0	1.07 d-g	1.18 c-f	1.21 b-f	1.15 b	1.16 ab
	200	1.09 d-g	1.21 b-f	1.29 b-e	1.20 ab	
	400	0.80 g	1.19 b-f	1.36 bcd	1.12 b	
100	0	0.91 fg	1.14 c-g	1.53 ab	1.19 ab	1.24 a

	200	0.95 d-g	1.12 c-g	1.45 abc	1.17 b
	400	1.12 c-g	1.27 b-e	1.71 a	1.37 a
Mean effect of A		1.01c	1.16 b	1.34 a	**Mean effect of Ca**
GA3*Amino	0	1.04 cde	1.10 cde	1.17 bcd	
	50	0.99 e	1.19 bc	1.29 b	
	100	0.99 de	1.18 bcd	1.56 a	
Ca*Amino	0	0.98 e	1.12 cde	1.28 abc	1.126 a
	200	1.04 de	1.15b-e	1.32 ab	1.170 a
	400	1.01 e	1.20 bcd	1.42 a	1.211 a

Based on Duncan multiple at the 0.05 level, the mean with a column, row, and their interaction with the same latter are not significantly different.

The results of table (3) demonstrated that the pomegranate 'Mahdawi' cultivar treated with GA3 concentrations had significantly increased the leaf Nitrogen ratio particularly at (100 mg. L^{-1}) which presented (1.24) comparing to the other concentrations. Moreover, Kelatex at concentration (400 mg. L^{-1}) give the highest value of leaf Nitrogen ratio but, there aren't any significant differences between them. Where, the Aminoplasmal concentrations was meaningfully increased the leaf Nitrogen ratio at (200 mg. L^{-1}) level concentrations which noted (1.34) likened to the other concentrations. The results refer that there is a significant difference between the interaction of Gibberellins (GA3), Kelatex (Ca), and Aminoplasmal (A) at (100,400 and 200 mg. L^{-1}) concentrations respectively got the highest leaf nitrogen ratio and noted (1.71) compared when compared with the other treatments.

Table (4): Effect of foliar spray of Gibberellins, Kelatex, Aminoplasmal, and their interactions on leaf Calcium ratio of 'Mahdawi' cv. pomegranate.

GA3 mg`. L^{-1}	Ca mg. L^{-1}	Aminoplasmal mg. L^{-1}			GA3* Ca	Mean effect of GA3
		0	100	200		
0	0	0.67 de	0.78 cde	0.84 a-d	0.77 c	0.80 b
	200	0.78 cde	0.83 a-d	0.88 abc	0.83 bc	
	400	0.79 b-e	0.79 b-e	0.86 abc	0.81 bc	
50	0	0.65 e	0.78 cde	0.86 abc	0.77 c	0.84 ab
	200	0.84a-d	0.85 abc	0.93 abc	0.87 ab	
	400	0.84 a-d	0.89 abc	0.94 abc	0.89 ab	
100	0	0.68 de	0.67 de	0.89 abc	0.75 c	0.86 a
	200	0.86 abc	0.88 abc	0.96 ab	0.90	

					ab	
	400	0.86 abc	0.93 abc	1.00 a	0.93 a	
Mean effect of A		0.77 b	0.82 b	0.91 a		**Mean effect of Ca**
GA3*Amino	0	0.75 d	0.80 cd	0.86 abc		
	50	0.77 cd	0.84 bcd	0.91 ab		
	100	0.80 cd	0.83 bcd	0.95 a		
Ca*Amino	0	0.67 d	0.74 cd	0.86 ab		0.759 b
	200	0.82 bc	0.86 ab	0.92 a		0.868 a
	400	0.83bc	0.87 ab	0.93 a		0.876 a

Based on Duncan multiple at the 0.05 level, the mean with a column, row, and their interaction with the same latter are not significantly different.

The results of table (4) demonstrated that the pomegranate 'Mahdawi' cultivar treated with GA3 concentrations had significantly increased the leaf Calcium ratio particularly at (100 mg. L^{-1}) which presented (0.86) comparing to the other concentrations. Moreover, Kelatex at concentrations (400 mg. L^{-1}) and (200 mg. L^{-1}) give the highest rate of leaf Calcium when compared to the control. Where, the Aminoplasmal concentrations was meaningfully increased the Calcium at (200 mg. L^{-1}) level concentrations which noted (0.91) likened to the other concentrations. The results refer that there is a significant difference between the interaction of Gibberellins (GA3), Kelatex (Ca), and Aminoplasmal (A) at (100,400 and 200 mg. L^{-1}) concentrations respectively got the highest rate of leaf calcium which noted (1.00) when compared to the other treatment.

Table (5): Effect of foliar spray of Gibberellins, Kelatex, Aminoplasmal, and their interactions on dry weight of 'Mahdawi' cv. pomegranate.

GA3 mg`. L^{-1}	**Ca mg. L^{-1}**	**Aminoplasmal mg. L^{-1}**			**GA3* Ca**	**Mean effect of GA3**
		0	100	200		
0	0	2.38 cd	2.94 a-d	2.96 a-d	2.76 c	2.87 b
	200	1.99 d	2.88 a-d	3.19abc	2.69 c	
	400	2.60 bcd	3.39 abc	3.47 abc	3.15 abc	
50	0	3.05 a-d	3.28 abc	2.94 a-d	3.09 abc	3.28 a
	200	2.76 a-d	3.40 abc	3.69 ab	3.28 ab	
	400	3.28 abc	3.87 a	3.28 abc	3.47 a	
100	0	3.07 a-d	3.20abc	3.57 ab	3.28	3.48 a
	200	3.73 ab	3.18abc	3.86 a	3.59 a	
	400	3.38 abc	3.64 ab	3.71 ab	3.57 a	
Mean effect of A		2.91 b	3.31 a	3.41 a		**Mean effect of Ca**
GA3*Amino	0	2.32 c	3.07 b	3.21ab		

	50	3.03 b	3.52 ab	3.30 ab	
	100	3.39 ab	3.34 ab	3.71 a	
Ca*Amino	0	2.83 b	3.14 ab	3.15 ab	3.042 b
	200	2.82 b	3.15 ab	3.58 a	3.185 ab
	400	3.09 ab	3.63 a	3.48 a	3.400 a

Based on Duncan multiple at the 0.05 level, the mean with a column, row, and their interaction with the same latter are not significantly different.

The results of table (5) demonstrated that the pomegranate 'Mahdawi' cultivar treated with GA3 concentrations had significantly increased the dry weight particularly at (100 mg. L^{-1}) and (50 mg. L^{-1}) which presented (3.48) and (3.28g) comparing to the control. Moreover, Kelatex at concentration (400 mg. L^{-1}) give the highest dry weight when compared to the other concentrations. Where, the Aminoplasmal concentrations was meaningfully increased the dry weight at (200 mg. L^{-1}) and (100 mg. L^{-1}) concentrations which noted (3.41 g) and (3.31 likened to the control. The results refer that there is a significant difference between the interaction of Gibberellins (GA3), Kelatex (Ca), and Aminoplasmal (A) and concentration of (100,200 and 200 mg. L^{-1}) respectively got (3.86g) the highest leaf dry weight value when compared with other treatments.

DISCUSSION

In this study the vegetative and leaf nutrient parameters such (leaf area, total Chlorophyll, dry weight of leaves, leaf nitrogen and leaf calcium) are improved by 3rd concentration of GA3 when compared with control and this results agreement with (T., Prasad *et al*., 2017 and Masoud *et al.,* 2019). The increase in these vegetative characteristics were most likely caused by gibberellin, which stimulates auxin activity, resulting in the production of more auxin., (Harhash *et al*., 2019) as they also reported the positive role of GA3 in enhancing cell elongation and division in the plant. Meanwhile, the effect of calcium in same table of studied parameters are increased such as (leaf calcium content and leaf dry weight) and these increasing may due to the role that plays an important role in reducing cell membrane permeability, resulting in the obstruction of ethylene and enzyme passages that are responsible for analyzing cell walls and linking pectin. (Carl *et al*., 1991). and decrease same the ca rate in (leaf area, total Chlorophyll, dry weight of leaves) This finding is similar to the findings of (Korkmaz *et al*., 2017) and (Mirdehghan *et al*., 2006), who investigated seasonal changes in nutrition in pomegranate fruits. The researcher discovered that the Ca concentration had decreased throughout the vegetation. As for the effect of Aminoplasmal in same characteristics of pomegranate c.v Mahdawi' such as (leaf area, total Chlorophyll, dry weight of leaves, leaf nitrogen and leaf calcium) are increased and these results are agreement with (Khattab *et al.,* 20.12). Amino acids are essential components of the protein synthesis process. Amino acids requirements are critical for improving plant growth and development. The use of amino acids is critical, especially during critical stages of growth. Exogenous amino acid application has been shown to improve the growth, of pomegranate trees (Wassel *et al*., 2015 and Khodair, 2021), and the interaction of GA3, Ca and A on vegetative growth and leaf nutrients of pomegranate had significantly increased by a combination of GA3, Ca and A in same tables such **(**(leaf dry weight, chlorophyll, leaf nitrogen rate and leaf calcium rate, these differences are due to the role of GA3, CA, and A alone or combination between them, trees treated with GA3 build up biomass Enzyme activity and membrane permeability advancements may facilitate the transfer of photosynthates as well as the uptake and use of minerals (Gan *et al*., 2021).Amino acids are organic nitrogenous compounds and they are playing a role in the building blocks in the synthesis of proteins which formed by a process in which ribosome catalyze the polymerization of amino acids (Davies, 1982). Among calcium's physiological roles are the preservation of the cation-anion balance, the integrity of plant membranes, and the activation of various enzymes. (Marschner, 2002). While significant differences are clearly

shown based on the results of above tables, GA3, CA, and A, GA3 effect on cell elongation and cell division, CA for building blocks in the synthesis of protein and Aminoplasmal is the main source of nitrogen.

REFERENCES

Adsule, R. N., and Patil, N. B. (1995). Pomegranate. In Handbook of fruit science and technology (pp. 471-480). CRC Press.

Carl, W., & Emrich, L. S. (1991). Management of oral mucositis during local radiation and systemic chemotherapy: a study of 98 patients. The Journal of Prosthetic Dentistry, 66(3), 361-369.

Davarpanah, S., Tehranifar, A., Abadía, J., Val, J., Davarynejad, G., Aran, M., and Khorassani, R. (2018). Foliar calcium fertilization reduces fruit cracking in pomegranate (Punica granatum cv. Ardestani). *Scientia Horticulturae*, *230*, 86-91.

Davies, D. D. (1982). Physiological aspects of protein turnover. *Nucleic Acids and Proteins in Plants I: Structure, Biochemistry and Physiology of Proteins*, 189-228.

Gan, L., Su, H., Yan, M., Han, L., & Yin, S. (2021). Differential expression of gibberellin-related genes in wild type and dwarf mutant of Poa pratensis implied their roles in regulating plant height. Crop Science, 61(5), 3023-3034.

Harhash, M. M., Ali, M. A., El-Megeed, A., & Ben Hifaa, A. B. (2019). Effect of some growth regulators, nutrient elements and kaolin on cracking and fruit quality of pomegranate 'Wonderful'cultivar. Journal of the Advances in Agricultural Researches, 24(3), 280-297.

Khalil, H. A., and Aly, H. S. (2013). Cracking and fruit quality of pomegranate (*Punica granatum* L.) as affected by pre-harvest sprays of some growth regulators and mineral nutrients. *Journal of Horticultural Science and Ornamental Plants*, *5*(2), 71-76.

Khodair, O. A., & El-Rahman, A. (2021). Response of manfalouty Pomegranate trees to foliar application of humic acid and amino acids. SVU-International Journal of Agricultural Sciences, 3(1), 10-17.

Korkmaz, A. (2017). Exact solutions to (3+ 1) conformable time fractional Jimbo–Miwa, Zakharov–Kuznetsov and modified Zakharov–Kuznetsov equations. Communications in Theoretical Physics, 67(5), 479.

Legua, P., Melgarejo., Abdel Majid, H., Martínez, J. J., Martinez, R., Ilham, H., ... and Hernández, F. (2012). Total phenols and antioxidant capacity in 10 Moroccan pomegranate varieties. *Journal of food science*, *77*(1), C115-C120.

Lekshmi, A., Varadarajan, S. N., Lupitha, S. S., Indira, D., Mathew, K. A., Chandrasekharan Nair, A., ... and Santhoshkumar, T. R. (2017). A quantitative real-time approach for discriminating apoptosis and necrosis. Cell death discovery, 3(1), 1-10.

Marschner, P., Marino, W., & Lieberei, R. (2002). Seasonal effects on microorganisms in the rhizosphere of two tropical plants in a polyculture agroforestry system in Central Amazonia, Brazil. *Biology and Fertility of Soils*, *35*, 68-71.

Masoud, A. A. B., Ibraheem, F. E., & Khodair, O. A. (2019). Effect of Gibberellic Acid, Naphthalenacetic acid, Calcium and Zinc Spraying on Fruiting of Manfalouty Pomegranate Trees. Assiut Journal of Agricultural Sciences, 50(2), 219-228.

Merwad, A. R. M. (2016). Efficiency of potassium fertilization and salicylic acid on yield and nutrient accumulation of sugar beet grown on saline soil. *Communications in Soil Science and Plant Analysis*, *47*(9), 1184-1192.

Mirdehghan, S. H., Rahemi, M., Serrano, M., Guillén, F., Martínez-Romero, D., & Valero, D. (2006). Prestorage heat treatment to maintain nutritive and functional properties during postharvest cold storage of pomegranate. Journal of Agricultural and food Chemistry, 54(22), 8495-8500.

Naik, S. K., and Chand, P. K. (2011). Tissue culture-mediated biotechnological intervention in pomegranate: a review. Plant cell reports, 30(5), 707-721. devices. Journal of the American Chemical Society, 133(26), 9960-9963.

OlyaieTorshiz,0. A,., Goldansaz, S. H., Motesharezadeh, B., Asgari Sarcheshmeh, M. A., and Zarei, A. (2017). Effect of organic and biological fertilizers on pomegranate trees: yield, cracking, sunburning and infestation to pomegranate fruit moth Ectomyelois ceratoniae (Lepidoptera: Pyralidae). *Journal of Crop Protection*, *6*(3), 327-340.

Shiraishi, K., Takihara, H., and Matsuyama, H. (2010). Elevated scrotal temperature, but not varicocele grade, reflects testicular oxidative stress-mediated apoptosis. *World journal of urology*, *28*(3), 359-364.

Wassel, C. L., Berardi, C., Pankow, J. S., Larson, N. B., Decker, P. A., Hanson, N. Q., ... & Bielinski, S. J. (2015). Soluble P-selectin predicts lower extremity peripheral artery disease incidence and change in the ankle brachial index: the Multi-Ethnic Study of Atherosclerosis (MESA). Atherosclerosis, 239(2), 405-411.

پۆختە

ڤەکولین هاتە ئەنجامدان لسەر جۆرەکێ تایبەت یێ هنارێ بناڤێ (مهداوی)، د باخەکێ تایبەت کو دکەڤیتە گوندێ دوولبێ ل سنورێ قەزا سێمێلێ ل پارێزگەها دهۆك ل بهارا سالا 2022. ئارمانج ژڤێ ڤەکولینێ دیارکرنا کارتێکرنا هەر سێ ماددێن (Gibberellins (GA3), Kelatex (Cosmocel) (Ca) and Aminoplasmal (A)) لسەر گەشا کەسکاتیێ و پێکهاتەیێن خوراکی دناڤ بەلگێن هنارێ جۆرێ (مەهداوی) دا. د ئەنجامێن ڤەکولینێ دا دیاربوو (Gibberellins at 100mg. L-1) کارتێکرنەکا بەربەلاڤ هەبوو لسەر رووبەرێ بەلگان، کێشا هشك یا بەلگان، پێکهاتەیا کلوروفیلی و نایتروجینی و کالسیومی د ناڤ بەلگان دا. ژ لایەکێ دیڤە ((Kelatex at 400 mg. L -1 کارتێکرنەکا بەربەلاڤ هەبوو لسەر کێشا هشکا بەلگا، پێکهاتا (کلوروفیل و کالسیوم) د ناڤ بەلگیدا، بەلێ خەستیا Aminoplasmal (200 mg. L -1) ، کارتێکرن هەبوو لسەر رووبەر و کێشا هشکا بەلگان، پێکهاتا (کلوروفیل, نێتروجین و کالسیوم) د ناڤ بەلگان دا. هەر وسا کارتێکرنا ڤان هەرسێ ماددا تێکرا لسەر رووبەرێ بەلگان پێکهاتەیا کلوروفیلی و نایتروجینی و کالسیومی دناف بەلگان د ل خەستیا (100,400 and 200 mg. L -1) یا بسەرکەفتی بوو ل سەر هەمی خەستیەیێت دی. و کارتێکرن ل سەر کیشا بەلگێت هشك ل خەستیا .(100, 200 and 200 mg L -1)یا بسەرکەفتی بوو ل سەر هەمی خەستیەیێت دی.

الخلاصة

نفذت هذه الدراسة خلال موسم النمو 2022 في احد البساتين الخاصة المزروعة باشجار الرمان صنف مهداوى الذي يقع في قرية دولب ، محافظة دهوك ، إقليم كردستان لدراسة تأثير الرش الورقي لكل من جبرلينات (GA3) و كيلاتيكس(Ca) و أمينوبلازمال(A) . نفذت تجربة عاملية وفق تصميم القطاعات العشوائية الكاملة (RCBD) بثلاث مكررات لكل معاملة وتم تمثيل كل مكرر بشجرة واحدة.

كانت هناك ثلاثة تراكيز من جبرلينات (0 ، 50 ، و 100 ملجم/ لتر) ؛ ثلاثة تركيز من الكالسيوم (0 ، 200 ، و 400 ملجم. لتر) وثلاثة تركيز من أمينوبلازمال (0 ، 100 ، 200 مل. لتر -1) في الدراسة. أظهرت النتائج أن GA3 عند 100 ملغ/لتر كان له تأثير معنوي على مساحة الورقة ، ووزن الورقة الجافة ، ومحتوى كلوروفيل الأوراق ، ومحتوى النيتروجين في الأوراق ، ومحتوى الكالسيوم في الأوراق عند المقارنة مع الكنترول من ناحية أخرى ، فإن الكالسيوم عند 400 ملغ/لتركان له تأثير معنوي على الوزن الجاف للأوراق ، ومحتوى كلوروفيل الأوراق والكالسيوم الورقي عند المقارنة مع الكنترول ، بالإضافة إلى الأمينوبلازمال عند 200 مجم/لتر أثرت معنويا على مساحة الورقة ، ووزن الورقة الجاف ، ومحتوى الكلوروفيل ، ومحتوى النيتروجين ، ومحتوى الكالسيوم. علاوة على ذلك ، كان للتفاعل بين (GA3، Ca، A) تأثيرا معنويا على كلوروفيل الأوراق ، محتوى الكالسيوم في الأوراق ، محتوى الأوراق من النيتروجين ، ومساحة الورقة بتركيزات (100 ، 400 ، 200 مجم/لتر) على التوالي. أما وزن الورقة الجافة فقد تأثر معنوياً بتركيزات (100.200 و 200 مجم لتر) على التوالي.