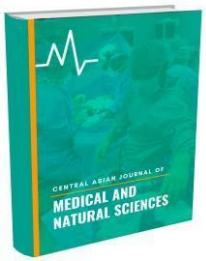

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Article

Optimizing Gibberellic Acid and Phosphate for Apple Growth

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Abstract: In a private orchard in Al-Mahawil, Babil Governorate, Iraq, during the 2022-2023 growing season, apple trees were subjected to a factorial experiment involving gibberellic acid spraying at 0, 10, and 30 ml.l^-1 concentrations with two applications spaced thirty days apart, and soil fertilization with phosphate at 0, 20, 30, and 50 g.l^-1 levels with irrigation water. Results indicated that a concentration of 20 ml L^-1 gibberellic acid significantly increased chlorophyll content, carbohydrate percentage, and nutrient levels (N, P, K, Mn, and Fe) compared to other concentrations. Furthermore, soil treatment with 30 g L^-1 phosphate, combined with irrigation water, significantly impacted all studied traits except carbohydrate percentage, which was higher than the 50 g L^-1 spray treatment, registering a 37.52% rate. These findings highlight the potential of optimized gibberellic acid and phosphate application in enhancing apple tree growth and nutrient uptake, underscoring the importance of tailored fertilization strategies for orchard management and productivity optimization.

Keywords: Gibberellic acid, Phosphate fertilization, Iraqi soils, Apple trees, Carbohydrates.

1. Introduction

The apple (Pome Fruits L.) is a deciduous fruit that belongs to the Pomegranate family. The cultivation of apple trees is widespread in a wide range of the world, where Kazakhstan is considered the main homeland of apples. Apple cultivation has spread in Central Asia for thousands of years, and in Asia, Europe, and throughout South Africa. Western Russia, China and eastern India. Winter temperature is considered one of the factors determining the growth of apple trees. It is one of the fruit trees most in need of a cold period in order to break the resting period of buds. Therefore, its cultivation is not successful in Iraq, not in the regions of northern Iraq, and it is limited [1]. Apple trees are grown commercially in areas located between 30 and 50 latitudes, and they can be extended to 30 latitudes, provided that there are sufficient hours of cold during the winter. They can be extended to more than 50 latitudes, provided that the areas are close to oceans and seas. Apple trees are considered light-loving trees, as many of the characteristics and colour of the fruits are improved. Soils that are neutral or slightly acidic, with a pH ranging between 6-7 and with a mixed texture with good drainage and ventilation, are suitable for all varieties of apples.

The problem of providing plants with the elements necessary for growth is one of the problems that affects growth and production, as most of the soils in which these fruit trees grow in Iraq are characterized by their low content of organic matter, which

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negatively affects the fulfillment of their needs for the necessary nutritional elements, and thus the plants suffer from a deficiency in meeting their needs for the elements. Nutrients, so the fertilization process is one of the most important service processes for the crop and an important means of production because of its significant impact on regulating the plant's vital processes, especially micronutrients [2], in addition to the role of nutrients in growth processes and increasing tree productivity when they are sprayed on the plant [3]. Foliar feeding is one of the preferred methods of fertilizing with micronutrients due to the high benefit of plants and the lack of environmental pollution.

Gibberellic acid is a natural hormone that regulates the growth of plants and stimulates their growth. It is present in a natural form in most plants, where it was found to have many different effects on the plant. A study by Mohammed and Mahmood (2023) showed that apple seedlings of the Anna variety were sprayed with gibberellic acid at levels (0, 10 and 20 ml.l-1) had a significant effect in increasing the leaves' content of chlorophyll and the percentage of major elements (nitrogen, potassium and phosphorus).

Iraqi soils suffer from a deficiency in the amount of phosphorus ready for absorption, because Iraqi soils have a basic degree of reaction due to the increasing percentage of calcium carbonate, which causes the fixation of phosphate ions on the surfaces of calcium carbonate. Given the importance of phosphorus as it is one of the basic nutrients necessary for plants and its direct role in most physiological and biochemical processes, these processes cannot take place inside plant cells without it, Phosphorus is also considered part of the plant's reproductive system because it is one of the components of the genetic memory system, which is represented by RNA/DNA. Phosphate fertilizer is added either in deep lines halfway between the tree lines or under the location of the tree branches. The basic condition for the tree to benefit from this fertilizer is to bury it deep in the soil. Al-Shareefi et al. (2020) found that treating apple trees with phosphate fertilizer at concentrations of (0, 20, 30 and 50 kgP2O5. ha-1) led to a significant increase in the average plant content of carbohydrates and macro- and micro-nutrients. The aim of the research is to study the effect of different levels of gibberellic acid sprayed on the plant and phosphate fertilization on the content of chlorophyll and carbohydrates and the chemical content of some nutrients in the plant.

2. Materials and Methods

The experiment was conducted in one of the private orchards in the Al-Mahawil area in Babil Governorate / Iraq during the growing season (2022-2023) on apple trees. Soil samples were taken and their chemical and physical properties were analyzed as shown in (Table 1). The study included two factors: spraying gibberellic acid (AG3) at three concentrations (0, 10, 20 ml.L-1). The product is brought by (UK/Ltd.,Co Avonchem). The percentage of concentrated active ingredient was 97%. The plant was sprayed at a rate of two sprays, every thirty days, and the tree leaves were sprayed early in the morning using a 100liter sprinkler operated automatically, adding liquid soap as a dispersing agent to the spray solution at a concentration of 1 ml L-1 to reduce surface tension and facilitate the absorption of the agent. The second factor included phosphate fertilization at four levels (0, 20, 30, 50 g.L-1), added all at once, mixed with the soil. The study was implemented as a factorial experiment according to a randomized complete block design (RCBD) with three replications. The data obtained from the experiment were analyzed using the GenStat statistical program, and the arithmetic means were compared using the least significant difference (LSD) test at a probability level of 0.05 [4].

Table 1. Same characteristics of the soil of the experiment.

Character	Value	Measure unit
EC	1.4	**ds m^{-1}**
pH	7.1	-
M.O.	3.1	**%**
Available N	28.7	**mg.gm^{-1} dry weight**
Available P	0.52	**mg.gm^{-1} dry weight**
Available K	40.0	**mg.gm^{-1} dry weight**
	Sand %	74.02
Soil texture	Silt %	13.44
	Clay %	12.54

3. Results and Discussion

3.1 Characteristics of vegetative growth

The results in Table (2) show that the treatment of apple trees with a concentration of 20 ml.L-1 was significantly superior in giving the highest rate of leaf content of chlorophyll and carbohydrates, reaching 38.32 SPAD and 38.52%, respectively, compared to the comparison treatment, which gave the lowest rate, amounting to 27.53 SPAD and 31.99%. respectively. The explanation for this result is due to an increase in the concentration of chlorophyll in the leaves due to the role of gibberellic acid in working to build important proteins in some metabolic processes, which increases the formation of plastids, the retention of chlorophyll, and the delay of leaf senescence. This is accompanied by an increase in the readiness, absorption, and concentration of phosphorus in the leaves when added to the soil, and because Phosphorus is included in the composition of energy-carrying compounds. ADP and ATP, which contribute indirectly to building chlorophyll molecules, in addition to phosphorus contributing to increasing the growth and branching of roots, which may contribute to increasing the absorption of many nutrients from the soil, especially the nitrogen that is included in its composition. In the structure of chlorophyll molecules [5].

The results in the table below also showed that fertilizing apple trees with phosphate fertilizer gave a significant increase, especially at the level of 30 gm. L-1 where a significant increase was recorded in the chlorophyll content of the leaves, amounting to 38.07 SPAD, compared to the comparison treatment, which gave the lowest rate for this trait, amounting to 29.27 SPAD, while the level was 50 gm. l-1 The highest rate of carbohydrate amount was 37.52% compared to the comparison treatment, which recorded the lowest rate of 34.00%. The increase in the leaves' content of carbohydrates is due to the increased chlorophyll content of the leaves and its impact on activating the process of photosynthesis and raising its efficiency, which led to an increase in the net CO2 represented in the leaf, which represents the basic unit for building carbohydrates [6].

Table (2) Effect of foliar spraying with gibberellic acid and ground fertilization of phosphate fertilizer on the chlorophyll and carbohydrate content of the leaves of apple trees (Anna).

A = Gibberellic acid level			
Type factor	Factor concentration	Studied attributes	
		Chlorophyll content of leaves (spad)	Percentage of carbohydrates %
Gibberellic acid mg. l^{-1}	0	27.53	31.99
	10	35.20	35.79
	20	38.23	38.52
	$LSD_{0.05}$	**0.806**	**0.868**
B= Phosphate fertilizer level			
Phosphate fertilizer level g.l^{-1}	0	29.27	34,00
	20	32.00	34.43
	30	38.07	35.88
	50	35.27	37.52
	$LSD_{0.05}$	**0.931**	**1.003**
C = Interaction between gibberellic acid level x phosphate fertilizer level			
Gibberellic acid mg. l^{-1}	Phosphate fertilizer level g.l^{-1}	Chlorophyll content of leaves (spad)	Percentage of carbohydrates %
0	**0**	25.50	30.32
	20	27.00	30.55
	30	30.60	32.05
	50	27.00	35.06
10	**0**	30.20	33.58
	20	33.90	35.54
	30	41.40	36.50
	50	35.30	37.50
20	**0**	32.10	38.09
	20	35.10	37.00
	30	42.20	39.00
	50	43.20	39.10
$LSD_{0.05}$		**1.612**	**0.992**

3.2 Chemical properties

The results in Table (3) show that the foliar spray treatment with gibberellic acid at a concentration of 20 ml. L-1 was significantly superior in giving apple trees the highest percentage of nitrogen, phosphorus, and potassium content in apple trees, as it reached (3.65, 0.42, 4.34%), respectively, as well as for iron and manganese, as the treatment was superior to the same concentration, reaching (163.52 and 32.31 mg.gm-1 dry weight), respectively. The reason for the increase in the leaves' content of major nutrients is a result of the role of gibberellic acid in regulating plant growth, which is reflected in stimulating the absorption, movement and transfer of nutrients in the plant towards the tissues treated with it, thus increasing the concentrations of the elements in the plant leaves, in addition to its role in improving root growth and providing the necessary energy. To absorb ready-made nutrients in the soil and thus achieve nutritional balance in the plant [7].

Also, the results in the same table below show that the ground addition of phosphate fertilizer to apple trees led to a significant increase in the apple trees' content of mineral elements (nitrogen, phosphorus, and potassium), where nitrogen reached 3.65%, phosphorus 0.44%, and potassium 3.40%, respectively, at the level of 30 gm. L-1. It was also found that when treating trees with the same fertilizer level, it led to a significant increase in the amount of iron and manganese, as the amount of iron reached 176.05 mg. gm-1 dry weight, as well as manganese, amounted to 30.14 mg. gm-1 dry weight respectively. It is noted from the results that the effective role of phosphate fertilizer added to the soil to raise the plant's phosphorus content, which increased the plant's activity and efficiency, represented by an improvement in the process of carbon metabolism, respiration, and transpiration, as well as cell division and elongation, which was reflected in improved root growth and an increase in its ability to absorb nutrients from the soil. This had a positive impact on the nutritional status of the plant [8].

Table (3) Effect of foliar spraying with gibberellic acid and ground fertilization with phosphate fertilizer on the mineral nutrient content in the leaves of apple trees (anna).

A = Gibberellic acid level						
Type factor	Factor concentration	Studied attributes				
		Nitrogen content %	Phosphorus content %	Potassium content %	Iron $mg.gm^{-1}$ dry weight	Manganese $mg.gm^{-1}$ dry weight
Gibberellic acid mg. l^{-1}	0	3.34	0.34	4.25	156.27	24.56
	10	3.50	0.38	4.31	160.59	29.21
	20	3.65	0.42	4.34	163.52	32.31
	$LSD_{0.05}$	**3.49**	**0.018**	**4.30**	**1.984**	**0.775**
B= Phosphate fertilizer level						
Phosphate fertilizer level $g.l^{-1}$	0	3.39	0.34	3.20	157.27	26.85
	20	3.44	3.35	3.23	156.63	28.50
	30	3.65	0.44	3.40	176.05	30.14
	50	3.50	0.40	3.39	159.65	29.27
	$LSD_{0.05}$	**3.55**	**0.020**	**3.30**	**0.992**	**0.895**
C = Interaction between gibberellic acid level x phosphate fertilizer level						
Gibberellic acid mg. l^{-1}	Phosphate fertilizer level $g.l^{-1}$	Nitrogen content %	Phosphorus content %	Potassium content %	Iron $mg.gm^{-1}$ dry weight	Manganese $mg.gm^{-1}$ dry weight
0	0	3.23	0.31	3.09	153.09	22.43
	20	3.32	0.33	2.20	154.30	24.11
	30	3.30	0.35	2.35	157.65	25.65
	50	3.52	0.38	3.35	160.03	27.34
10	0	3.40	0.34	3.21	157.40	29.09
	20	3.41	0.35	4.26	158.03	28.89
	30	3.50	0.39	4.37	159.00	31.43
	50	3.68	0.45	4.39	167.42	30.72
20	0	3.54	0.36	4.30	158.31	32.31
	20	3.54	0.37	4.33	160.55	30.20
	30	3.71	0.46	4.46	162.03	30.88
	50	3.75	0.48	4.46	173.19	31.35
$LSD_{0.05}$		**3.33**	**0.020**	**3.33**	**0.882**	**0.892**

4. Conclusion

The significant increase in characteristics is due to the fact that these fertilizers contain the necessary elements and amino acids to carry out vital processes within the plant, which have an important role in building chlorophyll and preventing its breakdown (Mengel and Kirkby, 1982). The reason for the increase in the leaves' content of nutritious elements is due to treating the trees with a growth regulator. Gibberellin, which has a role Solidarity in stimulating the absorption, movement and transfer of nutrients towards the plant tissues treated with them and thus increasing their concentration in the leaves. The reason may also be due to the effect of the two study workers in increasing and improving the vegetative growth of trees and this is linked to the increase in carbohydrates, some of which are used in root growth and providing the energy needed for absorption nutrients available in the soil, thus achieving nutritional balance in the plant [9], and this is consistent with the findings [10].

REFERENCES

[1] K. K. J. Mohammed, "The development of comfort and its impact on apple trees in Anbar province," Journal of the Iraqi University, vol. 34, no. 1, 2015.

[2] L. U. Opara, M. R. Al-Ani, and Y. S. Al-Shuaibi, "Physico-chemical properties, vitamin C content, and antimicrobial properties of pomegranate fruit (Punica granatum L.)," Food and Bioprocess Technology, vol. 2, pp. 315-321, 2009.

[3] J. A. Oliet et al., "Nutrient loading of forest tree seedlings to promote stress resistance and field performance: A Mediterranean perspective," New Forests, vol. 44, pp. 649-669, 2013.

[4] K. M. Al-Rawi and A. M. Khalaf Allah, "Design and analysis of agricultural experiments," El Mosul Univ., Iraq, vol. 19, p. 487, 1980.

[5] S. H. Shah, "Physiological effects of pre-sowing seed treatment with gibberellic acid on Nigella sativa L.," Acta Botanica Croatica, vol. 66, no. 1, pp. 67-73, 2007.

[6] M. A. F. A. Al-Janabi, "Effect of foliar application with forchlorfenuron and gibberellic acid in vegetative growth and chemical content of Washington navel orange transplants," 2022.

[7] V. N. Le et al., "Foliage applied gibberellic acid influences growth, nutrient contents and quality of lettuces (Lactuca sativa L.)," 2021.

[8] J. T. Mahmood and H. K. A. Salmani, "Effect of organic and mineral fertilization on concentrations of N, P and K at leaves of potato," 2013.

[9] F. B. Salisbury and C. Ross, "Plant physiology," Wadsworth Publishing Company, Inc., Belmont, CA, 1992.

[10] A. Al-Shareefi et al., "Response of pomegranate seedlings (Punica granatum L.) to spraying with organic fertilizer (Special Marine) and nutrient solution (Micro Nate14)," Plant Archives, vol. 20, no. 2, pp. 7608-7612, 2020.

[11] A. H. A. Al-Douri and A. K. S. Al-Rawi, "Fruit production for departments not specialized in horticulture," Ministry of Higher Education and Scientific Research, University of Mosul, College of Agriculture and Forestry, 1st ed., 2000.

[12] S. N. A. Al-Nuaimi, "Fertilizers and soil fertility," Kutub House for Printing and Publishing, Ministry of Higher Education and Scientific Research, Mosul University, 1999.

[13] F. H. R. Al-Sahaf, "Applied plant nutrition," Higher Education Press, University of Al Mosul, Ministry of Higher Education and Scientific Research, Iraq, 1989.

[14] T. J. Mohammed Ali and O. H. Mahmood, "Effect of foliar application of gibberellic and the addition of humic acid on the apple seedlings growth," International Journal of Agricultural & Statistical Sciences, vol. 19, no. 1, 2023.

[15] T. S. Hassan, "Book on soil fertility and fruit tree nutrition," Aladdin Publishing, Distribution and Translation House, 2003.