



## The effect of Spraying schedules and spraying with growth regulators on some field and fruit characteristics of Qaisi Apricot trees grown in Karbala Governorate

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### Abstract

The study was conducted in a private orchard in Karbala Governorate - Al-Husseiniyah during the growing season 2024. The research studied two factors: the first factor was the spraying schedules (at the full flowering stage, after the fruit-setting stage, and before the fruit-ripening stage), and the second factor was plant growth regulators (0, GA<sub>3</sub> 25 mg/L, and NAA 25 mg/L). Four characteristics were studied: the percentage of fruit drop, the percentage of soluble solids, the percentage of total acidity, and the fruit flesh thickness rate. After collecting and statistically analyzing the field data, it was found that both factors had a significant effect. The spraying schedules at the ripening stage exceeded all the characteristics under investigation, as they gave the lowest percentage of fruit drop, the highest percentage of soluble solids, the lowest percentage of total acidity, and the highest fleshy thickness of the fruit. (6.57%, 5.30%, 0.62%, and 2.24 cm) The growth regulator NAA also excelled in all other aspects.

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### 1. Introduction

The apricot tree (*Prunus armeniaca* L.) is a perennial, deciduous tree belonging to the Rosaceae family. Seven wild species are known to grow naturally in China, Korea, the Far East, and Central Asia. The wild apricot is native to the eastern regions of western China, dating back to 2000 BC. Frost-resistant varieties are found in Siberia, southern Manchuria, Mongolia, and the Himalayas. Apricots were introduced from China to North Africa, India, Persia, and the Arab world, particularly Syria, and to Europe in the 10th century AD by the Arabs of Andalusia. Their cultivation was introduced to Virginia in the United States in 1720, and they are now an important fruit tree in California.) (Qatna, 2022) [8].

Apricot cultivation has been practiced in Iraq since ancient times, and its area continues to expand due to the fertility of its production, the high price of its fruit, and its nutritional importance. It is considered an economically valuable and delicious fruit, beneficial to health, and rich in sugars; vitamins (B2, C, and A); minerals; and other nutrients. Several varieties of apricots are cultivated in Karbala Governorate, including the Qaisi variety. (Ethbeab and Hmiz, 2026) There is a logical sequence to the development of the apricot fruit, consisting of three stages: the first stage is flowering, the second stage is fruit set, and the third stage is fruit ripening. These stages differ in their nutritional requirements. (Audergon *et al.*, 2018) [5]. Al-Badawi (2015) [3] studied the effect of spraying growth regulators on the developmental stages of apricot fruit and obtained significant results in terms of growth and yield. Fikri *et al.* (2019) [7] studied the effect of spraying growth regulators on pear trees (*Prunus domestica* var. *domestica*) at different stages of fruit development and obtained significant results in some vegetative and chemical characteristics. Al-Maamouri (2026) [4] obtained significant results in fruit characteristics when treating the fruits of the date palm variety "Asta Omran" during the Hababouk and Jamri stages.

Foliar spraying, or foliar feeding, is defined as spraying solutions of nutrients, growth regulators, vitamins, and amino acids in liquid form on the foliage of the plant, as the leaf is an important center for many metabolic processes and has the ability to absorb nutrients just like the roots. Therefore, foliar spraying is a complementary process to soil fertilization and not a replacement for it (Brayan, 2017) [6].

Plant growth regulators are non-nutritive organic substances that can be used in small concentrations. They either promote, inhibit, or modify a specific physiological process, depending on the concentration used and the timing of application. Although there are more than one hundred types of gibberellins, they share the same functions. They stimulate plant growth and development, as they help in cell elongation and the preservation of green matter or chlorophyll. They also work to produce seedless plants and help in fruit ripening (Al-Khaikani and Al-Asadi, 2019) [2]. Their basic structure is the presence of (C<sub>20</sub>-C<sub>19</sub> C<sub>19</sub>) with a carboxyl group that gives them the characteristic of acidity. The gibberellins differ among themselves in the number of carbon atoms and in the presence or absence of the (OH) group. NAA is a synthetic auxin with many physiological effects, including regulating fruit set, reducing pre-harvest drop, stimulating cell elongation, increasing fruit growth, and improving fruit quality characteristics such as increasing sugar and reducing fruit acidity (Saqr, 2010) [9]. Sharif and Jamil (2012) [10] found that spraying date palm trees of the Barim variety with a concentration of 25 mg/L of GA<sub>3</sub> during different stages of fruit growth caused a significant response in the studied traits. Abdel-Salam (2015) [1] found in his study on pear trees that spraying pear trees with gibberellin during the fruit set stage resulted in significant differences in growth characteristics and yield.

### The main objective

The main objective of this experiment is to study the effect of Spraying schedules and growth regulators on some of Some field, chemical, and anatomical characteristics of the fruit, Also, determining the appropriate stage for spraying growth regulators, as well as determining the appropriate type of growth regulator.

### Materials and Methods

The study was conducted in a private orchard in Karbala Governorate - Al-Husseiniyah 2024. Apricot trees were planted at 6 x 6 spacing. The experiment was designed as a factorial experiment according to a Randomized Complete Block Design (RCBD) with three replicates and two factors. The first factor was the Spraying schedules, (At the full

flowering stage, After the fruit setting stage and Before the fruit ripening stage). The second factor was the growth regulators (Control, NAA 25 mg L<sup>-1</sup> And Ga<sub>3</sub> 25 mg L<sup>-1</sup>. 27 well-grown Apricot trees Qaisi varieties. as uniform in size as possible and 10 years old, were selected. Each tree represented an experimental unit. The trees were then marked with indicator signs according to the design used, and the service process was carried out according to the needs of the plant and throughout the duration of the study. Then, samples of the field soil were taken, and the soil properties were estimated before the treatments were carried out in order to measure some of its physical and chemical properties, according to the method of) Page *et al.* (1982) [12].

**Table 1:** Some physical and chemical properties of the soil used before starting the experiment.

Value	Unit of measurement	property	
97	gm. kg-1	Sand	Soil separators
101		Silver	
802		Clay	
is clay.		The texture	
7.50	---	pH 1 : 1	
104	Decismens. M-1	EC 1 : 1	
0.23	%	N	Elements
0.1		P	
0.08		K	

**Spraying schedules:** Use three spraying schedules according to the stages of fruit growth (At the full flowering stage, After the fruit setting stage and before the fruit ripening stage).

**Spraying Method:** Spray the trees according to the required schedule and concentration in the early morning using a 20 ml backpack sprayer, adding a few drops of liquid washing solution to reduce surface tension.

**The studied characteristics:** During the fruit ripening stage, the following characteristics were measured. (Fruit drop%, Total Soluble Solids TSS, %Total Titratable Acidity TAA % and The thickness of the flesh of the fruit cm

**Statistical Analysis:** At the end of the study, the results were recorded, then the variance was analyzed and the factors and their interactions were tested using a computer and the ready-made statistical program Genstat. The differences between the means were compared according to the least significant difference (LSD) test at a probability level of 0.05.

### Result

**Table 2:** Effect of spraying schedules and growth regulators on the percentage of fruit drop for apricot fruits.

Spraying schedules	Growth regulators			Spraying schedules
	NAA /mg/L.25	GA3 25 mg/L	0	
26.68	19.33	27.49	33.22	At the full flowering stage
20.59	13.11	21.33	27.35	After the fruit-setting stage
6.57	3.16	7.13	9.44	Before the fruit ripening stage
	11.86	18.65	23.33	Growth regulators
Spraying schedules Growth regulators infraction 2.44 2.11 3.50				L.S.D

From the results shown in Table 2, it can be said that there are clear and significant differences between the spraying schedules in the percentage of fruit drop, where the ripening stage had the lowest percentage of fruit drop at 6.57%, while the full flowering stage had the highest percentage of fruit drop at 26.68%.

Based on the same table, it can be concluded that growth regulators have a significant effect on the percentage of fruit drop. The lowest percentage of fruit drop was observed when

trees were sprayed with NAA 25 mg/L, resulting in a drop rate of 11.86%, while the highest percentage of fruit drop was observed in the control treatment, which showed a 23.33% drop.

The results also showed that the interaction between the experimental factors had a significant effect, as the interaction between before fruit ripening and NAA gave 3.16% outperforming the infraction treatment consisting of 0 mg/L from regulators and at full flowering, giving 33.22%.

**Table 3:** Effect of Spraying Schedules and Growth Regulators on Percentage of TSS for Apricot Fruits.

Spraying schedules	Growth regulators			Spraying schedules
	NAA /mg/L 25	GA3 25 mg/L	0	
5.01	5.44	5.49	4.12	At the full flowering stage
5.17	5.14	5.20	5.19	After the fruit-setting stage
5.30	5.80	4.13	5.99	Before the fruit ripening stage
	5.46	4.94	5.10	Growth regulators
Spraying schedules Growth regulators infraction 0.04 0.04 0.08				L.S.D

From the results shown in Table 3, it can be said that there are clear and significant differences between the spraying schedules in the percentage of TSS, where the before the fruit ripening stage had the higher percentage of TSS, 5.30%, while the at the full flowering stage had the lowest percentage of fruit drop at 5.01%. Based on the same table, it can be concluded that growth regulators have a significant effect on the percentage of TSS. The lowest percentage of TSS was observed when trees were sprayed with GA<sub>3</sub> 25 mg/L,

resulting in a TSS of 4.94%, while the highest percentage of TSS was observed in the NAA treatment, which showed a 5.46%. Which gave the highest TSS. The results also showed that the interaction between the experimental factors had a significant effect, as the interaction between the pre-fruit-ripening stage and NAA gave 5.80% outperformance compared to the interaction treatment consisting of 0 mg/L from regulators at the full flowering stage and gave 4.12%.

**Table 4:** Effect of Spraying Schedules and Growth Regulators on Percentage of TTA for Apricot Fruits.

Spraying schedules	Growth regulators			Spraying schedules
	NAA /mg/L 25	GA3 25 mg/L	0	
1.31	0.33	1.49	2.11	At the full flowering stage
1.90	0.31	2.80	2.60	After the fruit-setting stage
0.62	0.15	0.50	1.22	Before the fruit ripening stage
	0.26	1.59	1.97	Growth regulators
Spraying schedules Growth regulators infraction 2.44 2.11 3.50				L.S.D

From the results shown in Table 4, it can be said that there are clear and significant differences between the spraying schedules in the percentage of TTA, where the before the fruit ripening stage had the lowest percentage of TTA at 0.62%, while the after the fruit setting stage had the higher percentage of TTA at 1.90%. Based on the same table, it can be concluded that growth regulators have a significant effect on the percentage of TTA. The highest percentage of TTA was observed when trees were sprayed with 0 mg/L, resulting

in a TTA of 1.97%, while the lowest percentage of TTA was observed in the NAA treatment, which showed a 0.26%. The results also showed that the interaction between the experimental factors had a significant effect, as the interaction between before the fruit ripening stage and NAA gave 0.15% outperformance compared to the infraction treatment consisting of 0 mg/L from regulators and at the full flowering stage, giving 2.11%.

**Table 5:** Effect of Effect of Spraying schedules and Growth regulators on Percentage of The thickness of the flesh of the fruit (cm) for apricot

Spraying schedules	Growth regulators			Spraying schedules
	NAA /mg/L 25	GA3 25 mg/L	0	
0.65	0.90	0.71	0.36	At the full flowering stage
1.25	1.88	1.29	0.60	After the fruit-setting stage
2.24	2.50	2.30	2.22	Before the fruit ripening stage
	1.76	1.43	1.06	Growth regulators
Spraying schedules Growth regulators infraction 2.44 2.11 3.50				L.S.D

## Fruits

From the results shown in Table 5, it can be said that there are clear and significant differences between the spraying schedules in the percentage of the thickness of the flesh of the fruit, where the stage before the fruit ripening had the highest percentage of the thickness of the flesh of the fruit at 2.24 cm, while fruit at the full flowering stage had the least thickness of the flesh of the fruit at 0.65 cm. Based on the same table, it can be concluded that growth regulators have a significant effect on the percentage of the thickness of the flesh of the fruit. The highest percentage of the thickness of the flesh of the fruit was observed when trees were sprayed with NAA at 25 mg/L, resulting in a thickness of the flesh of the fruit of 0.76 cm, while the lowest thickness of the flesh of the fruit was observed in the 0 treatment, which showed 1.06 cm. Which gave the lowest thickness of the flesh of the fruit. The results also showed that the interaction between the experimental factors had a significant effect, as the interaction between before the fruit ripening stage and NAA gave 2.50 cm, outperforming the infraction treatment consisting of 0 mg/L from regulators and the full flowering stage, which gave 0.36 cm.

## Discussion

The reason for the positive statistical superiority in all traits is at the time of spraying during the ripening stage. and its superiority over the rest of the stages may be due to the control of genetic factors that affect the growth strength of the variety and the extent of its response to environmental conditions (Muhammad and Younis, 1991) <sup>[11]</sup>. The reason for the superiority of the ripening stage in the trait of fruit flesh thickness, Table (3), may be attributed to the increased transfer of ions and products of photosynthesis into the cells through the cell membrane via the intercellular spaces and cytoplasmic bridges to the vascular tissues in the phloem, and then their transfer to other parts of the plant and their transfer to the fruit by means of the protoplasmic links present between the cells, where they continue to build amino acids, nucleic acids, and others (Al-Sahaf, 1989) <sup>[15]</sup>. The increase in fruit flesh thickness may also be attributed to the role of growth regulators in increasing leaf chlorophyll and protein content, leading to the synthesis of nucleic acids and chloroplasts. This, in turn, results in increased photosynthetic efficiency and consequently higher growth rates, including increased fruit flesh thickness (Sharaki *et al.*, 1985) <sup>[13]</sup>. Furthermore, the increased fruit flesh thickness may be due to the role of growth regulators (BA, GA3) in promoting physiological processes and stimulating cell growth and division as a result of the nutritional balance between the three experimental factors, thus leading to increased fruit flesh thickness. The reason for the superiority of GA3 and NAA in reducing the percentage of fruit drop is that plants need hormonal stimulants during their growth stages, and spraying them on the plant increased their concentration, thus preventing or reducing the formation of the abscission zone. The result is a reduction in fruit drop (Davies, 1995) <sup>[14]</sup>. The reason for the low percentage of fruit drop may also be attributed to the increase in the amount of youth hormones (auxin and gibberellins) in the tree and fruit, which reduced the activity of aging hormones such as ethylene, which stimulates the formation of the abscission zone between the fruit and the fruit stalk through the synthesis of cellulase and pectinase enzymes that break down cellulose and the middle lamella of the cells in the abscission zone (Saqr, 2010) <sup>[9]</sup>. The

reason for the superiority of GA3 and NAA in reducing the percentage of fruit drop is that plants need hormonal stimulants during their growth stages, and spraying them on the plant increased their concentration, thus preventing or reducing the formation of the abscission zone. The result is a reduction in fruit drop (Davies, 1995) <sup>[14]</sup>. The reason for the low percentage of fruit drop may also be attributed to the increase in the amount of youth hormones (auxin and gibberellins) in the tree and fruit, which reduced the activity of aging hormones such as ethylene, which stimulates the formation of the abscission zone between the fruit and the fruit stalk through the synthesis of cellulase and pectinase enzymes that break down cellulose and the middle lamella of the cells in the abscission zone (Saqr, 2010) <sup>[9]</sup>. These results are consistent with those of Al-Badawi (2015) <sup>[3]</sup> and ) Fikri, 2019) <sup>[7]</sup>, as well as with (Al-Maamouri, 2026) <sup>[4]</sup>.

## Conclusion

Karbala Governorate is one of the most important apricot-growing regions in Iraq. Apricot cultivation is a source of income for many farmers and owners of private orchards due to consumer demand for this type of fruit, which is valued for its high quality and high prices. Apricot trees suffer from several problems, including increased fruit drop and poor fruit set at different stages of fruit development. This problem was identified and studied, and the results showed that studying the fruit's development stage plays a crucial role in determining fruit growth and yield. The study also demonstrated that the type of growth regulator used plays an important role in addressing the problem by reducing fruit drop and improving fruit characteristics. At the end of the experiment, we recommend using the growth regulator NAA to treat this problem in apricot trees and extending its application to other stone fruit trees. We also recommend studying the fruit development stages in other apricot varieties or other stone fruit trees.

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