Effect of Supplemental Pollination, Boron Spray and Cultivar on Fruit Quality and Quantity of Olive (*Olea europaea* L.)

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https://doi.org/10.36077/kjas/2022/v14i2.3842

Received date: 27/6/2022

Accepted date: 28/7/2022

Abstract

This study was conducted during the 2020-2021 growing season at the orchard of Horticulture Department, College of Agricultural Engineering Sciences, University of Sulaimani, Bakrajo, Iraqi Kurdistan Region, in order to investigate the effects of artificial pollination, boron application, and cultivar on some fruit quality and quantity of olive. Six selected pollinizers (Arbequina, Ashrasi, Hojiblanca, K18, Kaissy, and Picual) in addition to self and open-pollination, two boron levels (0 and 200 mg.L^{-1}) as well as two main cultivars (Sorani and Khodeiri) were used. Results showed that cultivars are relatively self-incompatible while cultivar, pollinizer, and boron recorded significant differences with regard to some studied parameters. Sorani Cultivar gave the highest percentage of final fruit set (1.96%), self-incompatibility index (0.59), fruit weight (2.64 g), fruit size (2.51 cm^3), content percentage of oil (38.81%), content of soluble sugar (185.74 μg/g DW), the lowest fruit dropping (13.56%), and the lowest oil acidity (0.46%). Besides, the highest content of boron (6.62 mg.L^{-1}) were obtained from Khodeiri cultivar. Boron sprayed with 200 mg.L^{-1} achieved the highest values of all studied parameters. Moreover, Arbequina, Ashrasi, and Picual pollinizers gave the best results. The interactions of the two factors revealed that Sorani and 200 mg.L^{-1} boron, every cultivar with Arbequina, Ashrasi, Picual and Hojiblanca pollinizers, and 200 mg.L^{-1} boron with Arbequina, Ashrasi, Picual and Hojiblanca pollinizers gave the best results. Additionally, total interaction of all the factors indicated that the combination of the either cultivar, 200 mg.L^{-1} boron and Arbequina, Ashrasi, Picual and Hojiblanca pollinizers, demonstrated the best significant results.

Keywords: Olive cultivars, Boron, Pollinizer, Self-incompatibility, Fruit set, Oil content

Introduction

Olive (*Olea europaea* L) is one of the most important fruit trees. In Iraq, olive trees grow in some areas of central North Iraq and the Kurdistan region. Number of olive orchards in the Kurdistan region is about 3000, which produce more than 4000 tons, from which 527 tons of oil are extracted, in addition to the part used for the table purpose. Annually world olive production is 21,068,691tons. Spain is the large olive producer in the world, with 5,965,080 tons. Italy comes second with 2,194,110 tons. Morocco is the third-largest country, with 1,912,238 tons (10). Olive fruit is an essential food for human because of its high nutritional value as a table olive and olive oil (19).

Blooming in olive trees is profuse with a great number of pollens. Despite this, fruit set is about 10% to 15% out of about 500000 flowers in a mature olive (8). Fruit production of olive trees is dependent to a large degree on successful fertilization, as well as endogenous and exogenous factors. One of the factors is high abortion of ovary, or barriers in reproduction, for instance, pollen sterility and self-incompatibility. The most prominent reproductive barrier is self-incompatibility which influences olive yield (24). Self-incompatibility refers to the inability of the plant to set seeds with functional pollen after self-pollination. The commercial cultivars of olive can be self-compatible, partially self-compatible, or self-incompatible (33). Mainly, olive is regarded as a partially self-incompatible, wind-pollinated fruit crop (4). To overcome self-incompatibility in olive varieties, many measurements have been applied, such as spraying with boron and cross-pollination via compatible pollinizers of olive.

Effect of boron (B) on *in vitro* pollen germination and tube elongation has been well recorded (20). It builds up in flower buds and flower parts (15). B involves in the reproductive process with reference to the findings that refer B levels are higher in floral than in vegetative tissues. Furthermore, there is a link between flowers drop and B deficiency in some fruit species (9). On the other hand, B involves in carbohydrate and hormone metabolism and translocation as well (13). As another option. Many studies have been conducted worldwide to identify the optimal pollinizers for olive cultivars using fruit set resulting from self-, open-, and cross-pollination. Ghrisi *et al*. (12) who reported that the highest fruit set rates were obtained when a certain cultivar of olive was pollinated with pollens of a compatible pollinizer.

Therefore, the purpose of this study is to determine the self and cross incompatibility of the two grown cultivars, identifying suitable pollinizers, and evaluation of boron foliar application on fruit set and some other physical properties.

Materials and Methods:

Experimental Location**:**

The study was carried out during 2020-2021 growing season at orchard of Horticulture Department, College of Agricultural Engineering Sciences, University of Sulaimani, Bakrajo, Sulaimani, Iraqi Kurdistan Region, which is located in North-East of Iraq (latitude: 35.53576 N, longitude: 45.36663 E), and an Altitude of (741 m) above sea level. The climate of the study area is generally characterized by a hot, dry summer and cold winters (25). Thus, soil texture of the study is clay.

Olive trees selection:

The experiment was conducted on twelve-year-old trees of two olive cultivars Sorani and Khodeiri, which were planted at 4 x 4 m spacing. Six trees for each cultivar were selected on the basis of blooming density branch, homogenous size, healthy status and vigour. From each tree, 16 branches were selected, labelled and treated with pollens from eight source (self and open-pollination), and cross-pollination with pollen from 6 pollinizers) in addition to foliar boron spray. To prevent unwanted pollination, before flower opening at the white bud stage, the branches were covered with white paper bags on 26th April 2021.

Pollen grain Collection:

Flowering inflorescences collected from different Olive cultivars (Arbequina, Ashrasi, Hojiblanca, K18, Picual, Kaissy) at white bud balloon stage one day before anthesis, at Bakrajo Nursery Station-Sulaimani, Kurdistan Region-Iraq, and located 15 km southwestern of Sulaimani city.

Pollinizer Selection**:**

Pollen grains were obtained at the beginning of blooming from inflorescences collected from different olive cultivars. To determine the percentage of pollen viability 1% acetocarmine was used as a colorant. Constricted and unstained pollen grains were considered to be unviable, while those which were found red-colored to be viable.

Boric acid fertilizer preparation

To prepare 200 mg.L^{-1} Boron, 1.144 g.L^{-1} of boric acid (H_3BO_3 17% Boron) were completely dissolved in 100 ml distilled water and then completed to 1L. The boric acid was sprayed twice, first directly after pollination and the second after 15 days from fruit setting.

Acetocarmine preparation (1% solution**)**

For preparing the acetocarmine solution (1%), 10 g carmine (Fisher C579-25) was dissolved in 1 L of 45% glacial acetic acid, heated on hotplate, and refluxed for 24 hours. After overnight, the solution was filtered into dark bottles and store at 4°C.

Treatments and experimental design**:**

A factorial experiment with three factors was used, as explained below

1.Two Olive cultivars (Sorani and Khodeiri).
2. Six sources of pollen grains (Arbequina, Ashrasi, Hojiblanca, K18, Kaissy, Picual) in addition to open pollination and self-pollination as control. .
3.Two boric acid concentrations (0 and 200) mg.L^{-1}.

Treatment application with pollen grains was fulfilled in the mid-flowering during the morning of 28th April and repeated during full blooming on 3th May 2021. For this purpose, 20 open inflorescences of the pollinizers were inserted for each treatment combination and covered with paper bags (6). Boric acid was carried out with pollination using hand sprayer and repeated 15 days after fruit set. The bags were shaken daily and removed at the end of the flowering period on May 6th, 2021. The experiment consisted of 32 treatment combinations (2x8x2), with six replications, one branch from each cultivar was selected as the experimental unit, and 16 branches were chosen from each cultivar. The experiment conducts in a randomized complete block design.

Studied Parameters

1-Pollen grains viability (%)

The pollen grains were collected from open flowering inflorescences, transferred onto a microscope slide by vibrating the flowers slowly, a drop of acetocarmine (1%) was added to the slide, the content was distributed uniformly, a glass cover was placed onto the slide. The percentage of the pollen grains viability was determined according to Borna *et al*. (7) by using colorimetric method.

2-Fruit set percentage (%)

The percentage of the final fruit set was calculated according to Saadati *et al*. (30): Initial fruit set: first fruit set date was calculated after abscise petals (after one week), Final fruit set was determined after the June drop. Percentage of fruit set in each treatment was calculated as follows:

$$\text{Fruit set\%} = \frac{\text{Number of fruit set}}{\text{Total number of flowers}} \times 100$$

3-Fruit dropping percentage (%):

Fruit dropping was calculated according to the following equation: Number of fruit drop = number of fruit set – number of harvested fruit,

Fruit dropping (%) = $\frac{\text{Number of Fruit drop}}{\text{Final fruit set}}$ x 100

5-Self-incompatibility index

The index of self-incompatibility was calculated as fruit set obtained by self-pollination/fruit set obtained by cross-pollination. ISI evaluated as follows: ISI = 0: completely self-incompatible, ISI = 0.1–0.2: highly self-incompatible, ISI = 0.2–0.9: partially self-incompatible, ISI≥1: completely self-compatible (40).

6-Sex expression: Calculated as follows**:**

Sex expression = $\frac{\text{Number of perfect flowers}}{\text{Number of staminate flowers}}$ x 100

The sex ratio of flowers was determined for Sorani and Khodeiri Cultivar during flowering in April (39).

7-Boron content in leaves

Twelve leaves were randomly collected from the branches on 15th of August, 2021. Boron content was determined by using Atomic Absorption Spectrophotometer (34).

8-Soluble sugar content

Soluble sugar content in prepared fine leaf powder of olive was measured following the method described by (35).

9-physical properties of fruit:

-Average of fruit weight (g)

Three olive fruits in each sample were taken and weighed with electronic precision balance, and the average weight was then calculated.

-Average of fruit size (cm^3)

Fruit size is determined according to Archimedes.

10- Oil content%

six replicates of 25 g dried fruit flesh from samples were manually ground into powder in a mortar and extracted in Soxhlet apparatus according to AOAC method (18). Cellulose thimbles (Whatman Ltd) were used to hold the samples. The tissue was extracted continuously for two and half hours using 500 ml n-hexane at 40 degrees Celsius with some modifications. Solvents mixed with oil were then evaporated by a vacuum rotary evaporator. The yield of oil extracted was expressed as a percentage of the weight of oil obtained after extraction relative to the weight of the dry sample used for extraction, as shown below:

Oil content% = $\frac{\text{weight of oil btained after extraction}}{\text{weight of dry sample}} \times 100$

11- Acid value of olive oil

The acid value was measured according to modified AOAC method (18). Samples titrated with NaOH 0.1 N. The acid value was calculated from the following equation:

Acid value = $\frac{A \times N \times 56.1}{\text{weight of sample}} \times 100$

Where A= ml of KOH solution used for titration of sample,

, N= normality of KOH solution, W= the oil weight, equivalent weight of KOH = 56.1

Statistical analysis:

All obtained data were tabulated and statically analysed with computer using XLSTAT system (1), and the means were compared according to Duncan's Multiple Range test (P≤ 0.05).

Results and Discussion

Sex ratio percentage

The average sex ratio for the Sorani cultivar was 66.90%, while the Khodeiri cultivar was 60.27%.

Pollen grains viability% of pollinizers

Figure (1) demonstrates that pollen viability differed among the cultivars. Hojiblanca had the highest viability percentage (93.09%), while Khodeiri had the lowest value (73.01%).

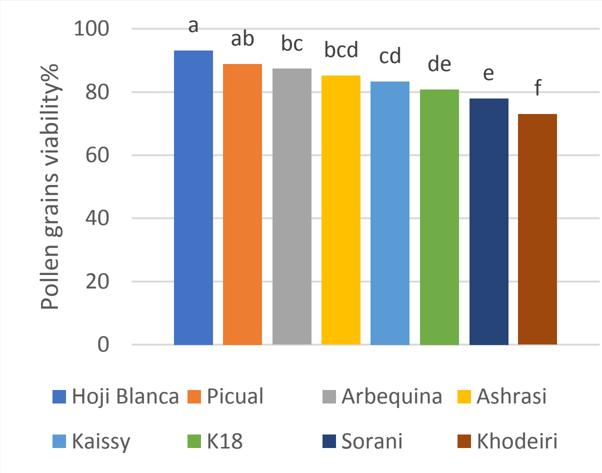

Figure 1. Pollen grains viability. The same letter indicates that there is no significant difference among cultivars according to Duncan's multiple range tests ($P<0.05$).

Self-incompatibility index

Table (1) illustrated that Sorani was a partially self-incompatible cultivar with SII = 0.59, significantly dominating Khodeiri with SII=0.51. Significant differences were shown for the impact of boron gave the highest value (0.60) at 200 mg.L^{-1} boron, compared to (0.49) for the control. Kaissy pollinizer gave the highest self-incompatibility index (0.60), which was significantly superior to Arbequina (0.47), while no significant differences were noticed for other pollinizers.

The cultivars and boron interacted significantly to improve self-incompatibility index. Sorani cultivar and 200 mg.L^{-1} boron combined gave the highest value (0.65) of self-incompatibility index, which exceeded the lowest value (0.46) for the combination of Khodeiri and the control. Also, the result shows that the highest value was recorded (0.65) at the interaction between Sorani cultivar with K18 pollinizer, which is significant to the lowest value (0.45) for Khodeiri cultivar with Arbequina pollinizer. Significant differences were obtained from the interaction effect between boron and the pollinizers on self-incompatibility index in olive. The highest value (0.70) was noted for 200 mg.L^{-1} boron with Kaissy pollinizer significantly dominated the lowest value (0.43) for 0 mg.L^{-1} boron with Arbequina pollinizer.

Sorani cultivar combined with 200 mg.L^{-1} boron and Kaissy Pollinizer gave the highest values (0.72) that significantly dominated the lowest value (0.43) for Sorani combined with both control and Arbequina pollinizer. The data from the same table indicated that cultivars and pollinizers are partially or relatively self-incompatible. The Self-incompatibility index was used to assess the degree of self-incompatibility in cultivars, meaning the higher value of ISI, the higher degree of self-compatibility.

According to Linskens, (21), the incompatibility may become apparent on the stigma so that pollen do not germinate, as in sporophytic SI (SSI), or in the style, as in gametophytic SI (GSI) when pollen tube growth is arrested in the style.

Initial fruit set percentage%

Table (2) explains that no significant differences were confirmed from the impact of the cultivars individually on initial fruit set percentage, 200 mg.L^{-1} boron gave (22.68%) was significantly superior to the control (17.69%). In this respect, Hassan (16) who stated that the improving fruit set could be explained as a result of increasing pollen grains germination and pollen tube elongation due to boron treatments. The highest value (25.52%) of initial fruit set was observed with pollinated by Ashrasi pollens that significantly exceeded to self-pollination exhibited the lowest value (12.73%) of initial fruit set. The highest value of initial fruit set (23.01%) came from Khodeiri cultivar combined with 200 mg.L^{-1} of boron which significantly dominated the lowest value (16.77%) for the combination of Sorani and control. With respect to the interaction between the cultivars and the pollinizers, the initial fruit set was affected significantly. The highest (28.47%) of initial fruit set was verified from the combination pollination of Khodeiri with Ashrasi pollens that significantly dominated the least value (12.26%) for self-pollination and Sorani combination. The highest value (28.67%) was recorded at the interaction between 200 $mg.L^{-1}$ boron and Ashrasi pollinizer, which was significantly superior to the least value (12.05%) for the combination of the control with self-pollination. The maximum value (31.07%) for initial fruit set was observed for the interaction among triple interaction, Sorani Cultivar, 200 $mg.L^{-1}$ boron and Hojiblanca pollinizer were significantly superior to most other combinations, whereas the least value (11.42%) was noticed from the interactions of self-pollination, Sorani cultivar and control. However, there are no significant differences with the highest value for some triple interactions.

Table1. Effect of cultivars, boron, different pollinizers and their interactions on self-incompatibility index in olive.

Cultivars	Boron ($mg.L^{-1}$)	Pollinizers								Cultivars x Boron	Cultivars
		Self	Open	Arbequina	Ashrasi	Hojiblanca	K18	Kaissy	Picual		
Sorani	0	-	-	0.43 c	0.47 bc	0.52 abc	0.61 abc	0.56 abc	0.56 abc	0.52 bc	0.59 a
	200	-	-	0.57 abc	0.64 abc	0.64 abc	0.68 ab	0.72 a	0.64 abc	0.65 a	
Khodeiri	0	-	-	0.44 bc	0.48 abc	0.46 bc	0.46 bc	0.45 bc	0.48 abc	0.46 c	0.51 b
	200	-	-	0.47 bc	0.58 abc	0.50 abc	0.63 abc	0.67 ab	0.53 abc	0.56 b	
Pollinizers		-	-	0.47 b	0.54 ab	0.53 ab	0.59 a	0.60 a	0.55 ab	Boron ($mg.L^{-1}$)	
Cultivars X pollinizers	Sorani	-	-	0.50 ab	0.55 ab	0.58 ab	0.65 a	0.64 a	0.60 ab		
	Khodeiri	-	-	0.45 b	0.53 ab	0.48 ab	0.54 ab	0.56 ab	0.50 ab		
Boron X pollinizers	0	-	-	0.43 d	0.47 cd	0.49 cd	0.53 bcd	0.51 bcd	0.52 bcd	0.49 b	
	200	-	-	0.52 bcd	0.61 abc	0.57 a-d	0.66 ab	0.70 a	0.59 a-d	0.60 a	

Means within individual factors and their interactions followed by the same letters are not significantly different according to Duncan multiple ranges test ($P \leq 0.05$).

Table2. Effect of cultivars, boron, different pollinizers and their interactions on initial fruit set in olive.

Cultivars	Boron (mg.L^{-1})	Pollinizers: Self	Open	Arbequina	Ashrasi	Hojiblanca	K18	Kaissy	Picual	Cultivars x Boron	Cultivars
Sorani	0	11.42 m	14.04 j-m	20.11 d-k	18.12 f-m	18.41 f-m	17.10 g-m	15.77 i-m	19.22 f-l	16.77 b	19.56 a
	200	13.10 k-m	16.13 i-m	23.77 b-h	27.02 a-d	31.07 a	21.20 c-j	22.33 c-i	24.14 b-g	22.35 a	
Khodeiri	0	12.68 lm	14.49 j-m	19.32 f-l	26.62 a-e	21.10 c-j	18.33 f-m	16.64 h-m	19.66 e-l	18.61 b	20.81 a
	200	13.74 k-m	16.92 h-m	24.90 a-f	30.32 ab	24.30 a-g	22.58 c-i	23.38 c-h	27.93 abc	23.01 a	
Pollinizers		12.73 e	15.39 e	22.03 bcd	25.52 a	23.72 ab	19.80 cd	19.53 d	22.74 abc	Boron (mg.L^{-1})	
Cultivars X pollinizers	Sorani	12.26 f	15.08 ef	21.94 bc	22.57 bc	24.74 ab	19.15 cde	19.05 cde	21.68 bc		
	Khodeiri	13.21 f	15.70 def	22.11 bc	28.47 a	22.70 bc	20.45 bc	20.01 bcd	23.80 bc		
Boron X pollinizers	0	12.05 h	14.27 gh	19.72 c-f	22.37 b-e	19.76 c-f	17.72 efg	16.20 fgh	19.44 def	17.69 b	
	200	13.42 gh	16.52 fgh	24.33 abc	28.67 a	27.69 a	21.89 b-e	22.85 bcd	26.04 ab	22.68 a	

Means within individual factors and their interactions followed by the same letters are not significantly different according to Duncan multiple ranges test ($P \leq 0.05$).

Final fruit set percentage%

Table (3) showed that the final fruit set of olive, the highest value (1.96%) was noticed for Sorani cultivar which is significantly superior to the lowest value (1.60%) for Khodeiri. The highest value (1.98%) was recorded with 200 mg.L^{-1} boron which was significantly lowest value (1.58%) for control. Indeed, the highest value (2.21%) was recorded for Arbequina pollinizer, significantly exceeded the lowest value (1.05%) for self-pollination. Interactions of the Sorani cultivars with 200 mg.L^{-1} boron gave the highest value (2.13 %), which was significantly superior to the lowest value (1.37%) for Khodeiri cultivar and the control combination. The highest value (2.47%) was recorded for the interaction between Sorani cultivar and Arbequina pollinizer, which was significant to the lowest value (0.89%) for Khodeiri cultivar and self-pollination. As illustrated in the same table, the interactions between boron and pollinizer has significant differences on the final fruit set, 200 mg.L^{-1} of boron combined Arbequina pollinizer gave the highest value (2.48%), which was significantly superior to the lowest values (0.82%) for control and self-pollination. The highest value (2.62%) was recorded for the interaction between Sorani cultivar with 200 mg.L^{-1} boron and pollination with Arbequina pollinizer were significantly superior to the lowest value (0.68%) for Khodeiri cultivar with 0 mg.L^{-1} of boron and self-pollination. Similar results have been obtained in some studies; Mangena and Mokwala (22) showed an improvement in fruit set between 10% and 30% in ‘Leccino’ when ‘Casaliva’ pollen was applied twice (between 50% and 95% of flowering) at a dose of 2 g per tree. In ‘Picual’, supplementary artificial pollination with pollen of different cultivars caused the increase the final fruit set greatly, while self-pollination failed to increase the fruit set obtained through open pollination in mixed orchards (31). Final fruit set and yield increase after free pollination and cross-pollination compared with self-pollination have also been widely reported for different olive cultivars in other regions (28). Fruit set following self-pollination was consistently lower than that obtained from cross- and open pollination, as reported in many other works in the Mediterranean region (2). Our results agree with the study of Perica *et al.* (27) who reported a significant positive effect of foliar applied boron (B) on olive fruit set. Fruit set increase after B sprays of open-pollinated olive trees might be mainly related to a positive function of B on female reproductive organs or on fertilized developing fruits.

Table 3. Effect of cultivars, boron, different pollinizers and their interactions on final fruit set in olive.

Cultivars	Boron ($mg.L^{-1}$)	Pollinizers								Cultivars x Boron	Cultivars
		Self	Open	Arbequina	Ashrasi	Hojiblanca	K18	Kaissy	Picual		
Sorani	0	0.96 kl	1.55 f-j	2.32 abc	2.10 a-f	1.89 b-h	1.85 b-h	1.81 c-i	1.82 c-i	1.79 b	1.96 a
	200	1.45 h-k	1.75 d-i	2.62 a	2.39 ab	2.30 a-d	2.14 a-e	2.09 a-f	2.26 a-e	2.13 a	
Khodeiri	0	0.68 l	1.27 ijk	1.54 f-j	1.50 g-j	1.50 g-j	1.46 h-k	1.43 h-k	1.54 f-j	1.37 c	1.60 b
	200	1.10 jkl	1.40 h-k	2.34 abc	2.03 b-g	2.22 a-e	1.80 c-i	1.73 e-i	2.13 a-e	1.84 b	
Pollinizers		1.05 d	1.49 c	2.21 a	2.01 ab	1.98 ab	1.81 b	1.77 b	1.94 b	Boron ($mg.L^{-1}$)	
Cultivars X pollinizers	Sorani	1.21 gh	1.65 def	2.47 a	2.24 ab	2.10 bc	1.99 bcd	1.95 b-e	2.04 bc		
	Khodeiri	0.89 h	1.33 fg	1.94 b-e	1.77 cde	1.86 cde	1.63 def	1.58 ef	1.83 cde		
Boron X pollinizers	0	0.82 g	1.41 ef	1.93 bcd	1.80 cd	1.70 cde	1.65 cde	1.62 c-f	1.68 cde	1.58 b	
	200	1.27 f	1.57 def	2.48 a	2.21 ab	2.26 ab	1.97 bc	1.91 bcd	2.19 ab	1.98 a	

Means within individual factors and their interactions followed by the same letters are not significantly different according to Duncan multiple ranges test ($P \leq 0.05$).

Fruit Dropping%

Table (4) illustrates that Khodeiri cultivar gave the highest value (16.41%), which is superior to the lowest value (14.78%) for Sorani. 200 $mg.L^{-1}$ of boron (14.28%) was significantly lower than the control (16.91%) fruit dropping. The present data agree with the findings by Talaie *et al*. (36) on olive, who reported that foliar spray of boron increased the final fruit set. This might be due to roles of boron in reducing nutrients competition among fruitlets and hormonal balance and thus preventing fruit drop and increased their survival. Talaie *et al*. (36) showed that foliar spray of B decreased fruit drop and increased fruit quality in the 'Zard' olive. Several authors reported that B is required for fruit retention (30). The lowest fruit dropping (11.87%) for Picual pollinizer was significantly to self-pollination, gave the highest values (22.53%) of fruit dropping.

The interaction effects of the cultivars with boron gave the best low value (13.56%) of fruit dropping for Sorani cultivar and 200 mg.L^{-1} boron, which exceeded the other combinations significantly; the highest value (17.83%) of fruit dropping was observed from the interaction between Khodeiri cultivar with the control. The lowest value (11.12%) for fruit dropping was recorded for Sorani cultivar and Picual pollinizer combination that significantly superior to Khodeiri cultivar and self-pollination gave the highest values (23.53%) of fruit dropping. In addition, significant differences were confirmed for the interaction of boron and the pollinizers. The lowest value (10.38%) of fruit dropping was observed for the interaction between 200 mg.L^{-1} boron and Picual pollinizer, which exceeded the other combination significantly, whereas the highest value (24.46%) of fruit dropping was obtained at the interaction between control and self-pollination.

With regard to triple interactions, the lowest (9.22%) of fruit dropping was observed for Sorani cultivar combined with both 200 mg.L^{-1} boron and Picual pollinizer, which is different significantly from most other combinations, the highest value (25.56%) resulted in the interaction between self-pollination of Khodeiri cultivar and control.

Table 4. Effect of cultivars, boron, different pollinizers and their interactions on fruit dropping % in olive.

Cultivars	Boron (mg.L^{-1})	Pollinizers								Cultivars x Boron	Cultivars
		Self	Open	Arbequina	Ashrasi	Hojiblanca	K18	Kaissy	Picual		
Sorani	0	23.37 ab	17.89 b-f	15.38 c-h	14.47 d-h	12.32 fgh	15.74 c-h	15.75 c-h	13.03 e-h	15.99 ab	14.78 b
	200	19.68 a-e	15.83 c-h	13.30 d-h	11.73 fgh	10.58 gh	14.11 d-h	14.06 d-h	9.22 h	13.56 c	
Khodeiri	0	25.56 a	20.33 a-d	15.71 c-h	13.49 d-h	17.82 b-f	18.54 b-f	17.51 b-g	13.69 d-h	17.83 a	16.41 a
	200	21.50 abc	18.12 b-f	12.63 e-h	11.96 fgh	15.96 c-h	14.27 d-h	13.89 d-h	11.55 fgh	14.99 bc	
Pollinizers		22.53 a	18.04 b	14.26 cd	12.91 cd	14.17 cd	15.66 bc	15.30 bc	11.87 d	Boron (mg.L^{-1})	
Cultivars X pollinizers	Sorani	21.53 ab	16.86 cd	14.34 de	13.10 de	11.45 e	14.92 cde	14.90 cde	11.12 e		
	Khodeiri	23.53 a	19.23 bc	14.17 de	12.72 de	16.89 cd	16.41 cd	15.70 cde	12.62 de		
Boron X pollinizers	0	24.46 a	19.11 bc	15.55 cde	13.98 def	15.07 c-f	17.14 bcd	16.63 b-e	13.36 def	16.91 a	
	200	20.59 ab	16.98 bcd	12.97 def	11.85 ef	13.27 def	14.19 def	13.97 def	10.38 f	14.28 b	

Means within individual factors and their interactions followed by the same letters are not significantly different according to Duncan multiple ranges test ($P \leq 0.05$).

Fruit Weight

Data presented in table (6) explained that the highest value of fruit weight (2.64 g) was recorded for Sorani cultivar, which is significantly superior to Khodeiri (2.29 g). The highest value (2.72 g) was observed from the Hojiblanca pollinizer, which was significant to the lowest value (2.12 g) for self-pollination. Different olive fruit weights were shown at 200 mg.L^{-1} of boron gave the highest value (2.64 g) that significantly exceeded the lowest value (2.30 g) for the control. .

The interaction between Sorani cultivar and 200 mg.L^{-1} boron recorded the highest (2.78 g) fruit weight which was significantly superior to Khodeiri and control combinations that recorded the lowest (2.10 g) fruit weight. In addition, cultivar combined with Hojiblanca pollinizer gave the highest value (3 g), significantly superior to Khodeiri cultivar and self-pollination gave the lowest value (2 g). On the other hand, 200 mg.L^{-1} boron combined with Hojiblanca gave the highest value (2.94 g), significantly dominated by control and self-pollination, which gave the lowest value (1.98 g).

The interaction of three factors showed that the highest (3.18 g) fruit weight recorded at the combination of Sorani cultivar, 200 mg.L^{-1} boron and Hojiblanca Pollinizer, which was superior to most other combinations; whereas the lowest (1.80 g) fruit weight was recorded from self-pollination, control and Khodeiri cultivar and. Our results are in line with finding (3).

Table 5. Effect of cultivars, boron, different pollinizers and their interactions on olive fruit weight (g).

Cultivars	Boron (mg.L^{-1})	Pollinizers: Self	Open	Arbequina	Ashrasi	Hojiblanca	K18	Kaissy	Picual	Cultivars x Boron	Cultivars
Sorani	0	2.16 lmn	2.19 k-n	2.51 d-k	2.78 b-e	2.83 bcd	2.44 e-l	2.34 g-m	2.74 c-f	2.50 b	2.64 a
	200	2.32 g-m	2.42 f-l	2.96 abc	3.06 ab	3.18 a	2.66 c-g	2.57 d-i	3.08 ab	2.78 a	
Khodeiri	0	1.80 o	1.94 no	2.29 h-m	2.21 j-n	2.18 k-n	2.06 mno	2.16 lmn	2.13 lmn	2.10 c	2.29 b
	200	2.20 j-n	2.27 i-n	2.53 d-j	2.65 c-g	2.70 c-f	2.44 f-l	2.52 d-k	2.61 d-h	2.49 b	
Pollinizers		2.12 c	2.20 c	2.57 a	2.68 a	2.72 a	2.40 b	2.40 b	2.64 a	Boron (mg.L^{-1})	
Cultivars X pollinizers	Sorani	2.24 ef	2.30 ef	2.73 bc	2.92 ab	3.00 a	2.55 cd	2.45 de	2.91 ab		
	Khodeiri	2.00 g	2.10 fg	2.41 de	2.43 de	2.44 de	2.25 ef	2.34 de	2.37 de		
Boron X pollinizers	0	1.98 f	2.06 ef	2.40 cd	2.50 c	2.51 c	2.25 de	2.25 de	2.43 cd	2.30 b	
	200	2.26 de	2.34 cd	2.75 ab	2.86 a	2.94 a	2.55 bc	2.54 bc	2.85 a	2.64 a	

Means within individual factors and their interactions followed by the same letters are not significantly different according to Duncan multiple ranges test ($P \leq 0.05$).

Fruit Size (cm^3)

Data presented in table (7) showed that Sorani cultivar recorded a maximum fruit size (2.51 cm^3) that was significantly superior to Khodeiri (2.24 cm^3). Moreover, significant differences were shown for the effect of 200 mg.L^{-1} boron had the highest value (2.57 cm^3) and significantly exceeded the lowest value (2.17 cm^3) for control. On the other hand, the Picual Pollinizer demonstrated the highest value of fruit size (2.67 cm^3), which was significantly superior to the lowest value (1.98 cm^3) for self-pollination.

The highest value (2.66 cm^3) was verified for the interaction between Sorani cultivar and 200 $mg.L^{-1}$ boron, which is significantly superior to other combinations with the lowest value (1.99 cm^3) for Khodeiri cultivar and the control. Additionally, the highest value (2.88 cm^3) was observed for the interaction between Sorani cultivar and Picual pollinizer, which significantly dominated the lowest value (1.90 cm^3) for Khodeiri and self-pollination. Finally, the highest value (2.99 cm^3) was recorded for the interaction between 200 $mg.L^{-1}$ boron with Picual Pollinizer, which differed significantly from the lowest value (1.80 cm^3) for the control combined with self-pollination. The highest value (3.17 cm^3) of fruit size was recorded for the interaction among Sorani cultivar, 200 $mg.L^{-1}$ boron and Picul Pollinizer, which is significantly superior to the lowest value (1.65 cm^3) verified for the interaction among Khodeiri cultivar, control, and self-pollination. In olive, fruit size differs greatly among cultivars (3). Both the endocarp and mesocarp contribute to final fruit size differences among cultivars (14). Fruit size differences among cultivars are mostly due to cell number, while cell size tends to be similar, although fruit growth, from the ovary to the mature fruit, is due in mostly to cell expansion than to cell division (14).

Table 6. Effect of cultivars, boron, different pollinizers and their interactions on olive fruit size (cm^3).

Cultivars	Boron ($mg.L^{-1}$)	Pollinizers: Self	Open	Arbequina	Ashrasi	Hojiblanca	K18	Kaissy	Picual	Cultivars x Boron	Cultivars
Sorani	0	1.94 h-k	2.08 e-k	2.43 c-i	2.65 a-e	2.55 b-f	2.34 c-j	2.29 c-j	2.60 b-f	2.36 b	2.51 a
	200	2.18 d-k	2.27 c-j	2.73 a-d	3.09 ab	2.76 a-d	2.56 b-f	2.54 b-g	3.17 a	2.66 a	
Khodeiri	0	1.65 k	1.84 jk	1.92 ijk	2.18 d-k	1.96 g-k	2.21 d-k	2.04 f-k	2.11 e-k	1.99 c	2.24 b
	200	2.14 e-k	2.07 e-k	2.59 b-f	2.57 b-f	2.76 a-d	2.42 c-i	2.50 c-h	2.82 abc	2.48 b	
Pollinizers		1.98 d	2.06 d	2.42 bc	2.62 ab	2.51 abc	2.39 bc	2.34 c	2.67 a	Boron ($mg.L^{-1}$)	
Cultivars X pollinizers	Sorani	2.06 efg	2.17 d-g	2.58 abc	2.87 a	2.65 ab	2.45 bcd	2.41 b-e	2.88 a		
	Khodeiri	1.90 g	1.95 fg	2.25 c-g	2.38 b-e	2.36 b-e	2.32 b-f	2.27 b-g	2.46 bcd		
Boron X pollinizers	0	1.80 g	1.96 fg	2.17 efg	2.42 cde	2.26 ef	2.28 ef	2.16 efg	2.35 de	2.17 b	
	200	2.16 efg	2.17 efg	2.66 a-d	2.83 ab	2.76 abc	2.49 b-e	2.52 b-e	2.99 a	2.57 a	

Means within individual factors and their interactions followed by the same letters are not significantly different according to Duncan multiple ranges test ($P \leq 0.05$).

Table 7. Effect of cultivars, boron, different pollinizers and their interactions on boron content ($mg.kg^{-1}$) in olive leaf nutrient.

Cultivars	Boron (mg.L^{-1})	Pollinizers								Cultivars x Boron	Cultivars
		Self	Open	Arbequina	Ashrasi	Hojiblanca	K18	Kaissy	Picual		
Sorani	0	2.31 y	3.47 u	5.68 k	8.54 g	2.78 w	2.98 v	3.89 s	3.65 t	4.16 d	4.95 b
	200	4.98 n	3.65 t	5.64 l	9.37 e	5.64 l	4.57 o	6.54 j	5.47 m	5.73 b	
Khodeiri	0	2.98 v	4.36 p	4.25 q	9.10 f	3.87 s	2.65 x	3.98 r	10.19 c	5.17 c	6.62 a
	200	5.65 l	5.65 l	9.65 d	11.20 a	5.64 l	7.54 i	8.36 h	10.84 b	8.07 a	
Pollinizers		3.98 h	4.28 g	6.31 c	9.55 a	4.48 e	4.44 f	5.69 d	7.54 b	Boron (mg.L^{-1})	
Cultivars X pollinizers	Sorani	3.65 o	3.56 p	5.66 f	8.96 c	4.21 m	3.77 n	5.21 g	4.56 k		
	Khodeiri	4.32 l	5.01 i	6.95 d	10.15 b	4.76 j	5.10 h	6.17 e	10.52 a		
Boron X pollinizers	0	2.65 p	3.92 m	4.97 j	8.82 b	3.33 n	2.82 o	3.94 l	6.92 f	4.67 b	
	200	5.32 i	4.65 k	7.65 d	10.29 a	5.64 h	6.06 g	7.45 e	8.15 c	6.90 a	

Means within individual factors and their interactions followed by the same letters are not significantly different according to Duncan multiple ranges test ($P \leq 0.05$).

Boron content (mg.Kg^{-1})

As shown in table (7), the highest value (6.62 mg.Kg^{-1}) of leaf boron content was achieved for Khodeiri cultivar, which is significantly superior to the lowest value (4.95 mg.Kg^{-1}) for Sorani cultivar. Application of boron at 200 mg.L^{-1} caused a significant increase in olive leaf boron concentration (6.90 mg.Kg^{-1}) which is significantly superior to (4.67 mg.Kg^{-1}) for the control as the lowest value. Pollinizers significantly affected olive leaf boron; the highest value (9.55 mg.Kg^{-1}) from pollination by Ashrasi exceeded the lowest value (3.98 mg.Kg^{-1}) significantly for self-pollination.

Khodeiri cultivar with 200 mg.L^{-1} boron gave the highest value (8.07 mg.Kg^{-1}) of olive leaf boron content, significantly dominating the lowest value (4.16 mg.Kg^{-1}) for Sorani cultivar and control combination. Khodeiri cultivar pollinated with Picual pollinizer got the highest value (10.52 mg.Kg^{-1}) of leaf boron content which was significantly superior to the lowest value (3.65 mg.Kg^{-1}) for Sorani and self-pollination. Significant differences were also observed for the interaction impact between boron and pollinizer on olive leaf boron content; the highest value (10.29 mg.Kg^{-1}) was verified for the interaction between 200 mg.L^{-1} With Ashrasi Pollinizer, which was superior to the lowest value (2.65 mg.Kg^{-1}), was also detected for self-pollination with the control. Khodeiri cultivar was pollinated with Ashrasi pollinizer and treated with 200 mg.L^{-1} boron gave the highest values (11.20 mg.Kg^{-1}) of boron content, which significantly dominated the lowest content of boron (2.31 mg.Kg^{-1}) for self-pollination of Sorani with the control. An increase in the boron concentration in the leaf following the application of boron, has been reported in olive (27). These results agree with results obtained by Genaidy *et al*. (11).

Table 8. Effect of cultivars, boron, different pollinizers and their interactions on the soluble sugar content (µg/g DW) in olive.

Cultivars	Boron ($mg.L^{-1}$)	Pollinizers: Self	Open	Arbequina	Ashrasi	Hojiblanca	K18	Kaissy	Picual	Cultivars x Boron	Cultivars
Sorani	0	154.40 n	176.32 gh	167.57 jk	160.27 lmn	181.46 fg	166.44 jkl	208.93 bc	175.08 ghi	173.81 d	185.74 a
	200	190.41 de	172.30 hij	275.29 a	189.07 de	193.60 d	169.12 ij	210.16 b	181.46 fg	197.68 a	
Khodeiri	0	180.95 fg	157.39 mn	175.08 ghi	202.86 c	189.69 de	176.52 gh	161.60 klm	177.65 gh	177.72 c	183.79 b
	200	192.26 d	174.47 ghi	177.65 gh	209.34 bc	193.91 d	185.37 ef	178.07 gh	207.80 bc	189.86 b	
Pollinizers		179.51 d	170.12 f	198.90 a	190.39 b	189.67 b	174.36 e	189.69 b	185.50 c	Boron ($mg.L^{-1}$)	
Cultivars X pollinizers	Sorani	172.41 gh	174.31 fg	221.43 a	174.67 fg	187.53 d	167.78 i	209.55 b	178.27 ef		
	Khodeiri	186.60 d	165.93 i	176.37 fg	206.10 b	191.80 c	180.95 e	169.84 hi	192.73 c		
Boron X pollinizers	0	167.67 gh	166.85 h	171.33 fg	181.56 d	185.58 d	171.48 fg	185.27 d	176.37 e	175.76 b	
	200	191.34 c	173.38 ef	226.47 a	199.21 b	193.76 c	177.24 e	194.12 c	194.63 c	193.77 a	

Means within individual factors and their interactions followed by the same letters are not significantly different according to Duncan multiple ranges test ($P \leq 0.05$).

Leaf content of soluble sugar (µg/g DW)

Table (1) showed that cultivars significantly impacted soluble sugar content in olive leaves. The highest value (185.74 µg/g DW) was recorded in Sorani cultivar, which is significantly superior to the lowest value (183.79 µg/g DW) for Khodeiri cultivar. Boron caused significant differences at 200 $mg.L^{-1}$ boron which gave the highest value (193.77 µg/g DW), which significantly dominated the lowest value (175.76 µg/g DW) for the control. These results agreed with those obtained by Hegazi *et al*. (17). This increase in sugar content could be due to boron involvement in sugar transport (23). Perica *et al*. (26) suggested that boron transportation in the phloem is facilitated by the sugar mannitol, and it is transported as mannitol-B complex in olive. Pollinizers showed a significant effect on soluble sugar content; cross-pollination with arbequina pollinizer gave the highest value (198.90 µg/g DW), which was significantly superior to the lowest value (170.12 µg/g DW) was recorded for open pollination. Regarding the interaction between Sorani and 200 $mg.L^{-1}$ boron recorded the highest value (197.68 µg/g DW) that significantly dominated Sorani and the control interaction as the lowest value (173.81 µg/g DW). Interaction between the cultivars and pollinizers significantly impacted olive leaf soluble sugar contents. Sorani and Arbequina got the highest value (221.43 µg/g DW), significantly superior to Khodeiri, and open pollination gave the lowest value (165.93 µg/g DW). The highest soluble sugar content value (226.47 µg/g DW) was verified at 200 $mg.L^{-1}$ boron and Arbequina pollinizer, which significantly exceeded the lowest value (166.85 µg/g DW) for the control and open- pollination.

In addition, interaction among three factors, Sorani was pollinated with Arbequina and sprayed with 200 mg.L^{-1} boron gave the highest soluble sugar content value (275.29 µg/g DW), which significantly dominated the lowest value (154.40 µg/g DW) achieved from Sorani with self-pollination and the control combination. These results may be because boron is an essential micro-element required for growth and development of vascular plants, with essential roles in plants metabolism, cell division, and sugar transport and hormone regulation. Another possible role attributed to boron is carbohydrate translocation as sucrose, inside the plant organs, is also considered a nutrient that increases the phloem carbohydrate movement (23).

Table 9. Effect of cultivars, boron, different pollinizers and their interactions on oil content percentage on dry weight (%).

Cultivars	Boron (mg.L^{-1})	Pollination sources: Self	Open	Arbequina	Ashrasi	Hojiblanca	K18	Kaissy	Picual	Cultivars x Boron	Cultivars
Sorani	0	35.32 jk	36.93 g	37.95 f	39.96 bc	38.11 f	38.48 ef	36.07 hij	39.03 de	37.73 b	38.81 a
	200	38.46 ef	39.33 cd	41.70 a	40.20 b	41.40 a	39.01 de	38.02 f	40.95 a	39.88 a	
Khodeiri	0	30.35 p	31.09 o	34.01 l	33.23 m	36.66 gh	33.05 mn	34.09 l	33.08 mn	33.20 d	34.39 b
	200	32.33 n	34.68 kl	36.16 ghi	35.42 ijk	38.17 f	36.77 gh	35.57 ij	35.60 ij	35.59 c	
Pollinizers		34.12 f	35.51 e	37.45 b	37.20 bc	38.59 a	36.83 c	35.94 d	37.17 bc	Boron (mg.L^{-1})	
Cultivars X pollinizers	Sorani	36.89 d	38.13 c	39.82 a	40.08 a	39.76 a	38.75 b	37.05 d	39.99 a		
	Khodeiri	31.34 h	32.88 g	35.08 e	34.32 f	37.42 d	34.91 e	34.83 ef	34.34 f		
Boron X pollinizers	0	32.84 k	34.01 j	35.98 g	36.59 f	37.39 de	35.77 gh	35.08 i	36.06 g	35.46 b	
	200	35.40 hi	37.00 ef	38.93 b	37.81 cd	39.78 a	37.89 cd	36.80 f	38.28 c	37.73 a	

Means within individual factors and their interactions followed by the same letters are not significantly different according to Duncan multiple ranges test ($P \leq 0.05$).

Oil content percentage/DW

Table (9) clarifies that the maximum value (38.81%) was recorded for Sorani cultivar, which is significant to the minimum value (34.39%) of oil percentage of olive fruit pulp for Khodeiri. Significant differences were also observed for the impact of boron on oil content percentage, in which boron 200 mg.L^{-1} gave the maximum value (37.73 %), which significantly dominated the lowest value (35.46%). The positive effect of foliar boron spray-on olive oil content has been reported previously (29). The results agree with Weisman *et al*. (38) who found a significant increase in oil yield due to boron treatment. Also, year and boron treatments significantly affected oil content and yield (37). Hojiblanca pollinizer gave the maximum value (38.59%) of oil content percentage, which is significantly superior to the minimum value (34.12%) for self-pollination. According to table (9), Sorani cultivar and 200 mg.L^{-1} boron combination caused the maximum value (39.88%), which significantly dominated Khodeiri cultivar with the control interactions as the minimum value (33.20%). Furthermore, Sorani cultivar pollinated with the pollens of Ashrasi brought about the maximum value (40.08%), which is superior to self-pollination and Khodeiri cultivar combination that recorded the minimum value (31.34%).

Hojiblanca pollinizer treated with 200 mg.L^{-1} provided the maximum value (39.78%) that was significantly exceeded to self-pollination with 0 mg.L^{-1} boron interactions as the minimum value (32.84%) of oil content percentage. As shown in the same table, the interaction among the three factors caused a significant impact on oil content percentage. Sorani cultivar sprayed with 200 mg.L^{-1} boron and pollinated with Arbequina pollinizer verified the maximum value (41.70%), which is significantly superior to the minimum value (30.35%) for the combination of self-pollination of Khodeiri cultivar and control. Sayyad *et al*. (32) revealed that foliar application with boric acid at 2000 mg.L^{-1} gave the highest fruit oil percentage compared with other treatments. Similarly, Oil yield increased with increasing fruit load as a result of applying 200 mg.L^{-1}.

Oi acidity (%)

Table (10) explains that the lowest (0.46%)

oil acidity was obtained from Sorani cultivar, while the highest (0.53%) oil acidity was recorded for Khodeiri cultivar. Oil acidity significantly decreased with the foliar boron application. The lowest value (0.44%) of oil acidity was observed at 200 mg.L^{-1} boron, whereas the highest value (0.55%) was recorded at 0 mg.L^{-1} boron. The stability of olive oil is strongly attributed to the acidic profile and nutritional value. Palmitic acid and oleic acid values were influenced in opposite trends by 105 mg.L^{-1} boron treatment. Palmitic acid is a major undesirable saturated, and oleic acid is the most important monounsaturated fatty acids in olive oil (5). Regarding the effect of the pollinizers, significant effects was found on oil acidity; Kaissy pollinizer exhibited the highest, worst (0.53%) oil acidity, whereas Arbequina pollinizer verified the best and the least value (0.42%) oil acidity. Sorani cultivar was treated with 200 mg.L^{-1}boron produced the best value (0.39%) oil acidity, while the highest value (0.57%) was obtained from Khodeiri cultivar without boron application (0 mg.L^{-1}). Moreover, the highest (0.56%) oil acidity was obtained from Khodeiri cultivar with self-pollination, but the lowest value (0.35 %) was detected from Sorani cultivar with open pollination. Dual interaction between boron and the pollinizers caused significant effects on oil acidity (%). Pollination by Arbequina pollens and spraying with 200 mg.L^{-1} boron gave the lowest value (0.39%) which was the best value of oil acidity, whereas the highest value (0.60%) was discerned at the combination of self-pollination and spraying with 0 mg.L^{-1}.

In the same table, it is clear that significant differences were recorded at the combination of all the three factors. The least (0.34%) oil acidity was observed at the interaction between Sorani cultivar, 200 mg.L^{-1} boron and Arbequina pollinizer, whereas the highest (0.61%) oil acidity was noticed from the interactions of Sorani cultivar self-pollination without boron.

Table 10. Effect of cultivars, boron, different pollinizers and their interactions on oil acidity in olive.

Culti	Boro	Pollinizers	Culti	Culti

		Self	Open	Arbequina	Ashrasi	Hojiblanca	K18	Kaissy	Picual		
Sorani	0	0.58 abc	0.45 h-k	0.36 lm	0.50 d-h	0.59 ab	0.59 ab	0.57 abc	0.58 abc	0.53 b	0.46 b
	200	0.39 klm	0.41 i-l	0.34 m	0.39 j-m	0.37 lm	0.39 j-m	0.46 ghi	0.38 lm	0.39 d	
Khodeiri	0	0.61 a	0.59 ab	0.52 c-g	0.58 abc	0.55 b-e	0.57 abc	0.58 abc	0.56 a-d	0.57 a	0.53 a
	200	0.52 c-g	0.48 e-h	0.45 hij	0.48 e-h	0.48 fgh	0.53 b-f	0.52 c-g	0.47 f-i	0.49 c	
Pollinizers		0.53 ab	0.48 c	0.42 d	0.49 c	0.50 bc	0.52 ab	0.53 a	0.50 bc	Boron ($mg.L^{-1}$)	
Cultivars X pollinizers	Sorani	0.49 de	0.35 g	0.43 f	0.45 ef	0.48 de	0.49 cde	0.51 bcd	0.48 de		
	Khodeiri	0.56 a	0.54 ab	0.49 de	0.53 abc	0.51 bcd	0.55 ab	0.55 ab	0.52 bcd		
Boron X pollinizers	0	0.60 a	0.52 cd	0.44 f	0.54 bc	0.57 ab	0.58 ab	0.57 ab	0.57 ab	0.55 a	
	200	0.46 ef	0.45 ef	0.39 g	0.44 f	0.42 fg	0.46 ef	0.49 de	0.42 fg	0.44 b	

Means within individual factors and their interactions followed by the same letters are not significantly different according to Duncan multiple ranges test ($P \leq 0.05$).

Conclusions:

Based on the data obtained from our study, the following conclusions and recommendations could be stated.

1-Arbequina, Ashrasi, and Picual pollinizer improved the most characteristic of the olive fruit. .
2- Sorani cultivar gave the best results with regard to relatively all the characteristics compared to Khodeiri. Sorani interacted with 200 $mg.L^{-1}$ and different pollinizers obtained the highest values for the characteristics.
3- The application of boron at 200 $mg.L^{-1}$ increased all parameters in the studied characteristics.
4- These results confirm the possibility of improving olive yield by pollination with a suitable pollinizer at the flowering stage.
5-It could be drawn from this study that Sorani and Khodeiri cultivars have partially self-incompatibility.

Conflict of interest

The authors have no conflict of interest.

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