

Synergistic Effects of Biofertilization and Foliar Boron Application on Reproductive Performance, Yield, and Fruit Quality of Olive (*Olea europaea* L.) Trees

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Abstract

Olive trees (*Olea europaea* L.) are among the most important fruit crops in semi-arid regions; however, their productivity is often limited by inadequate nutrient management during the flowering period. This study was conducted during the 2025 growing season in Dibis District, Kirkuk Governorate, Iraq, to evaluate the effects of biofertilizer and foliar boron application, individually and in combination, on flowering characteristics, yield, and fruit quality of olive trees. A field experiment was arranged in a randomized complete block design (RCBD) using three levels of biofertilizer (0, 10, and 20 mL L⁻¹) and three levels of foliar boron (0, 50, and 100 mg L⁻¹). The results revealed significant effects of both factors and their interaction on all studied parameters. The application of 20 mL L⁻¹ biofertilizer significantly improved flowering traits, yield components, fruit physical characteristics, oil content, and total soluble solids compared with the control treatment. Likewise, foliar spraying with 100 mg L⁻¹ boron enhanced reproductive efficiency, fruit set, and overall fruit quality. The combined application of 20 mL L⁻¹ biofertilizer and 100 mg L⁻¹ boron produced the highest values for most measured traits, indicating a strong synergistic effect. This response was attributed to enhanced microbial activity in the rhizosphere, improved nutrient availability and uptake, better carbohydrate translocation, and the positive role of boron in reproductive and metabolic processes. Consequently, the combined treatment reduced flower and fruit abscission and improved source–sink relationships. The findings suggest that integrating biofertilizer with foliar boron application is an effective and environmentally sustainable strategy for improving olive yield and fruit quality under semi-arid conditions.

Keywords: Biofertilizer; Boron; Foliar application; Fruit quality; Olive Tree.

1.Introduction

Olive trees (*Olea europaea* L.) are highly valued evergreen trees in the Oleaceae family that have high value both economically and nutritionally. They are able to grow in extremely adverse environmental conditions, particularly drought and high salinity in the soil, which has allowed for their successful cultivation in arid and semi-arid areas, thereby making them one of the major agricultural crops grown there (1,2). Olive production is

mostly located at latitude 30–45°N worldwide, where environmental conditions are conducive to reproductive development of olives. While olives are grown all over the world, there are many regions, including Iraq, where yields are below optimum due to a lack of advancements in orchard management practices and, in particular, with regard to nutrient/fertilizer management practices (3,4). Flowering and fruiting in olive trees are dramatically impacted by the

nutritional status of an olive tree during flowering and fruit set. The amounts and ratios of the macro and micronutrients available to an olive tree will have a tremendous influence on determining the density of flowers, efficiency of fruit set, and development and quality characteristics of mature olives (5,6). Boron is a crucial micronutrient for reproductive processes in many plants, including being important for the maintenance of pollen viability, the support of successful pollen germination, and the stimulation of pollen tube growth—all three of these things are necessary for successful fertilization and the optimization of fruit set (7,8,9, and 10). If there is not enough boron available to the plant; however, these processes will be negatively impacted, so that there will be less successful flowering, resulting in higher rates of flower/young fruit drop and decreased yield and fruit quality (11,12). Additionally, the use of biofertilizers has gained significant interest as a sustainable method to improve soil health and point to an increase in microbial activity. These inputs, by providing nitrogen fixation, phosphorus mobilization, and plant growth-promoting substances, produce greater availability of nutrients within the soil, increasing the efficiency at which nutrient uptake occurs (13,14, and 15). The improvement of both vegetative and reproductive development through internal

physiological function and nutrient assimilation has been evident from the effectiveness of applying their binocular (16,17). The combination of improved nutrition and enhanced photosynthesis also results in increased accumulation of carbohydrates necessary for long term growth; thus, allowing fruit/vegetative parts and greater yield and quality to develop (18,19). Recent literature highlights the synergistic value of bio-fertilization coupled with micronutrients in order to provide an integrated approach to yield/quality improvement of fruits/vegetation of perennial crops (20,21,22, and 23). Research on the combined application of bio-fertilizer and foliar-applied boron in olive trees is currently very limited. The factors that control reproductive traits, yield parameters, and various fruit quality parameters (such as total soluble solids and oil concentration) have not been thoroughly studied and understood in their totality on a physiological level and how they interact together (24,25). Therefore, the purpose of this study will be to evaluate bio-fertilizers and foliar application of Boron combined with regard to their effects on production parameters, yield, and fruit quality for olive trees, and also to understand the physiological means of achieving improved productivity under the local environmental scenario.

2. Material and Methods

2.1 Experimental Site:

The study was conducted in an olive orchard belonging to the Dibis Dam Project, located in Dibis District, Kirkuk Governorate, Iraq (35.68° N latitude, 44.11° E longitude), at an elevation of 247.5 m above sea level. The experiment was carried out from March 19 to December 31, 2025.

2.2 Plant Material and Experimental Setup:

The experiment was performed on olive trees (*Olea europaea* L.) cv. Sorani, a dual-purpose cultivar (oil and table) characterized by its tolerance to adverse environmental conditions and relatively low alternate bearing. A total of 54 trees, 11 years old and as uniform as possible in vigor and growth, were selected. Trees were spaced at 4 × 4 m.

2.3 Soil Analysis:

Soil samples were collected from five points across the experimental field in an X-shaped pattern at a depth of 0–30 cm. The samples were analyzed at the Kirkuk Directorate of Agriculture laboratory. The physical and chemical properties of the soil are presented in Table 1.

Table 1. Selected physical and chemical properties of the experimental soil

Property	Unit	Value
EC	Ms.cm ⁻¹	0.290
PH	—	8.135
TDS	mg L ⁻¹	185.674
Total N	mg kg ⁻¹	1793.280
Available P	mg kg ⁻¹	3.079
Available K	mg kg ⁻¹	235.102
Organic matter	%	1.104
Texture	—	Silt loam
Clay	%	2
Silt	%	60
Sand	%	38

Soil analysis was performed at the Kirkuk Directorate of Agriculture laboratory.

2.4 Experimental Treatments:

The experiment included two factors:

1. Biofertilizer (soil application): Applied at three levels (0, 10, and 20 mL L⁻¹), in two equal doses on May 1 and June 1.

2. Foliar boron application: Boron was applied as boric acid at concentrations of 0, 50, and 100 mg L⁻¹. Foliar spraying was conducted in three applications:

First spray: at the onset of flowering (May 1), Second spray: 21 days after the first, and Third spray: 21 days after the second. Spraying was carried out in the early morning until full wetting of the canopy. Control trees were sprayed with distilled water only.

2.5 Cultural Practices:

All standard orchard management practices were uniformly applied to all experimental units, including tillage, weeding, drip irrigation, and pest control as required.

2.6 Experimental Design and Statistical Analysis:

The experiment used an RCBD factorial design to study biofertilizer and boron, replicated three times. There was a total of 54 trees, the experimental unit being two trees. The data were analyzed using ANOVA in SAS software (26) using the RCBD analysis method. Duncan's Multiple Range Test (DMRT) was used to separate treatment means at a probability of $P \leq 0.05$ according to the method described by (27).

2.7 Studied Traits:

2.7.1 Flowering Growth Traits:

Number of Flowers per Inflorescence (flower cluster⁻¹): Twenty inflorescences were randomly selected from each experimental unit (across three replicates), and the number of flowers per inflorescence was recorded.

Flowering-to-fruit set duration (days): Calculated as the number of days from 75% flowering to the onset of fruit set.

2.7.2 Fruit Quantitative and Qualitative Traits:

Average Fruit Weight (g fruit⁻¹): Determined by weighing 30 randomly selected fruits per experimental unit using a precision balance.

Average Yield per Tree (kg tree⁻¹): Estimated by multiplying the average fruit weight by the total number of fruits per tree.

Average Fruit Volume (cm³): Measured for 10 fruits using the water displacement method.

Fruit Length (mm, measured at mid-fruit position) Measured for 30 fruits using a digital Vernier caliper.

Fruit Diameter (mm): Measured using the same instrument and method.

Oil content (%): Determined using a Soxhlet extraction system with hexane at 60–80°C.

Total soluble solids (TSS %):
Measured using a refractometer after extracting juice from 20 fruits.

3. Result:

3.1 Flowering Growth Traits

3.1.1 Number of Flowers per Inflorescence (flower cluster⁻¹):

According to Table 2, the number of flowers per inflorescence showed a statistically significant increase when biofertilizers were applied at different rates. The treatment applied at the rate of 20 mL L⁻¹ produced the greatest mean

number of clusters with 16.85 flowers in each cluster compared to the controls.

In addition, foliar applications containing boron as a treatment with a concentration of 100 mg L⁻¹ significantly increased the number of flowers per cluster 14.97 flowers compared to the untreated control. There was also a significant interaction effect on flower cluster number when combining biofertilizer and boron levels, with the maximum number of flowers per inflorescence from the combination of biofertilizer 20 mL L⁻¹ and boron 100 mg L⁻¹ resulting in 18.37 flowers per inflorescence.

Table 2. Effects of biofertilizer and foliar boron on number of flowers per Inflorescence in olive trees.

Biofertilizer (mL L ⁻¹)	Boron (mg L ⁻¹)			Mean of Biofertilizer
	0	50	100	
0	10.07 i	11.15 h	11.99 g	11.07 c
10	12.95 f	13.73 e	14.56 d	13.75 b
20	15.43 c	16.73 b	18.37 a	16.85 a
Mean of Boron	12.81 c	13.87 b	14.97 a	

Means followed by the same letter(s) are not significantly different at $P \leq 0.05$ according to Duncan's Multiple Range Test (DMRT).

3.1.2 Flowering-to-fruit set duration (days):

Table 3 shows that a 20 mL L⁻¹ biofertilizer application significantly decreased the time from complete flowering to fruit set. This treatment accelerated the transition stage, producing a mean of 11.72 days, which was lower than the control treatment. The higher levels of boron also resulted in an earlier transition from flowering to fruit set. At 100 mg L⁻¹ of boron applied by way of foliar application, the transitioning period was also significantly decreased when compared with the control treatment, having an average time-to-transit of 13.61 days. In addition, the interaction between the biofertilizer and boron treatments also displayed a statistically significant synergistic effect. The combined application of biofertilizer at 20 mL L⁻¹ along with boron at 100 mg L⁻¹ resulted in the shortest amount of time transitioning from complete flowering to fruit set at 10.84 days, illustrating the highest performance when compared with all other treatments.

Table 3. Effects of biofertilizer and foliar boron on Flowering-to-fruit set duration (days) in olive trees.

Biofertilizer (mL L ⁻¹)	Boron (mg L ⁻¹)			Mean of Biofertilizer
	0	50	100	
0	18.54 a	17.54 b	16.57 c	17.55 a
10	15.68 d	14.44 e	13.43 f	14.52 b
20	12.57 g	11.75 h	10.84 i	11.72 c
Mean of Boron	15.60 a	14.57 b	13.61 c	

Means followed by the same letter(s) are not significantly different at $P \leq 0.05$ according to Duncan's Multiple Range Test (DMRT).

3.2 Yield and Fruit Quality Traits

3.2.1 Average Fruit Weight (g fruit⁻¹):

The analysis found in Table 4 that applying a biofertilizer application had a significant effect on the average weight of fruit produced. The highest average weight of fruit was in the treatment containing 20 mL L⁻¹ of biofertilizer 3.32 g fruit⁻¹ compared to the controls. When treated with 100 mg L⁻¹ boron as a foliar application, the average fruit weight increased significantly 3.01 g fruit⁻¹ over the control. There was also a significant interaction between levels of biofertilizer and boron on average fruit weight. The combination of the 20 mL L⁻¹ biofertilizer and the 100 mg L⁻¹ boron produced the highest average weight 3.54 g fruit⁻¹.

Table 4. Effects of biofertilizer and foliar boron on average fruit weight (g) in olive trees.

Biofertilizer (mL L ⁻¹)	Boron (mg L ⁻¹)			Mean of Biofertilizer
	0	50	100	
0	2.27 h	2.40 g	2.57 f	2.42 c
10	2.72 e	2.83 d	2.92 d	2.82 b
20	3.09 c	3.31 b	3.54 a	3.32 a
Mean of Boron	2.69 c	2.84 b	3.01 a	

Means

followed by the same letter(s) are not significantly different at $P \leq 0.05$ according to Duncan's Multiple Range Test (DMRT).

3.2.2 Average Yield per Tree (kg tree⁻¹):

According to the data presented in Table 5, yield per tree was found to be significantly impacted by the factors investigated. The use of biofertilizer had a significant positive effect on yield, with 20mL L⁻¹ of biofertilizer providing the highest yield of 23.14 kg tree⁻¹ compared to the control group. In a similar manner, foliar applications of boron can significantly improve yields. This is particularly true for foliar applications of boron at a concentration of 100 mg L⁻¹ which resulted in the highest yield 21.16 kg tree⁻¹, followed by those treated with only water (the control). Additionally, the interaction of biofertilizer and boron was significant. The two treatments of 20 mL L⁻¹ biofertilizer and 100 mg L⁻¹ boron produced the greatest yield per tree, 24.47 kg tree⁻¹, in combination with each other.

Table 5. Effects of biofertilizer and foliar boron on yield per tree (kg tree⁻¹) in olive trees.

Biofertilizer (mL L ⁻¹)	Boron (mg L ⁻¹)			Mean of Biofertilizer
	0	50	100	
0	16.32 h	16.88 h	17.91 g	17.04 c
10	19.40 f	20.23 e	21.09 d	20.24 b
20	21.85 c	23.10 b	24.47 a	23.14 a
Mean of Boron	19.19 c	20.07 b	21.16 a	

Means followed by the same letter(s) are not significantly different at $P \leq 0.05$ according to Duncan's Multiple Range Test (DMRT).

3.2.3 Average Fruit Volume (cm³):

According to the Table 6 results, the fruit volume of olives increased when biofertilizer was applied. At 20 mL L⁻¹, the fruit volume measured 3.32 cm³, compared to the control. Furthermore, foliar boron at 100 mg L⁻¹ produced an increase in fruit volume of 3.02 cm³, compared to the control. In conjunction with both treatments, the interaction between biofertilizer and boron levels was statistically significant and produced a greater fruit volume 3.54 cm³ in response to the combined treatment of 20 mL L⁻¹ and 100 mg L⁻¹ 100.

Table 6. Effects of biofertilizer and foliar boron on fruit volume (cm³) in olive trees.

Biofertilizer (mL L ⁻¹)	Boron (mg L ⁻¹)			Mean of Biofertilizer
	0	50	100	
0	2.34 g	2.41 g	2.59 f	2.45 c

10	2.74 e	2.85 ed	2.94 d	2.84 b
20	3.10 c	3.32 b	3.54 a	3.32 a
Mean of Boron	2.72 c	2.86 b	3.02 a	

Means followed by the same letter(s) are not significantly different at $P \leq 0.05$ according to Duncan's Multiple Range Test (DMRT).

3.2.4 Fruit Length (mm, measured at mid-fruit position):

Table 7 tells us about how fruit size was influenced by the application of a biofertilizer product. The longest fruit 19.72 mm occurred with biofertilizer applied at the rate of 20 mL L⁻¹ compared to the control, while the application of foliar boron at 100 mg L⁻¹ produced an effect 18.74 mm greater than the control 17.44 mm. In addition to these two treatments, there was a significant interaction between biofertilizer and boron levels. When biofertilizer at 20 mL L⁻¹ and boron at 100 mg L⁻¹ were used together, the longest fruit 20.62 mm was produced.

Table 7. Effects of biofertilizer and foliar boron on fruit length (mm) in olive trees.

Biofertilizer (mL L ⁻¹)	Boron (mg L ⁻¹)			Mean of Biofertilizer
	0	50	100	
0	15.76 i	16.26 h	17.12 g	16.39 c
10	17.56 f	17.97 e	18.47 d	18.00 b
20	18.99 c	19.53 b	20.62 a	19.72 a
Mean of Boron	17.44 c	17.92 b	18.74 a	

Means followed by the same letter(s) are not significantly different at $P \leq 0.05$ according to Duncan's Multiple Range Test (DMRT).

3.2.5 Fruit Diameter (mm):

According to the results of the statistical analysis shown in Table 8, there was a significant effect of biofertilizer application on fruit diameter. The treatment of the highest amount of biofertilizer 20 mL L⁻¹ was found to provide the largest fruit diameters 15.05 mm which were significantly greater than those of the control group 12.13 mm. Boron also significantly increased fruit diameter from the foliar application of boron levels as indicated by the treatment of 100 mg L⁻¹ boron having the largest fruit diameter 14.23 mm compared to the control. Finally, a significant interaction existed between these two treatments, whereby fruit diameter was maximized at 15.50 mm from the combined treatment of biofertilizer at the amount mentioned and boron level of 100 mg L⁻¹; on the other hand, the lowest recorded fruit diameter in this experiment 11.23 mm was found with the control treatment.

Table 8. Effects of biofertilizer and foliar boron on fruit diameter (mm) in olive trees.

Biofertilizer (mL L ⁻¹)	Boron (mg L ⁻¹)			Mean of Biofertilizer
	0	50	100	
0	11.23 g	12.21 f	12.94 e	12.13 c
10	13.46 d	13.82 d	14.24 c	13.84 b
20	14.67 b	14.98 b	15.50 a	15.05 a
Mean of Boron	13.12 c	13.67 b	14.23 a	

Means followed by the same letter(s) are not significantly different at $P \leq 0.05$ according to Duncan's Multiple Range Test (DMRT).

3.2.6 Oil Content (%):

Results from Table 9 indicated that adding biofertilizer to olive fruit leads to a large increase in the amount of oil expressed as a percentage by the fruit. The maximum oil percentage was found to be at the highest level of biofertilizer application 20 mL L⁻¹, at this level of biofertilizer the olive fruit oil percentage was significantly higher 19.31% than that of the control treatment. Additionally, trees receiving the foliar application of boron at 100 mg L⁻¹ produced a significantly higher olive fruit oil percentage 17.42% than that of the control treatment. Interaction between the biofertilizer and boron was statistically significant. The greatest oil percentage 19.76% was found when the of 20 mL L⁻¹ biofertilizer and 100 mg L⁻¹ boron was combined.

Table 9. Effects of biofertilizer and foliar boron on oil content (%) in olive fruits.

Biofertilizer (mL L ⁻¹)	Boron (mg L ⁻¹)			Mean of Biofertilizer
	0	50	100	
0	13.87 i	14.35 h	14.84 g	14.35 c
10	15.71 f	16.63 e	17.67 d	16.69 b
20	18.83 c	19.34 b	19.76 a	19.31 a
Mean of Boron	16.13 c	16.79 b	17.42 a	

Means followed by the same letter(s) are not significantly different at $P \leq 0.05$ according to Duncan's Multiple Range Test (DMRT).

3.2.7 Total Soluble Solids (TSS %):

As shown in Table 10, utilizing biofertilizer demonstrated remarkable increases in total soluble solids. The highest total soluble solid was observed when using 20 mL L⁻¹ of

biofertilizer, which resulted in a total of 20.02% TSS as opposed to the control. Furthermore, 100 mg L⁻¹ of boron also revealed significant variation from control as the TSS recorded after treatment was 18.87%. The overall interaction between biofertilizer and boron produced highly significant results with the combined treatment of 20 mL L⁻¹ biofertilizer and 100 mg L⁻¹ boron exhibiting the greatest effect, and thus generating a TSS of 20.77%.

Table 10. Effects of biofertilizer and foliar boron on total soluble solids (TSS %) in olive fruits.

Biofertilizer (mL L ⁻¹)	Boron (mg L ⁻¹)			Mean of Biofertilizer
	0	50	100	
0	15.26 h	16.06 g	17.23 f	16.19 c
10	17.83 e	18.16 ed	18.63 d	18.21 b
20	19.26 c	20.05 b	20.77 a	20.02 a
Mean of Boron	17.45 c	18.09 b	18.87 a	

4. Conclusion

Applications of biofertilizer, particularly at the higher application rate of 20 mL L⁻¹, greatly increased the flowering ability of olive trees. Trees that received the treatment exhibited greater inflorescence flower numbers and a shorter period between full flowering and fruit set compared to trees that did not receive the treatment. These findings suggest that biofertilization enhanced reproductive development and physiological processes involved in flower initiation. Similar findings for vegetable crops have been published (28,29), which demonstrated that the application of biofertilizers led to an increase in flower and fruit set productivity in all fruit species. Other fruits with similar findings (30,31, and 32), illustrate that any enhancement of the plant nutritional status results in increased vegetative growth as well as increased reproductive growth. It has been hypothesized that the acquisition of flowering trait improvements has been connected through the enhanced capacity for nutrient acquisition from the rhizosphere by beneficial micro-organisms.

Such improvements in nutrient availability (particularly N and P) provide plants with improved access to nutrients; therefore, they can form more chlorophyll and photosynthesize with greater proficiency. This can result in greater assimilation of carbohydrates within plant tissues. The elevated availability of carbohydrates and the C/N ratio is believed to be an important factor that influences the differentiation of flowers and reproductive development. Microbial activity may also stimulate the production of growth-promoting chemicals and improve the efficiency of nutrient uptake, which may promote flower bud development and flower development (18,19).

Application of boron on the leaves of plants has had a very beneficial impact on flowering characteristics where trees at the rate of 100 mg L⁻¹, produced improved flowering and faster fruit setting than the control trees. These results support previous research (9,12), indicating how important boron is for developing flowers and setting fruit in olives and also were confirmed through similar observations

(33,34, and 35). One of the reasons for boron being beneficial is its important role as a means of moving carbohydrates through the phloem into the developing flower tissues that are being formed. Sufficient amounts of boron present allow the movement and accumulation of assimilates in flower buds, which promotes better floral differentiation and reproductive efficiency. Boron also contributes to the structural integrity of the cell walls and membranes of the cells and is necessary for elongation of pollen tubes and germination of pollen. When combined, these processes lead to increased success in fertilization and fruit set (18,19). The observed enhancement in the physical and chemical characteristics of fruit due to biofertilizer applications is indicative of the significant role that increased nutritional balance plays on the growth and quality of fruit. The application of 20 mL L⁻¹ of biofertilizer produced increased weights of fruit, increased yields, and larger dimensions of fruit, as well as higher amounts of oil and total soluble solids, compared to those not treated with biofertilizers. Similar findings were also reported for (20,21), that indicated that increased nutrient availability is a direct contributor to fruit size and yield increases in long-term fruit crops. The work by (22,23), also suggested that the accumulation of more assimilates may have a positive effect on the formation of oil as well as overall fruit quality. Physiologically, the enhanced growth of fruits may be due to the more efficient use of photosynthesis and the better movement of assimilates from source leaves to developing fruit. Enhanced nutrient availability may also contribute to the improvement of sugar transport and fruit filling, leading to a greater amount of carbohydrate accumulation and metabolic substrates within the fruit tissues; this is expected to lead to increased lipid biosynthesis and improved oil accumulation in olives (36,37, and 38). A

similar relationship occurs when foliar application of boron; foliar application of boron significantly improved fruit weight, yield, fruit size, oil content, and total soluble solids. According to (8,9), the use of boron will lead to increased development and productivity of fruit. The positive effects of boron may result from its role in carbohydrate mobilization, cell division, and cell elongation, all of which contribute to the improvement of quality of fruit. Furthermore, it has been suggested that Boron will indirectly stimulate metabolic function and subsequently, increase sugar and oil accumulation in the fruit tissue (18). A major finding of this study was that optimal performance was observed with combined biofertilizer and foliar application of Boron (20 mL L⁻¹ biofertilizer + 100 mg L⁻¹ Boron). With this treatment, the flowering and fruiting aspects of the trees exhibited the most positive response, including, greater fruit set, larger size, greater yield and higher oil fraction and soluble solids content. The extent of improvement when using these treatments together suggests that there is a synergistic effect between biofertilization and Boron nutrition. This synergistic effect can be attributed to how both treatments complement set plant physiological processes. Biofertilizer treatments promote higher levels of microbial activity and increase the availability of nutrients within the root zone, while Boron facilitates the transport of assimilated material and improves the reproductive efficiency of the tree. The effects that are integrated will most probably increase photosynthetic activity; therefore, it is thought that floral and fruit abscission will be reduced when assimilates are partitioned effectively to produce a developing fruit. This conclusion was also indicated by (8,9,22, and 39). reinforce these conclusions by providing further evidence for the significance of biofertilizers in improving rhizosphere activity and nutrient utilization efficiency. Thus, this study demonstrated

that the combination of biofertilizer application with foliar boron spraying offers a viable and sustainable nutrient strategy to enhance olive tree productivity and the quality of fruit produced under prevailing local environmental conditions; the positive response generated from the research can therefore be attributed to improved nutrient acquisition and improved carbohydrate metabolism leading to better harmonization of physiological and reproductive activities.

Conclusion:

In this study, we show that the use of biofertilizer and boron in olive tree foliage when added together is an effective way to produce better reproductive performance, yield, and fruit quality of oaks under field conditions.

Application of biofertilizer at 20 mL L⁻¹ increased flower production, yield components and all physical and chemical attributes of fruit. To complement biofertilizer applications made in conjunction with foliar application of boron at 100 mg L⁻¹; thus, resulting in improved flowering efficiency and fruit set along with increased fruit quality attributes. The treatment combination of these two inputs resulted in an even greater magnitude of response than when either input was applied alone.

The synergistic effect observed appears to demonstrate that the two factors were able to work in harmony with each other. The improvement of soil biological activity and availability of nutrients in the rhizosphere from biofertilization, combined with boron promoting efficient carbohydrate movement and reproductive process regulation, resulted in improved source-sink relationships, improved assimilate partitioning to developing fruits and lower levels of flower and fruit abscission all contributing to greater yield and quality. The overall findings support the principle of a sustainable and effective method of optimizing olive yield and quality by

combining the use of biological fertilizers with the application of targeted micronutrient management in particular environmental conditions where they grow.

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