The influence of spraying Boron and Potassium on the development of floral buds and productivity of two olive cultivars grown under salinity stress.

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ABSTRACT

This study has been conducted during two successive seasons (2021 & 2022) on 15 years old Aggazi shami and Picual Olive trees grown under soil salinity of 3.52 dSm^{-1} and water salinity of 8.4 dSm^{-1} in a private orchard located at Sarabium, Ismailia Governorate, Egypt. The main purpose of this investigation was to study the effect of spraying Boron (1 & 1.5 cm /L) and Potassium (1.5 & 3 cm/L) on olive buds' development, fruit characteristics and productivity. Trees were sprayed (twice), on January and repeated three weeks later. The obtained results showed a considerable variation in the morphological and anatomical characteristics of two Olive cultivars (Aggazi shami & Picual). The highest vegetative parameters (Shoot length, number of leaves/shoot) were recorded by Picual olive cultivar in both studied seasons and highest leaf length in the first season, without significant difference with those recorded by Aggazi Shami c.v in second one. While, Aggazi shami olive cultivar gave the higher most floral aspects (No. of flowers/inflorescence and sex ratio). On the other hand, the data of fruit characteristics and yield showed different trends. Whereas, Picual cv. achieved the highest significant values for fruit shape index and Aggazi shami olive cultivar recorded the highest yield/tree. Finally, it can be concluded that, treating olive cultivars (Aggazi Shami & Picual) with potassium 3 cm/l improved vegetative measurements, floral & fruiting aspects.

Keywords: Aggazi shami - Boron - Olive (*Olea europaea*)- Picual- Potassium and spraying.

INTRODUCTION

Olive trees (*Olea europaea* L.) have been a common factor in agriculture and culture in the Mediterranean region for hundreds of years due to their high nutritional and economic value. Olive trees can be grown in many types of lands that may not be suitable for growing other types of fruit trees. The climatic conditions prevailing in the Mediterranean region are compatible with the needs of olives, represented by cold, wet winters and hot, dry summers (Mervat et al., 2011, Torres et al., 2017 and Hassan and Ahmed, 2019).

In Egypt, olive cultivations occupy a large area (257896 Feddan), and hold a special status in areas such as the Sinai, Siwa and Fayoum. The country's climate and soil type in the different regions of the country contributed to the spread of olive cultivation and an increase in productivity, which reached 1056548 tons (Ministry of Agriculture statistics).

One of the main challenges facing the agricultural sector in Egypt in general, and the olive cultivation in particular is the availability of usable irrigation water (Bedawy, 2014 and Mansour et al., 2019). Although olive trees are tolerant to salinity stress, olive trees exposed to excessive salinity levels may have stunted growth, low yields, and poor oil quality (Chartzoulakis, 2005), This is because salts have an adverse influence on a plant's roots' ability to absorb nutrients and water (Ehtaiwesh, 2022). This issue is particularly important in arid and semi-arid regions where irrigation with salt water is common.

Another factor affecting olive production in Egypt is the poor fertility of the soil in which olive trees are grown and its inability to retain water, which leads to a decrease in the productivity of olive trees in these areas, that requires the implementation of fertilization programs capable of supplying the trees with the macro- and micro-nutrients they need (Ahmed and Morsy, 2001 and Tubeileh et al., 2014).

One of the micronutrients that affects the productivity of olive trees is boron, This nutrient is necessary for the metabolism and serves a number of purposes, including the vegetative development and reproductive activities that are necessary for the germination, viability, and expansion of pollen tubes, as well as for flowering, fruit set, olive tree cell elongation, and cell division. (Stellacci et al., 2010 and Hegazi et al., 2015). Foliar treatment of boron significantly affected the bud survival rate of Manzanillo and Picual olives (Eassa, 2006), reduced branches bud's dieback of the olive trees (Yang, 1982) and enhanced growth and production of olive tree (Maksoud et al., 2004). The common types of boron are: *sodium tetraborate decahydrate*, *sodium tetraborate pentahydrate and sodium tetraborate anhydrous*. Also, Potassium is a necessary nutrient for olive trees since it is a mineral that regulates osmotic pressure and plays a significant role in cell enlargement, plant growth, and the opening and closing of leaf stomata (Shabala, 2003, Haberman et al., 2019). In addition, Potassium stimulates the formation of Indole Acetic Acid oxidase (IAA), which stimulates the induction of olive flowering (Gonzalez-Garcia et al., 1972). This is why potassium has a positive effect on flowering, as demonstrated by (Fabbri and Benelli, 2000). Olives demand a lot of potassium (Restrepo-Diaz et al., 2008) and more than 60% of the potassium reserve in olive trees is depleted with the harvest and pruning (Erel et al., 2008). Many researchers presented the role of potassium on enhancing olive growth and yield (Hegazi et al., 2005; Mahmoud et al., 2017 and Gowda et al., 2022). The effects of different nutrients on growth and production of fruit trees varied between varieties Fernandez-Salvador et al. (2015) and Cavender et al. (2019) on Blackberry, Li et al. (2021) on kiwifruit.

The current investigation aimed to study the effects of foliar application of Boron and Potassium on flowering, fruit set and productivity of Aggazi shami and Picual olive cultivars.

MATERIALS AND METHODS

The experimental field was carried out on 15-year-old Aggazi shami & Picual Olive cultivars grown in a private orchard at Sarabium, Ismailia Governorate, situated between latitude (30.435421508569423) N$^{\circ}$ and longitude (32.15477538658834) E$^{\circ}$, through two successive seasons 2021 and 2022. The trees are almost uniform and their growth is vigorous. They planted at a distance of 5 x 6 m apart grown in sandy soil characterized by electrical conductivity (EC), 3.52 dSm^{-1} under drip irrigation system using well water with EC, 8.4 dSm^{-1} and received the regular horticultural practices. Organic and mineral fertilization was applied in winter on the Farm at the beginning of November, and a chemical fertilization program was applied during the growing season according to the recommendation of the Ministry of Agriculture and Land Reclamation. Soil samples were taken randomly from the area of the end of root ramification of the canopy in depth of 0-60 cm (Chapman and Pratt, 1975). Soil texture characterization and chemical analyses were determined according to the methods described by (Page et al., 1982) as shown in **Table (1**). Samples of irrigation water were collected during the experiment and analyzed as shown in **Table (2).**

Table (1). Physical and chemical characteristics of tested soil.

Soil characteristics	Value	Soil characteristics	Value
Soil particles distribution		Ph	8.03
Sand, %	95. 85	EC, (dSm^{-1})	3.52
Silt, %	2.60	Field Capacity (FC), %	10.20
Clay, %	1.55	$CaCO_3$, (%)	1.30
Textural class	Sandy	Organic matter, (%)	0.25
Soluble cations (m mole L^{-1})		**Soluble anions (m mole L^{-1})**	
Ca^{++}	9.20	$CO_3^{=}$	0.00
Mg^{++}	10.50	HCO_3^{-}	13.10
Na^{+}	11.80	Cl^{-}	12.50
K^{+}	3.50	$SO_4^{=}$	9.40
Available nutrient, (mg kg^{-1}soil)			
N	20.75		
P	12.35		
K	90.90		

Table (2). Chemical analysis of well's water

Characters	EC (dSm^{-1})	pH	Cations (meq/l)				Anions (meq/l)				SAR
			Ca^{2+}	Mg^{2+}	Na^{2+}	K^{2+}	CO_3^{-}	HCO_3^{-}	Cl^{-}	SO_4^{2-}	
Value	8.4	7.89	10.7	14.2	77.3	5.1	0.00	39.3	35.6	32.4	21.41

This experiment included 10 treatments which were the combinations of two olive cultivars Aggazi shami as a (table cultivar) and Picual as a (double - purpose cultivar) and five foliar treatments, which were:-

1. Boron at 1 cm/l.
2. Boron at 1.5 cm/l.
3. Potassium at 1.5 cm/l.
4. Potassium at 3 cm/l.
5. Control sprayed with tap water.

Foliar treatments were sprayed with Boron and Potassium (twice) on 1th January and repeated three weeks later. Tween 20 was added at 0.1% as a surfactant to all spray solutions (7 L. solution/ tree) including control.

These treatments were arranged in a split plot design with four replicates/ treatment. Olive cultivars represented the main plots, while foliar treatments were randomly distributed in the sub plots. It is worthy to mention that, a guard row of trees was placed between each two experimental plots to avoid the over lapping between the various treatments.

The effect of treatments under study was evaluated by determining the following measurements:

- **Vegetative Measurements:**
  - At the beginning of the growing seasons (March) twelve healthy one-year-old shoots/tree (3 in each tree direction) were selected randomly and labeled to determine the following characteristics: Shoot Length (cm), number of leaves, leaf width and leaf length (cm).
- **Floral aspects:**
  - Number of inflorescences/shoot and number of flowers/ inflorescence was counted at cessation of flowering.
  - Flower density was calculated as a number of inflorescences per meter.

Flowering density = (No. of inflorescences X 100)/shoot length (cm)

  - Sex ratio was determined by the ratio between the perfect flowers/ inflorescence and the total No. of flowers in the same inflorescence (El-Sharony, 2007).

Sex ratio= (Perfect flowers/ Total No. of flowers) X 100

- **Fruit and yield characteristics**:
  - Fruit and pulp weight was determined using an electric balance, and the samples included (10 fruits).

- Fruit shape index: fruit dimensions were measured by digital Caliper (cm) and fruit shape index is equal to the ratio between length and diameter.
- Yield/tree was determined and the average for each treatment was calculated as kg/tree.

- Anatomical studies:

Olive floral buds were collected throughout the 2nd growing season of two olive cultivars (Aggazi shami and Picual). Buds were killed and fixed in F.A.A. (10 ml Formalin, 5 ml Acetic Acid, 85 ml Ethyl Alcohol), samples were washed in 50% ethyl alcohol, dehydrated through a normal butyl alcohol series and embedded in paraffin wax. Martials were cut using a rotary microtome to a thickness of 18 microns, then stained with crystal violet-erythrosine and mounted in Canada balsam according to Nassar and El- Sahhar (1998).

Statistical analysis:

All collected data were analyzed by performing analysis of variance (ANOVA) according to Snedecor and Cochran (1980). Differences between means were compared using the Least significant Differences (LSD) method at 5%.

RESULTS AND DISCUSSION

Results under study exhibit a marked variation in most growth measurements as a response to cultivars and treatments.

1.Vegetative Measurements

Vegetative measurements were significantly affected by the different spraying treatments in each of the two Olive cultivars under study. As the results appear in **Table (3)**, it was noted that, Picual recorded the highest significant values of shoot length (30.73 & 27.90 cm) in both seasons and the highest number of leaves/shoot (51.00 & 57.93), leaf length (5.15 & 5.51 cm), leaf width (0.90 & 0.98 cm) without significant differences in most cases with those recorded by Aggazi shami cultivar. These findings are in parallel with those obtained by Ali et al. (2022) on olive. They showed that vegetative growth parameters (shoot length, leaf area and tree height) of Aggazi shami cultivar were lower than those obtained by Picual olive cultivar.

Regarding the influence of spraying treatments, it was noted that spraying potassium at 3cm/l gave the higher most vegetative growth parameters in 1st and 2nd seasons, respectively. Meanwhile, the lowermost values were recorded by control treatment.

The positive effect of potassium is owing to its important role in enhancing the ability of plants to perform photosynthesis by regulating the opening and closing of stomata, which leads to an increase in carbohydrates formation **(**Saykhul et al., 2011 and Tränknera et al., 2018). Moreover, the response of vegetative growth of olive trees to potassium may be due to its role in nutrition and sugar translocation in plant (Ho et al., 2020). The interaction between olive cultivars and spraying treatments was significant and indicate that, all vegetative measurements were significantly increased when Picual olive cultivar were sprayed with 3cm/l. Since, it achieved the highest values of shoot length, number of leaves/shoot and leaf length and width in 1st and 2nd seasons, respectively. Also, it can be concluded that olive cultivars under the study showed a different response to spry treatment. Aggazi shami olive cultivar treated with boron at 1 cm/l or 1.5 cm/l were superior regarding to shoot length, no. of leaves/shoot and both leaf dimensions (length & width). Meanwhile, Picual olive cultivar treated with potassium at 3 cm/l gave the highest values in this concern.

Table (3). Influence of spraying Boron and Potassium on vegetative growth of olive cultivars.

Cultivar	Aggazi	Picual	Mean	Aggazi	Picual	Mean

Treatment	Frist season			Second season		
				Shoot length		
Boron 1 cm/l	32.33	26.00	29.17	25.87	20.87	23.37
Boron 1.5 cm/l	31.67	36.60	34.13	26.43	27.17	26.80
Potassium 1.5 cm/l	26.17	28.17	27.17	25.00	29.60	27.30
Potassium 3 cm/l	29.67	39.17	34.42	22.87	39.27	31.07
Control	25.67	23.73	24.70	20.10	22.60	21.35
Mean	29.10	30.73		24.05	27.90	
LSD (0.05)	Cul = 1.11	Tre=5.00	Int=7.07	Cul= 3.04	Tre= 2.87	Int= 4.06
				Number of leaves		
Boron 1 cm/l	59.67	37.67	48.67	48.33	40.33	44.33
Boron 1.5 cm/l	34.67	55.00	44.83	40.33	50.67	45.50
Potassium 1.5 cm/l	37.33	45.33	41.33	36.00	63.00	70.17
Potassium 3 cm/l	61.67	76.33	69.00	47.67	92.67	49.50
Control	34.00	40.67	37.33	32.67	43.00	37.83
Mean	45.47	51.00		41.00	57.93	
LSD (0.05)	Cul = 6.33	Tre=11.28 11.28	Int=15.95	Cul =10.5	Tre=14.57	Int=20.60
				Leaf length (cm)		
Boron 1 cm/l	4.32	4.00	4.16	4.90	6.00	5.45
Boron 1.5 cm/l	4.50	5.40	4.95	5.15	4.03	4.59
Potassium 1.5 cm/l	4.57	4.63	4.60	5.27	5.27	5.27
Potassium 3 cm/l	4.50	6.30	5.40	5.37	6.63	6.00
Control	4.23	5.43	4.83	4.77	5.60	5.18
Mean	4.42	5.15		5.09	5.51	
LSD (0.05)	Cul = 0.44	Tre= 0.38	Int= 0.54	Cul = 0.61	Tre=0.50	Int=0.70
				Leaf width (cm)		
Boron 1 cm/l	0.92	0.87	0.89	1.20	1.05	1.13
Boron 1.5 cm/l	1.13	0.78	0.96	0.95	0.87	0.91
Potassium 1.5 cm/l	1.07	0.83	0.95	1.17	0.88	1.03
Potassium 3 cm/l	0.70	1.12	0.91	0.97	1.13	1.05
Control	0.50	0.92	0.71	0.63	0.95	0.79
Mean	0.86	0.90		0.98	0.98	
LSD (0.05)	Cul = 0.13	Tre= 0.18	Int= 0.26	Cul = 0.40	Tre= 0.25	Int= 0.36

Values have same letter are not significantly different at p = 5% level, using New LSD test.
* cul = cultivar ** tre= treatment *** int= interaction

2. Flowering Behavior:

Regarding to data presented in **Table (4)**, the tested cultivars showed a significant differences in both seasons. The highest number of flowers/ inflorescence (17.93 & 19.60) and sex ratio (70.33 & 56.80 %) came from Aggazi Shami olive cultivar, while, the least one were recorded for Picual cultivar in both seasons. **Table (4)** also, reveals different trends regarding the effect of cultivar on the number of inflorescence/shoot and flowering density. While, Picual olive cultivar gave statistically highest no. of inflorescence/shoot (21.80) in 1st season only, Aggazi Shami was recorded the highest flowering density (68.21) in 2nd one. These results are in harmony with those found by Ali et al. (2022) they found that, Picual recorded the lowest perfect flower % compared to cultivars that were studied. In addition, Seifi et al. (2011) and Zienab (2019) on olive illustrated that inflorescence and flower number varied between cultivar and from year to another.

Table (4). Influence of spraying Boron and Potassium on flowering behiver of olive cultivars.

Cultivar	Aggazi	Picual	Mean	Aggazi	Picual	Mean
Tretment	**Frist season**			**Second season**		
	Number of inflorescences/shoots					
Boron 1 cm/l	17.33	19.67	18.50	21.00	27.67	24.33
Boron 1.5 cm/l	17.33	23.00	20.17	24.67	33.67	29.17
Potassium 1.5 cm/l	16.00	21.00	18.50	23.00	30.67	26.83
Potassium 3 cm/l	18.67	30.33	24.50	27.33	46.00	36.67
Control	14.00	15.00	14.50	17.67	16.67	17.17
Mean	16.67	21.80		22.73	30.93	
LSD (0.05)	Cul = 4.68	Tre= 4.32	Int= 6.12	Cul=	Tre= 8.70	Int=
	Flowering density					
Boron 1 cm/l	67.49	94.04	80.77	67.03	41.79	54.41
Boron 1.5 cm/l	65.84	88.97	77.41	53.17	65.13	59.15
Potassium 1.5 cm/l	80.21	70.59	75.40	79.34	52.39	65.86
Potassium 3 cm/l	81.65	77.22	79.44	70.18	31.91	51.05
Control	56.54	65.66	61.10	71.40	60.37	65.85
Mean	70.35	79.30		68.21	50.32	
LSD (0.05)	Cul =	Tre= 17.94	Int=	Cul= 1.86	Tre= 9.59	Int=
	Number of flowers/inflorescence					
Boron 1 cm/l	20.00	13.33	16.67	21.67	15.33	18.50
Boron 1.5 cm/l	16.00	14.67	15.33	16.67	17.00	16.83
Potassium 1.5 cm/l	18.00	13.00	15.50	20.67	14.33	17.50
Potassium 3 cm/l	18.67	11.33	15.00	20.67	12.33	16.50
Control	17.00	13.67	15.30	18.33	14.33	16.33
Mean	17.93	13.20		19.60	14.67	
LSD (0.05)	Cul = 1.44	Tre= 1.61	Int= 2.70	Cul= 0.58	Tre= 2.18	Int= 3.66
	Sex ratio (%)					
Boron 1 cm/l	70.21	47.40	58.80	58.51	46.17	52.34
Boron 1.5 cm/l	74.74	54.48	64.61	62.27	45.56	53.91
Potassium 1.5 cm/l	64.51	48.72	56.61	44.82	41.75	43.28
Potassium 3 cm/l	80.52	49.28	64.90	76.48	46.36	61.42
Control	61.67	38.83	50.25	41.93	25.47	33.70
Mean	70.33	47.74		56.80	41.06	
LSD (0.05)	Cul = 9.81	Tre= 12.03	Int=20.30	Cul=	Tre=	Int=

Values have same letter are not significantly different at p = 5% level, using New LSD test.
* cul = cultivar ** tre= treatment *** int= interaction

Table (4) also, reveals that, floral aspects were significantly affected by foliar application of boron and potassium in both studied seasons. Trees sprayed with potassium at 3 cm/l recorded the maximum values compared to the control treatment and without significant difference with other spray treatments in most cases. The enhancing effect of potassium on flowering behavior of olive is due to the stimulating effect of photosynthesis and carbohydrate formation in the plant (Erel et al., 2014) and (Gowda et al., 2022). Meanwhile, Haberman et al. (2019) showed that, potassium application to the olive tree had a significant effect on the number of flowers/inflorescence and perfect flowers %, which reflected positively on the bearing of the trees. On the other hand, Perica et al. (2001), Hegazi et al. (2015), Desouky et al. (2009) and El Gammal (2022a) reported that, the application of boron improved flowering behavior of olive. This gain is in line with the findings of Gauch and Dugger (1953) and Blevins and Lukaszewski (1998), who proposed a role of boron in translocation of carbohydrate or hormonal regulation affecting flowering behavior.

The interaction between the two tested factors was significant on flowering behavior in both seasons. the highest no. of inflorescence/shoot were recorded by using potassium at 3cm/l with Picual olive cultivar (30.33 & 46.00) in both seasons, respectively. In addition, Both concentration of potassium and boron at 1 cm/l on Aggazi Shami olive cultivar achieved the most consistent effect of flowering density, no. of flowers/inflorescence and sex ratio (%).

3. Fruit characteristics and Yield

Data in **Table (5)** demonstrate the fruit characteristics and yield of two olive cultivars (Aggazi Shami & Picual). Fruit shape index was ranged between (1.11 & 1.35) in 1st season and (1.21& 1.33) 2nd one. Picual olive cultivar gave the highest significant values in this concern.

Meanwhile, both cultivars failed to show any significant differences regarding fruit weight in both seasons. Moreover, it could it could be noticed that, Aggazi Shami olive cultivar recorded the highest significant values for pulp weight during first season only and highest yield in both seasons.

As for the effect of spraying treatments, data in Table 5 reveal that the highest fruit characteristics and yield were obtained by potassium at 3 cm/l and boron at 1 cm/l followed by boron 1.5 cm/l in 1st and 2nd seasons, respectively. The aforementioned results are consistent with Ahmad et al. (2011) who noted that, the application of boron improved the fruit characteristics and yield in olive cv (Ulsu). Vishekaii et al. (2019) also reported that, boron application has a positive effect on olive productivity. Moreover, El Gammal (2022b) showed that foliar spraying with boron enhanced the yield and fruit quality of "Manzanillo" olive trees**.** Similarly, the increase in olive fruit yield is due to the role of boron in increasing cell wall strength and development, sugar transport and increasing IAA levels (Eman et al. (2007) and Camacho-Cristobal et al. (2008). In addition, Hegazi et al. (2015) mentioned that, the effect of boron on olive yield could be related to an enhancement of photosynthetic capacity and due to the increase of flowering behavior and pollen viability or pollen tube growth.

Table (5). Influence of spraying Boron and Potassium on fruit characteristics and yield of olive cultivars.

Cultivar	Aggazi	Picual	Mean	Aggazi	Picual	Mean
Tretment		**Frist season**			**Second season**	
			Fruit shape index			
Boron 1 cm/l	1.12	1.37	1.24	1.23	1.32	1.28
Boron 1.5 cm/l	1.06	1.37	1.22	1.17	1.35	1.26
Potassium 1.5 cm/l	1.22	1.33	1.27	1.26	1.30	1.28
Potassium 3 cm/l	1.17	1.35	1.26	1.25	1.30	1.28
Control	1.00	1.31	1.15	1.13	1.35	1.24
Mean	1.11	1.35		1.21	1.33	
LSD (0.05)	Cul = 0.11	Tre= 0.10	Int= 0.14	Cul= 0.005	Tre= 0.09	Int= 0.13
			Fruit weight (10 fruits) g			
Boron 1 cm/l	75.23	57.54	66.39	72.42	56.12	64.27
Boron 1.5 cm/l	59.11	68.96	64.04	59.92	68.03	63.98
Potassium 1.5 cm/l	66.40	62.09	64.25	58.79	50.71	54.75
Potassium 3 cm/l	71.43	67.71	69.57	71.20	63.84	67.78
Control	56.89	59.43	58.16	55.78	56.82C	56.30
Mean	65.81	63.15		63.72	59.11	
LSD (0.05)	Cul = 6.98	Tre= 3.49	Int=4.94	Cul= 5.60	Tre= 4.98	Int= 7.04
			Pulp weight (10 fruits) g			
Boron 1 cm/l	63.33	39.04	51.19	62.00	47.20	54.60
Boron 1.5 cm/l	48.67	51.06	49.86	49.82	58.26	54.04
Potassium 1.5 cm/l	52.81	45.09	48.95	49.29	43.98	46.64
Potassium 3 cm/l	62.78	49.21	56.00	62.44	54.56	58.50
Control	40.40	42.43	41.42	43.48	47.82	45.65
Mean	53.60	45.37		53.41	50.36	
LSD (0.05)	Cul = 7.94	Tre= 4.89	Int= 6.92	Cul= 5.21	Tre= 5.18	Int= 7.33
			Yield			
Boron 1 cm/l	36.83	16.33	26.58	37.33	12.50	24.92
Boron 1.5 cm/l	31.33	19.67	25.50	28.33	19.07	23.70
Potassium 1.5 cm/l	33.33	17.47	25.50	30.00	12.00	21.00
Potassium 3 cm/l	36.67	19.60	28.17	35.00	14.33	24.67
Control	21.67	16.40	19.17	26.67	10.00	18.33
Mean	31.97	17.89		31.47	13.58	
LSD (0.05)	Cul = 2.61	Tre= 2.38	Int= 3.37	Cul= 4.12	Tre= 2.18	Int= 3.08

values have same letter are not significantly different at p = 5% level, using New LSD test. * cul = cultivar ** tre= treatment *** int= interaction

As for the potassium effect on olive fruit characteristics and yield Mahmoud et al. (2017) reported that, potassium has an improving effect on the quality of olive fruits by promoting carbohydrate formation and translocation from olive shoot to fruit. Abd El-Megeed et al. (2007), El-Khawaga (2007) and Elloumi et al. (2009) found that, supply of potassium during flower bud swelling improved olive yield and quality. Moreover, Al-Atrushy and Abdul-Qader (2016) explained that, potassium has a role in preserving the physical properties of olive fruits. In addition, Hegazi et al. (2011) and Gowda et al. (2022) noticed that, the yield and olive fruit quality positively affected by spraying treatments of potassium nitrate.

The interaction between olive cultivars and spraying treatments pointed that, all parameters of fruit characteristics (fruit shape index, fruit & pulp weight and yield (kg/tree)) were significantly affected. The highest potassium concentration with both cultivars gained the highest fruit & pulp weight and highest yield without significant differences with Aggazi Shami olive cultivar treated by boron at 1cm/l. In addition, all treatments in Picual cultivar and Aggazi shami olive trees treated by potassium at 1. 5 cm/l recorded the highest fruit shape index comparing with other treatments in both seasons, respectively.

4. Anatomical studies

4.1. Influence of some nutrients on floral bud development of olive (Aggazi shami cv.).

Fig. 1 (A-C) shows the axial-longitudinal sections of the floral buds, the buds were taken two weeks after they were sprayed with boron at a concentration of 1 cm/l, potassium at a concentration of 3 cm/l and the control treatment. As for the buds that were not sprayed with any nutrient, vegetative buds were observed to appear before the floral parts began to grow. Meanwhile, the buds that were sprayed with boron at a concentration of 1 cm/l, the sepals and petals appeared clearly. likewise, when sprayed with potassium at a concentration of 3 cm/l, the sepals, petals, and stamens appeared clearly as well, according to Cevriye et al. (2013).

4.2. Influence of some nutrients on floral bud development of olive (Picual cv.).

Fig. 1 (D-F) shows the axial-longitudinal sections of floral buds, the buds were taken two weeks after spraying them with boron at a concentration of 1.5 cm/l, potassium at a concentration of 3 cm/l and the comparison treatment. It was found that, in the control treatment vegetative buds appeared before the beginning of the growth of the floral parts, while the treatment with boron appeared with 3 protuberances, as well as the primordial sepals in the floral bud. As for the treatment with potassium, intense mitotic activity, cell division appeared in the apical and axillary meristem formation, according to **Cevriye *et al*. (2013)**.

It was concluded that there is a difference in the differentiation of buds with the addition of different nutrients compared to the control taken at the same time, and therefore it can be expected that they will unfold into floral buds faster than the control. This may be due to the effect of potassium on meristematic plant growth and cell enlargement through osmoregulation in the plant cell and its effect on cytoplasmic alkalinization in dividing cells (Sano et al., 2007). Boron plays a role in enhancing plant growth, because of its role in cell division and elongation (Al-Atrushy and Abdul-Qader, 2016).

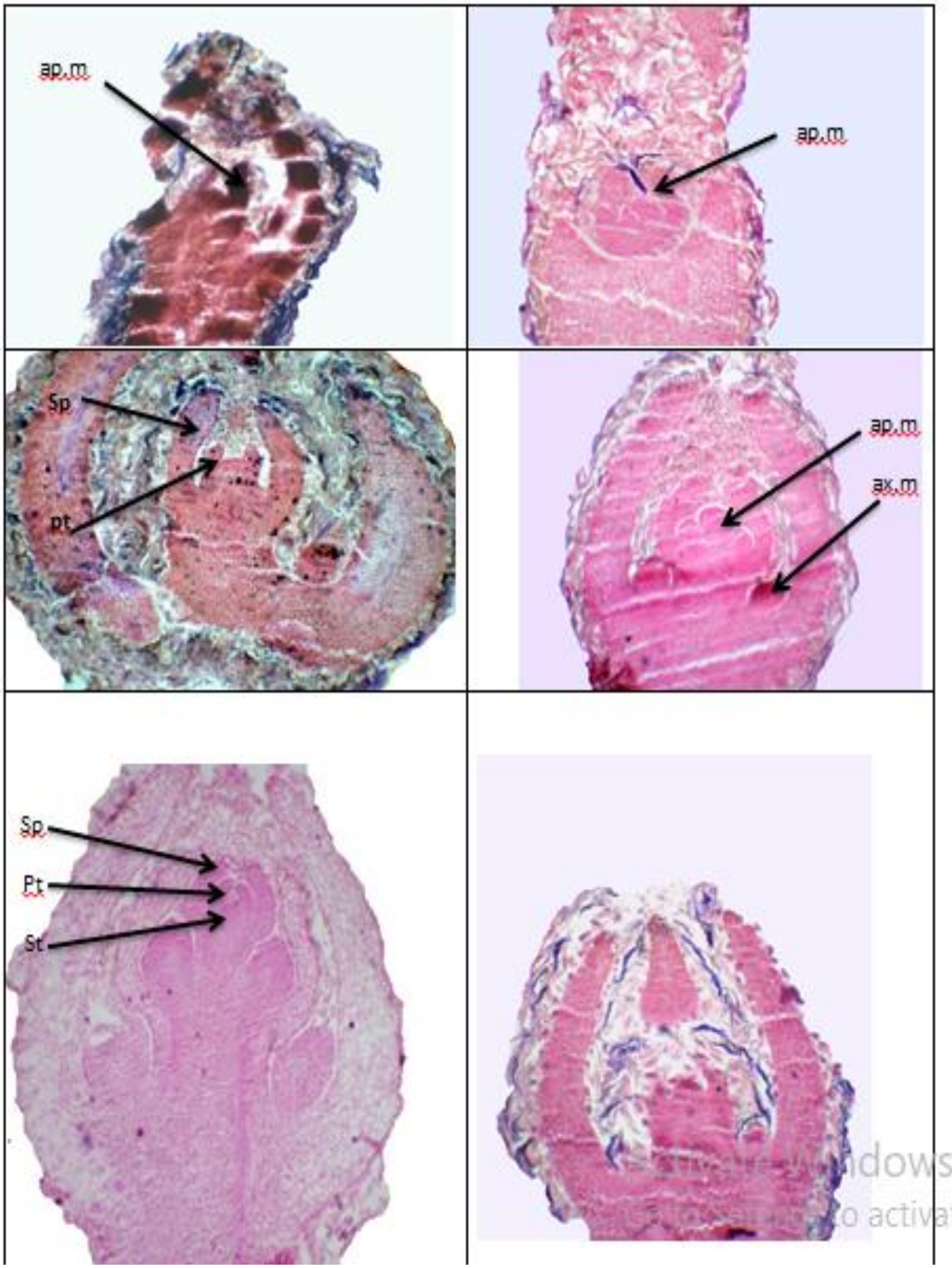

Fig. (1). Anatomical changes during differentiation in olive floral buds of *Olea europaea* (Aggazi shami cv.). (A-C), A (control), B (1 cm/l boron) and C (3 cm/l potassium) (Picual cv.). (D-F), D (control), E (1.5 cm / l boron), F (3 cm/l potassium). ap.m= apical meristem; ax.m= axillary meristem , sp= sepal , pt= petal and st=stamen

CONCLUSION

The results of the present study indicated that there is a considerable variation in the morphological and anatomical characteristics of two Olive cultivars (Aggazi shami & Picual) under different spraying rates of boron and potassium. As regard to Aggazi shami cultivar, spraying trees with boron at 1 cm/l enhancing different vegetative, floral aspects, fruit characteristics and yield without significant differences with those treated by potassium at 3 cm/l in most cases. On the other side, it appears that spraying trees with potassium at 3 cm/l or with boron at a rate of 1.5 cm/l was beneficial for the Picual olive variety as it showed remarkable superiority in the studied traits compared to the other treatments.

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الملخص العربي

تأثير رش البورون والبوتاسيوم على تطور البراعم الزهرية وإنتاجية صنفين زيتون ناميين تحت الإجهاد الملحي

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أجريت هذه الدراسة خلال موسمين متتاليين (٢٠٢١ و٢٠٢٢) على أشجار الزيتون صنفي العجيزي الشامي والبيكوال عمر ١٥ سنة والناميين تحت ملوحة تربة ٣.٥٢ ملليموز/م وملوحة مياه ٨.٤ ملليموز/م في بستان خاص يقع في منطقة سرابيوم بمحافظة الإسماعيلية، مصر. الهدف الرئيسي من هذا البحث هو دراسة تأثير الرش بعنصر البورون (١ و ١.٥ سم/لتر) وعنصر البوتاسيوم (١.٥ و ٣ سم/ لتر) على تطور براعم الزيتون وخصائص الثمار والإنتاجية. تم رش الأشجار (مرتين) في شهر يناير وتكرر ذلك بعد ثلاثة أسابيع.

أظهرت النتائج المتحصل عليها وجود اختلاف معنوي في الصفات المورفولوجية والتشريحية لصنفي الزيتون (العجيزي الشامي والبيكوال). سجلت اعلي الصفات الخضرية (طول الافرع، عدد الاوراق/فرع) في الزيتون صنف البيكوال في موسمي الدراسة، كما سجل أعلي طول للورقة في الموسم الاول، دون وجود اختلاف معنوي مع تلك التي سجلها صنف العجيزي الشامي. بينما أعطي صنف الزيتون العجيزي الشامي أعلي الصفات الزهرية (عددالازهار/النورة والنسبة الجنسية)، ومن ناحية اخري، أظهرت بيانات خصائص الثمار والمحصول اتجاهات مختلفة. حيث حقق صنف البيكوال أعلى القيم المعنوية لمؤشر شكل الثمرة وسجل صنف العجيزي الشامي أعلي محصول/شجرة، وأخيرا يمكن الاستنتاج ان معاملة أشجار الزيتون (العجيزي الشامي والبيكوال) بالبوتاسيوم (٣ سم/ لتر) أدى الي اتحسين القياسات الخضرية والزهرية والثمرية.