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(Original Article)

Performance of Some Olive (*Olea europaea L*) Cultivars Grown under Saline Stress Conditions in Newly Reclaimed Soils

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Abstract

The current study was conducted during two successive seasons (2019 and 2020) on seven fruitful olive cultivars (*Olea europaea L.*). The environmental adaptability of species and varieties has a significant impact on sustainable agricultural development and adaptation to climate change in arid and semi-arid regions. The vegetative growth, flowering, yield, fruit characteristics, and oil contents as well as salinity stress tolerance of seven olive cultivars ("Aggizi Shami", "Dolce", "Picual", "Manzanillo", "Coratina", "Koroneiki" and "Arbequina") in saline calcareous soils were studied. The results showed that "Coratina" and "Koroneiki" produced the longest highest canopy volume in comparison with the other studied cultivars, while "Arbequina" had the smallest ones followed by "Dolce" cultivar. Sexual expression as a percentage of ideal flowers differed significantly among the cultivars studied and the seasons. The highest yield was recorded in "Aggizi Shami" at 23.44 and 43.08 in 2019 and 2020 respectively. In contrast, the "Arbequina" variety recorded the lowest yield weight (kg/tree) in both seasons. The "Koroneiki" and "Coratina" varieties recorded the highest percentage of oil, while "Aggizi Shami" and "Dolce" recorded the lowest percentage. Moreover "Picual" and "Arbequina" cultivars had the highest leaf proline contents while "Dolce" cultivar had the least ones. From these results it can conclude that "Coratina" "Koroneiki", "Picual" and "Aggizi Shami" are the most suitable olive varieties under the studied conditions. These four cultivars have appropriate salinity responses and are recommended for cultivation in salinity affected areas.

Keywords: *Olive (Olea europaea L.), cultivars, canopy volume, proline, yield, fruit characteristics.*

Introduction

Olive (*Olea europaea* L.) belongs to the Oleaceae family, one of the first fruit tree species and has been cultivated since at least 3000 BC (Connor and Ferares, 2005) and plays an important role in the economy of many countries in the Mediterranean region, which occupies approximately 98% of the world's cultivated olive trees (Alfonso and Owen, 2002). Olive trees have an adaptive

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mechanism to grow well and produce fruit under salinity, drought and rainfall conditions in many arid and semiarid areas (Giuffre, 2017and Lorite *et al*., 2018). Calcareous soils cover more than 30% of the land surface area, as pH soil ranges among 7.5 and 8.5, which affects the viability of the elements and chemical reactions in the soil, which affect the loss and fixation of most nutrients in the soil. Plant species and cultivars differed in their ability to absorb and transmit nutrients (Clark, 1983). From a horticultural point of view, the success of different varieties is determined under certain environmental conditions by comparing the vegetative growth and productivity characteristics. Environmental adaptability of species and cultivars has a significant impact on sustainable agricultural development and climate changes adaptation in arid and semi-arid regions. Olive fruit is a drupe that is used for its oil and as a table fruit. Olive oil is a major component of the traditional Mediterranean diet and world consumption is steadily increasing as it is produced without purification and is rich in unsaturated fatty acids and antioxidants with purported preventive and curative effects for cardiovascular disease and cancer (Visioli *et al*. 1998 and Visioli & Galli 1998).

Olive trees has recently become one of the most important fruit crops in Egypt and new olive orchards are being established in the middle Egypt, because of its favourable ecological conditions and economic value, relatively easy production technology and wide adaptability. Since, the total cultivated area is about 245142 feddan with total annual production 981451 million tons according to the last Statistics of Ministry of Agriculture (2019) and the world production of olive fruits for the year 2019- 20 amounted to 3,057,500 tons, an increase of 5.5% compared to the last year according to international olive oil (IOC) (Anonymous, 2020). The new reclaim area suitable for olive plantings, some fruit trees failed to succeed in the desert because it's tolerance to water salinity and drought (Gowda, *et al*., 2011) , increasing the local consumption of oil due to the awareness about the value of health and nutrient(El-Badawy *et al*., 2019). It is well known that ecological and cultivation conditions have significant effects on both yield and quality of olives (Michelakis 2002 and Monica Calvo-Polanco *et al*., 2016). Therefore, expanding the cultivation of olive cultivars for pickling or oil, and with the different climatic conditions and soil in the cultivation areas, there is a need to evaluate and select good cultivars with high productivity and quality to expand their cultivation among farmers. Thus, the modern olive oil industry requires new and more competitive cultivars that can better adapt to new trends in olive growth. Hence, these cultivars must produce high and stable quality oils and olives to supply the increasing demand for olives (Bellini, *et al*., 2008).

So, the main objective of this study was to compare and evaluate the performance of some olive cultivars for growth, flowering, yield and fruit quality as well as salt stress tolerance.

Material and Methods

Plant material and experimental design

The study was conducted during the seasons of 2019 and 2020 on seven olive cultivars: Aggizi Shami, Dolce, Picual, Manzanillo, Coratina, Koroneiki and Arbequina. The selected trees were about 10 years old and planted at 6 x 6 meters a part in a private olive orchard located in the Egyptian Eastern Desert near Wady Sanoor at Beni Suef Governorate Egypt. Trees were nearly uniform in their shape and size, free disease and irrigated by groundwater with a drip irrigation system. The selected trees were received the common culture practices and fertilization. Soil chemical and physical properties and water chemical properties were determined according to the methods as described by Wilde (1985) and were summarized in Tables 1, 2.

Table 1. Chemical characteristics of the tested soil sample collected from the experimental area

PH 2.5:1	E.C. ds/M (1:5)	$CaCO_3$%	Soluble cations (meq/ L)				Soluble anions (meq/L)			
			Ca^{++}	Mg^{++}	Na^{+}	K^{+}	CO_3^{-}	HCO_3^{-}	SO_4^{-}	Cl^{-}
8.24	8.30	12.11	9.61	8	33	3.2	0	7.6	20.6	28

Table 2. Chemical characteristics of irrigation water

PH 2.5:1	E.C. ds/M (1:5)	E.C ppm	SAR	Soluble cations (meq/L)				Soluble anions (meq/ L)			
				Ca^{++}	Mg^{++}	Na^{+}	K^{+}	CO_3^{-}	HCO_3^{-}	SO_4^{-}	Cl^{-}
7.4	5.3	3392	12.3	2.24	1.08	1.85	0.30	0	1.6	2.6	1.23

The experiment was designed as a complete randomized block design with three replicates for each cultivar and two trees per replicate.

In general, the following measurements were determined during the two studied seasons.

Vegetative growth measurements

Tree vigor

1- Tree height (m).

2- Trunk cross section (cm^2): The diameter of the trunk was measured at 10 cm above soil level according to the following equation: $3.1416\ (D/2)^2$. D = the diameter of trunk (El- Said *et al*., 2006).

3- Canopy volume CV (m^3): CV = 0.5236 $(D)^2$ H (m), H = canopy height (m), D= average diameter of canopy = D1 + D2 / 2 (m) D1 , D2 : two cross diameters (El-Said *et al*., 2006).

4- Shoot length: Twenty shoots one-year-old of each tree per/replicate were randomly labeled to record the shoot length (cm):

5- Leaf area (cm^2): Samples of approximately 40 adult leaves take from the middle section of one-year-old shoots chosen from the most representative shoots to determine average leaf area (cm^2) according to Ahmed and Morsy (1999) using the following equation. Leaf area = 0.53 (length × width) +1.66

Flowering characteristics

1- Flowering date and duration: Start of flowering date were recorded when 10-25% of flowers were opened as well as full bloom date was recorded when 50-80% of flowers were opened. Moreover, the end of flowering date was recorded at 25% of set fruits.
2- Total flowers numbers per inflorescence: Sample of twenty inflorescences at bloom stage from each tree were randomly taken from the middle portion of shoots to measure the following inflorescence characteristics, total number of flowers as well as, perfect flowers per inflorescence was recorded and percentage of perfect was calculated according to Moffed (2009).

$$\text{Perfect flower percentage} = (\text{Perfect flowers No./Total flowers No.}) \times 100$$

3- Flowering density: One year-old shoots are assigned before onset of flowering to record number of inflorescences per meter.

Fruit set and Yield

1- Fruit set percentage: The percentage of initial fruit set was calculated after 20 days of full bloom as:
- Initial fruit set % = Number of fruits divided on total number of perfect flowers ×100. Also, number of retained fruits of normal size after 60 days from full bloom was calculated as final fruit set percentage.
- Final fruit set (%) = Number of fruits divided on initial number of fruits × 100.

2- Yield weight (kg/tree) was recorded at the commercial harvest date (late October from every season).

Fruit characteristics

On late of October during both seasons, 100 ripe fruits from each replicate were taken at a random according to the A.O.A.C. (1985) to determine the physical and chemical characteristics as follow:
1- Fruit weight (g)
2- Flesh (%)
3- Fruit moisture content (%) until constant weight
4- Fruit oil content as dry weight (%)

Fruit oil content (%) as a dry weight was determined according to A.O.A.C. (1985) methods by extracting the oil from the dried weight with Soxhlet apparent using petroleum ether at 60-80°C of boiling point.

Evaluation of saline water stress tolerance

Olive trees under studied were grown in the orchard and irrigated with saline water has EC = 5.3 therefore, the following characteristics were determined in the seven studied olive cultivars:

1- Leaf relative water content (RWC)

Twenty discs of about 1 cm in diameter were removed from each leaf sample per replicate to determine their fresh weight and were put in distilled water in a closed container until they reached constant weight (after 24 hours).Then the turgid weights of leaf discs samples were measured and dried at 60°C for 48h for dry weight determination. The RWC was calculated using the following equation,

$$RWC\ (\%) = [(FW\text{-}DW) / (TW\text{-}DW)] \times 100$$

Where FW, DW, and TW are fresh, dry and turgid weights. This method was described by (Saini, 2001) and followed by Hassan *et al.*, (2020)

2- Leaf total chlorophyll content was determined according to the method outlined in A.O.A.C. (1985) by extracting in 85% acetone solution and measuring their absorbance by using a Spectrophotometer at λ= 663 nm and 645 nm. The amount of total chlorophyll was calculated using the following equation:

$$\text{Total chlorophyll (mg /g f w)} = [(20.2\times OD\ 645\ nm + 8.02\times OD\ 663\ nm) \times V] \div (f\,w \times 1000)$$

OD is optical density; V is the final solution volume in ml and fw is tissue fresh weight in mg. V is the final solution volume in ml and fw is tissue fresh weight in mg.

3- Leaf proline content was extracted from the 0.5 g samples of fresh leaves by 3% sulfuric acid and determined by using the ninhydrin reagent, according to the method described by (Bates *et al*., 1973).

Statistical Analysis

All data obtained during both seasons were subjected to analysis of variance according to Snedecor and Cochran (1990) and significant differences among means were distinguished according to Duncan (1955).

Results

Vegetative growth measurements

Tree vigor

In general view data in Table (3) showed the tree vigor as, tree height (m), trunk cross section (cm^2) and canopy volume (m^3) in the studied olive cultivars namely, Aggizi Shami, Dolce, Picual, Manzanillo, Coratina, Koroneiki and Arbequina during 2019 and 2020 seasons. It was obvious from data that the results took similar trend during the two studied seasons.

Data in previously Table (3) cleared that a significant differences among seven olive cultivars during these studied seasons. Picual olive cv. was the tallest tree (4.11 & 4.33 m) whereas the shortest one was for Arbequina olive tree (2.93 & 2.99 m) in both seasons, respectively.

As for canopy volume (m^3), data clearly showed that the highest canopy volume was obtained in olive Coratina (42.83 & 43.38) and Koroneiki (42.13 &

45.65 m^2) CVs. followed by Aggizi Shami and Picual olive cvs, while the lowest values of canopy volume were recorded for Arabiquen olive (26.41 & 27.67 m^2) cv. in both seasons. Regarding the trunk cross section (cm^2), the data in Table (3) showed clearly variation among the seven olive cultivars under studied during two seasons. The values were ranged from 147.20 and 157.38 in Koroneiki olive cv. to 78.02 and 85.19 cm^2 in Dolce olive CV. during the first and second seasons, respectively.

In general, it can be concluded that seven olive cultivars under the study showed significant differences in their vigor in 2019 and 2020 seasons.

Table 3. Tree vigor of some olive cultivars grown under saline stress conditions in Newly Reclaimed soils during 2019 and 2020 seasons

Characters / Cultivars	Tree height (m)		Canopy volume (m^3)		Trunk cross section (cm^2)	
	2019	2020	2019	2020	2019	2020
Aggizi Shami	3.63^{B}	3.97^{B}	38.35^{B}	41.05^{B}	140.41^{AB}	144.79^{B}
Dolce	3.23^{BC}	3.35^{C}	27.83^{D}	32.48^{D}	78.02^{D}	85.19^{D}
Picual	4.11^{A}	4.33^{A}	38.57^{B}	40.47^{B}	132.86^{B}	143.58^{B}
Manzanillo	3.19^{BC}	3.46^{C}	31.83^{C}	35.31^{C}	125.09^{BC}	128.72^{C}
Coratina	3.60^{B}	3.85^{BC}	42.83^{A}	43.38^{A}	134.30^{B}	141.84^{B}
Koroneiki	3.38^{BC}	3.62^{C}	42.13^{A}	45.65^{A}	147.20^{A}	157.38^{A}
Arbequina	2.93^{C}	2.99^{D}	26.41^{D}	27.67^{E}	115.46^{C}	117.34^{C}

Means marked by the same letter are not significantly different at p = 5% level, using Duncan's test.

Shoot length and leaf area

Data in Table (4) showed that Coratina olive cultivar had the tallest shoot 65.6 & 60.0 cm and the highest leaf area (6.49 & 6.43 cm^2) in 2019 and 2020 seasons, respectively. It could be arranged the shoot length in descending order by Coratina, Arbequina, Manzanillo, Koroneiki, Dolce and Picual olive cultivars, respectively. In the meanwhile, the Aggizi Shami olive cultivar showed the shortest shoot length values in this respect (21.8 and 29.2 cm) in the first and second seasons, respectively.

Table 4. Shoot length and leaf area of some olive cultivars grown under saline stress conditions in Newly Reclaimed soils during 2019 and 2020 seasons

Characters / Cultivars	Shoot length (cm)		Leaf area (cm^2)	
	2019	2020	2019	2020
Aggizi Shami	21.8^{E}	29.2^{E}	4.13^{C}	4.21^{C}
Dolce	35.2^{C}	34.2^{D}	4.25^{C}	4.14^{C}
Picual	26.8^{D}	32.4^{D}	4.56^{B}	4.54^{B}
Manzanillo	36.8^{C}	49.0^{B}	4.29^{C}	4.35^{BC}
Coratina	65.6^{A}	60.0^{A}	6.49^{A}	6.43^{A}
Koroneiki	37.4^{C}	42.2^{C}	4.26^{C}	4.26^{C}
Arbequina	48.0^{B}	51.2^{B}	3.58^{D}	3.72^{D}

Means marked by the same letter are not significantly different at p = 5% level, using Duncan's test.

Also, data showed considerable variations among the studied olive cultivars in leaf area and the values ranged from 3.58 to 6.49 cm^2 in both seasons. Coratina olive cultivar had significantly the greatest leaf area (6.49 and 6.43 cm^2) followed in descending order by Picual, Manzanillo, Koroneiki, Dolce and Aggizi Shami in both seasons. The smallest leaf area was obtained in Arbequina olive cultivar (3.58 and 3.72 cm^2) in 2019 and 2020 seasons, respectively.

Flowering period

According to the data presented in the table (5), blooming in the first season began on April 1st and ended on April 21st, while blooming in the second season began on March 29th and ended on April 26th.

These data illustrated that flowering date varied among the tested cultivars. The earliest cultivars in terms of the beginning and end of flowering during the two seasons of study are Aggizi Shami, followed by Manzanillo and Dulce, while the latest the cultivars were Koroneiki, followed by Coratina and Picual. On the other hand, the differences in the date of flowering initiation were more varied for the varieties under this study compared to the differences in the end date of flowering, with the exception of Al-Aggizi Al-Shami and Manzanillo, where the end of flowering was approximately 6-8 days earlier than the other varieties during the two study seasons. Generally, the period from the beginning of the flowering to its end was shorter in the 2019 season compared to 2020 seasons.

Depending on the cultivar, the full bloom took among 7 and 15 days from the start of flowering. Furthermore, environmental factors such as temperature have a significant impact on the phonological behavior of olive trees. These data are compatible with Ikram *et al*. (2010), who noticed that flowering varied among cultivars as well as from season to season.

Table 5. Flowering period of seven some cultivars grown under saline condition during 2019 and 2020 seasons

Characters / Cultivars	Beginning		Full bloom		End of flowering	
	2019	2020	2019	2020	2019	2020
Aggizi Shami	April 1st	March 29th	April 6th	April 3rd	April 15th	April 17th
Dolce	April 5th	April 5th	April 10th	April 10th	April 20th	April 23rd
Picual	April 13th	April 11th	April 18th	April 16th	April 21st	April 22nd
Manzanillo	April 4th	April 2nd	April 9th	April 7th	April 17th	April 21st
Coratina	April 5th	April 5th	April 10th	April 10th	April 20th	April 23rd
Koroneiki	April 13th	April 11th	April 18th	April 16th	April 21st	April 26th
Arbequina	April 8th	April 9th	April 14th	April 13th	April 20th	April 22nd

Flowering characteristics

Data presented in Table (6) showed that flowers number / inflorescence were statistically varied among studied olive cultivars in both seasons. Coratina olive cultivar gave the highest values in this respect (18.26 and 18.41) followed by Aggizi Shami cv. (16.20 & 18.78). On the contrary, Picual olive cultivar recorded significantly last in this respect (11.63 and 11.03) in 2019 and 2020 seasons, respectively. The other olive cultivars were in among.

Also, data in Table (6) showed that the flowering density of seven olive cultivars under the study were significantly varied during both seasons and the values were ranged from 81.32 to 32.63 during the two experimental seasons. The highest flowering density was in Koroneiki and Aggizi Shami CVs. While the lowest values 38.54 and 32.63 recorded for Dolce in both seasons. The values of Picual, Manzanillo, Coratina and Arbequina cvs. We're not significant in both seasons.

Perfect flower percentages

Moreover, data in Table (6) clearly showed the differences among studied seven olive cultivars in this concern and the values were arranged from 69.43 to 39.09 during both seasons. The highest percentage of perfect flowers was achieved in Coratina olive cv. (66.62 & 69.43). On the contrary, the lowest percentage of perfect flowers was in Picual olive cultivar (39.09 & 44.33) in 2019 and 2020 seasons, respectively. The differences between Manzanillo, Arbequina, Aggizi Shami and Dolce cvs. Weren’t significant in both seasons.

Table 6. Flowering characteristics of some olive cultivars grown under saline stress conditions in Newly Reclaimed soils during 2019 and 2020 seasons

Characters / Cultivars	Number of flowers/ inflorescences		Flowering density		Perfect flower %	
	2019	2020	2019	2020	2019	2020
Aggizi Shami	16.20^{B}	18.78^{A}	72.92^{A}	65.96^{A}	46.56^{BC}	60.84^{AB}
Dolce	15.45^{B}	16.40^{BC}	38.54^{C}	32.63^{C}	45.25^{BC}	70.45^{A}
Picual	11.63^{D}	11.03^{D}	58.02^{B}	55.59^{AB}	39.09^{C}	44.33^{B}
Manzanillo	15.99^{B}	18.04^{A}	56.42^{B}	63.57^{AB}	50.22^{B}	47.06^{B}
Coratina	18.26^{A}	18.41^{A}	57.48^{B}	62.46^{AB}	66.62^{A}	69.43^{A}
Koroneiki	13.76^{C}	16.82^{B}	81.32^{A}	65.42^{A}	42.09^{BC}	47.80^{B}
Arbequina	13.60^{C}	15.68^{C}	57.88^{B}	51.62^{B}	47.64^{BC}	53.13^{B}

Means marked by the same letter are not significantly different at p = 5% level, using Duncan’s test.

Fruit set and Yield weight

Data in Table (7) showed that the percentage of initial fruit set, final fruit set and yield/tree of seven studied olive cultivars significantly differed in both seasons. Initial fruit set ranged among 23.73 to 45.96% in the first season and among 26.88 to 48.07% in the second seasons. Picual olive CV. had the lowest initial fruit set followed in ascending order by Aggizi Shami, Dolce, Manzanillo, Arbequina and Koroneiki in both seasons. Also, the highest percentage of final fruit set was (5.73 and 6.48%) in Arbequina followed by (5.32 and 6.30%) in Aggizi Shami, while the lowest percentage of final fruit set was achieved in Picual olive cv. (3.71 and 3.81%) in both seasons, respectively.

Table 7. Fruit set and yield weight (kg/tree) of some olive cultivars grown under saline stress conditions in Newly Reclaimed soils during 2019 and 2020 seasons

Characters / Cultivars	Initial fruit set %		Final fruit set %		Yield weight (kg/tree)		
	2019	2020	2019	2020	2019	2020	Mean
Aggizi Shami	36.09^{C}	35.57^{D}	5.32^{A}	6.30^{A}	43.08^{A}	23.44^{A}	33.26
Dolce	36.53^{C}	37.69^{C}	4.91^{AB}	5.69^{A}	36.16^{B}	19.41^{B}	27.79
Picual	23.73^{D}	26.88^{E}	3.71^{B}	3.81^{B}	32.42^{C}	18.18^{BC}	25.30
Manzanillo	37.79^{C}	38.77^{C}	3.80^{B}	5.33^{A}	35.12^{B}	17.03^{C}	26.08
Coratina	45.96^{A}	48.07^{A}	3.96^{B}	3.90^{B}	28.88^{D}	19.88^{B}	24.38
Koroneiki	42.27^{B}	46.17^{B}	4.39^{B}	6.28^{A}	22.69^{E}	18.67^{BC}	20.68
Arbequina	41.22^{B}	45.35^{B}	5.73^{A}	6.48^{A}	20.60^{E}	14.64^{D}	17.62

Means marked by the same letter are not significantly different at p = 5% level, using Duncan's test.

Moreover, yield weight per tree indicated the ability of the cultivar to have the economic production and its adaptability with cultivation region, as the yield was higher in the first season 2019 than the second one 2020 due to its climatic conditions. Maximum fruit yield values (43.08 and 23.44 kg/tree) were recorded in Aggizi Shami olive cultivar while minimum fruit yield values (20.60 and 14.64 Kg) were recorded in Arbequina olive cultivar in the first and second seasons, respectively. Average yield kg/tree over the two seasons were 33.26, 27.79, 26.08, 25.30, 24.38, 20.68 and 17.62 for Aggizi Shami, Dolce, Manzanillo, Picual, Coratina, Koroneiki and Arbequina, respectively. Based on the evidence provided by the results, it can be divided 7 studied cultivars for two orders, the first included Aggizi Shami, Dolce, Manzanillo and Picual CVs. which gave higher yield weight than 30 kg/tree and the second included Coratina, Koroneiki and Arbequina which yielded less than 30 kg / tree in both seasons.

Fruit characteristics

In general data in Table (8) showed the fruit characteristics of some studied olive cvs. Data declared that significant difference between the studied olive cultivars in 2019 and 2020 seasons. It is obvious that fruit weight values were differed according to cultivar and season and ranged from 1.21 and 1.10 in Arbequina to 10.08 and 9.41 in Aggizi Shami in 2019 and 2020 seasons, respectively. The other cultivars, Dolce, Manzanillo, Picual, Coratina and Koroneiki were in between in this respect. Fruit weight of olive cultivar reflects its yield and using of fruit in the olive product development and this character was affected by environmental conditions in seasons and cultivation regions as soon as different cultivars and nutritional status of olive trees.

From obvious data the percentage of flesh % significantly varied among studied cultivars in both seasons. In this respect, Aggizi Shami olive cultivar had the highest values (87.10 and 87.46) and the lowest ones (69.42 and 70.91) were in Arbequina olive cultivar in first and second studied seasons, respectively. Other olive cultivars were in among.

Table 8. Some fruit characteristics of some olive cultivars grown under saline stress conditions in Newly Reclaimed soils during 2019 and 2020 seasons

Characters / Cultivars	Fruit weight (gm.)		Flesh %		Fruit moisture content %		Oil % of fruit dry weight		
	2019	2020	2019	2020	2019	2020	2019	2020	Mean
Aggizi Shami	10.08^{A}	9.41^{A}	87.10^{A}	87.46^{A}	74.95^{A}	73.12^{A}	27.88^{E}	26.91^{E}	27.40
Dolce	4.63^{B}	4.06^{B}	81.21^{B}	82.51^{B}	72.29^{B}	71.78^{B}	33.75^{D}	31.46^{D}	32.61
Picual	3.74^{C}	3.60^{B}	79.41^{B}	79.44^{C}	70.01^{C}	69.72^{C}	38.82^{BC}	38.02^{B}	38.42
Manzanillo	4.78^{B}	4.13^{B}	80.54^{B}	80.15^{C}	72.35^{B}	72.09^{B}	37.33^{C}	35.92^{C}	36.63
Coratina	2.73^{D}	2.52^{C}	74.73^{C}	76.19^{D}	65.97^{D}	66.00^{D}	48.08^{A}	43.62^{A}	45.85
Koroneiki	1.78^{E}	1.66^{D}	76.41^{C}	75.30^{D}	62.54^{E}	61.07^{F}	49.04^{A}	44.17^{A}	46.61
Arbequina	1.21^{E}	1.10^{D}	69.42^{D}	70.91^{E}	63.01^{E}	62.48^{E}	40.15^{B}	37.20^{BC}	38.68

Means marked by the same letter are not significantly different at p = 5% level, using Duncan's test.

Also, data in Table (8) showed the fruit moisture content % of 7 studied olive cultivars. Fruit moisture content significantly differed among the studied olive cultivars; the highest values (74.95 & 73.12) were in Aggizi Shami olive cultivar and lowest percentage (62.54 & 61.07) in Koroneiki olive cultivar in 2019 and 2020 seasons, respectively. Other olive cultivars under study were in among.

Moreover, it can be noticed that oil fruit % significantly varied according to the olive cultivars and environmental conditions during both studied seasons. Koroneiki olive cultivar had the highest fruit oil percentage (49.04 & 44.17) while the lowest fruit oil percentage (27.88 & 26.91) were recorded in Aggizi Shami olive cultivar in 2019 and 2020 seasons respectively. In addition, the differences among Koroneiki and Coratina olive cultivars were not significant in both seasons. Average fruit oil content (%) over the two seasons was 46.61, 45.85, 38.68, 38.42, 36.63, 32.61 and 27.40% for Koroneiki, Coratina, Arbequina, Picual, Manzanillo, Dolce and Aggizi Shami, respectively.

Evaluation of saline water stress tolerance

Data in Table (9) showed that the contents of relative water, total chlorophyll and proline of leaves as indexes for salinity stress tolerance of studied olive cultivars. Leaf relative water content (RWC) showed high significant differences among the studied cultivars. Picual olive cultivar gave the highest values of leaf relative content followed in descending order by Arbequina, Aggizi Shami, Koroneiki, Manzanillo, Coratina and Dolce in both studied seasons.

Also, Significant differences of leaf total chlorophyll content values among seven studied olive cultivars growing under the salinity level 3392 ppm in this orchard during both seasons were shown. Picual olive cultivar had the highest significant content of chlorophyll while Dolce olive cultivar recorded the lowest significant in this respect. Other olive cultivars were among in 2019 and 2020 seasons.

Table 9. Relative water content, Total chlorophyll and proline content of some olive leaf cultivars grown under saline stress conditions in Newly Reclaimed soils during 2019 and 2020 seasons

Characters / Cultivars	Relative water content %		Total Chlorophyll mg / g f w		Proline µg / g f w	
	2019	2020	2019	2020	2019	2020
Aggizi Shami	80.75^{B}	78.12^{C}	3.02^{B}	2.93^{C}	29.45^{B}	29.92^{B}
Dolce	71.12^{D}	72.92^{E}	2.80^{D}	2.83^{C}	26.63^{C}	27.22^{C}
Picual	82.93^{A}	83.72^{A}	3.31^{A}	3.19^{A}	32.21^{A}	32.05^{A}
Manzanillo	76.81^{C}	77.32^{CD}	2.92^{C}	2.92^{C}	28.74^{B}	28.92^{C}
Coratina	76.14^{C}	75.34^{D}	2.89^{CD}	2.88^{BC}	28.11^{BC}	27.71^{C}
Koroneiki	77.89^{C}	80.61^{B}	2.91^{C}	3.01^{BC}	29.87^{B}	31.01^{B}
Arbequina	81.18^{AB}	80.07^{BC}	3.07^{B}	3.05^{B}	30.66^{AB}	31.89^{AB}

Means marked by the same letter are not significantly different at p = 5% level, using Duncan's test.

Moreover, data illustrated in Table (9) declared significant differences of leaf proline contents among olive cultivars during both studied seasons. Picual olive cultivar had the highest content (32.21 & 32.05) while the lowest leaf proline content was in Dolce olive cultivar (26.63 & 27.22) in 2019 and 2020 seasons, respectively. The other olive cultivars were in among.

Discussion

Olive trees are well known for their ability to adapt to various environments soil pH and humidity, from arid to semi-arid regions due to its high tolerance and high adaptability to poor soils, drought salinity, and excess of boron and chlorine. Olive trees are particularly important where soil is not suitable for other crops due to its ability to grow under several conditions and contributes to soil conservation likes other fruits trees, the quantity and quality of olive yield greatly dependent on the ecological environment with optimal practice management and genetic characteristics of any variety (Michelakis, 2002; Bignami *et al.*, 1994 and Cimato *et al.*, 1990).

The obtained results of the abovementioned flowering aspects positively affected by seven olive studied cultivars are in general agreement with that found by (Griggs *et al.*, 1975) who stated that the relative proportion of perfect and staminate flowers varies with varieties and with the particular year. Moreover, (Fabbri, *et al.*, 2004; Mehri, *et al.*, 2013 and Ahmed *et al.*, 2019) found that the percentage of perfect flowers in olive widely vary as a result of regional condition or year, cultivars, tree nutrition status as soon as shoots and inflorescence. Lavee *et al.* (1996) reported that flower bud induction and differentiation in olive trees depends on some factors as, environmental, nutrition and hormonal balance in the trees. In addition, a high percentage of perfect flowers can be important for fruit set and retention and certainly for the tree yield.

The yield of olive trees was the result of best plant growth, flowering and fruit set, all of which varies according to the olive cultivars and climatic conditions of the cultivation region and the extent of attention to the management of fertilization and irrigation on the olive orchard.

Results of initial and final fruit set of the studied olive cultivars may be due to the fruit set time, therefore early fruits set became larger and retained while the late fruits set did not continue to grow and fall. In addition, increasing the competition at bloom and after fruit set reduced and the percentage of retained fruits (Rosati *et al.*, 2010 and Eassa *et al*., 2011).

Al-Maaitah *et al*., (2009) and Tombesi *et al*., (1994) reported that fruit moisture contents can decrease with increasing evaporation process and the respiration rate resulted from hot weather, limited watering and lack of moisture during fruit ripening. Results are agreement with those reported by El-Said *et al*., 2006 and Ahmed *et al*., (2019).

The relative water content is one of the important physiological parameters to measure the water status. High salinity in water or soil decreases the RWC which varied according to the olive cultivars (Perica *et al*., 2008; Hassan *et al*., 2020).

The evaluation of chlorophyll content is very important since the reduction in chlorophyll content causes a reduction in photosynthetic activity of the plant. Leaf pigments in Picual olive trees were reduced in olive trees irrigated with saline water. Chlorophylls degradation under water stress conditions reported by (Bertamini *et al.,* 2006 and Gowda, *et al*., 2011) which may be related to the activity of photolytic enzymes (Tuna *et al.,* 2008).

Moreover, ability of olive cultivars to accumulate the proline in leaves was differed with differences of cultivars and environmental conditions. The accumulation of proline in leaves of olives grown under salt stress has a vital role in osmotic of cells and maintaining the intracellular stability and saving cells from the harmful effects of salting (Regni, *et al*., 2019).

From the previous study, it can be showed that olive cultivars differed in its fruit oil contents due to genetic trait and some management factors such as soil, temperature and climate (Oteros *et al*., 2014). The differences of the oil contents in the olive fruits are also related to the size of the fruit which is affected by the exogenous and endogenous factors (Hammami *et al*., 2011). Similarly, and El-Said *et al*., 2006 and Ahmed *et al*., (2019) revealed the differences among olive cultivars at some cultivation regions in concern the fruit oil content and that variation may be due to the environmental condition and nutritional status of olive trees.

Conclusion

In conclusion, our results cleared showed the tested olive cultivars had a different response to the environmental conditions of growing region. Therefore, the seven studied olive cultivars were significantly differed in tree vigor, flowering, fruit set, yield and fruit quality measurements as well as salt stress tolerance. In general, under the same conditions, it can be concluded to arrange and plant Aggizi Shami cultivar for pickling purpose and to plant Picual cultivar for double purpose as well as Coratina and Koroneiki for oil production.

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أداء بعض أصناف الزيتون النامية تحت ظروف الاجهاد الملحي بالأراضي الجديدة المستصلحة

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الملخص

أجريت الدراسة الحالية خلال موسمين متتاليين (2019 و2020) لتقييم سلوك وأداء سبعة أصناف من أشجار الزيتون النامية تحت ظروف الإجهاد الملحي بالأراضي الجديدة. حيث القدرة على التكيف البيئي للأنواع والأصناف لها تأثير كبير على التنمية الزراعية المستدامة والتكيف مع تغير المناخ في المناطق القاحلة وشبه القاحلة. لذا تم دراسة النمو الخضري والزهري والمحصول وخصائص الثمار ومحتويات الزيت ومدى التحمل للإجهاد الملحي لسبعة أصناف من الزيتون وهي عجيزي شامي، دولسى، بيكوال، منزانيللوا، كوراتينا، كوروناكي، اربيكوين، في التربة الجيرية المالحة.

أظهرت النتائج أن "كوراتينا" وكوروناكى سجلت أكبر حجم للأشجار ومساحة للأوراق بالمقارنة مع الأصناف الأخرى المدروسة، بينما سجل أقل القيم في صنفي اربيكوين ودولسى.

وكانت أفضل وأكثر عدد من النورات في صنفي كروناكي وعجيزى شامي بينما كان أقلها في الصنف دولسى.

اختلف التعبير الجنسي كنسبة مئوية من الأزهار المثالية بشكل كبير بين الأصناف المدروسة والمواسم.

وسجل أعلي محصول في أشجار العجيزى الشامي في عامي 2019 و2020 على التوالي في المقابل سجل الصنف أربيكوين أقل محصول.

وسجل صنفى كوروناكي وكوراتينا أعلي نسبة زيت بينما سجل صنفي عجيزي شامي ودولسى أقل نسبة.

كذلك أظهرت النتائج ان اعلى محتوى للأوراق من البرولين سجلت في صنفي بيكوال واربيكوين بينما اقلها كانت بالصنف دولسي.

من هذه النتائج نستنتج أن أنسب أصناف الزيتون تحت الظروف المدروسة هي كوراتينا وبيكوال وكوروناكى وعجيزي شامى.

مما سبق يمكن التوصية بالتوسع في زراعة صنف عجيزي شامي للتخليل وأصناف الزيتون كوروناكى وكوراتينا التي تصلح للزيت وكذلك الصنف بيكوال للغرضين لأنها تعطى إنتاجية أفضل وكذلك نسبة زيت عالية أي أن الأصناف الاربعة لديها استجابات مناسبة للملوحة ويوصي بزراعتها في المناطق المتأثرة بالملوحة لتحقيق عائد اقتصادي مرتفع للمزارع والدخل القومي.