Fruit and oil quality of olive (Olea europaea L.) under different irrigation regimes and harvest times in south eastern Australia

Ketema Tilahun Zeleke 1, 3* and Jamie Ayton 2, 3
1 School of Agricultural and Wine Sciences, Charles Sturt University, NSW 2650, Wagga Wagga, Australia. 2 Australia and Australian Oils Research Laboratory, NSW Department of Primary Industries, NSW 2650, Wagga Wagga, Australia. 3 Graham Centre for Agricultural Innovation, an alliance between Charles Sturt University and NSW Department of Primary Industries, NSW 2650, Wagga Wagga, Australia. *e-mail: kzeleke@csu.edu.au

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Abstract
Olive (Olea europaea L.) fruit growth and oil quality is affected by cultivar, degree of maturation and environmental factors such as water availability. In this study, a field experiment was conducted on 12 year old olive trees cv. Corregiola at Wagga Wagga, NSW (Australia) to determine the effect of irrigation and harvest time on olive fruit growth and the quantity and quality of oil. Three irrigation treatments during the olive pit hardening period were used: rainfed (0% of evapotranspiration), deficit irrigation (50% of evapotranspiration), and full irrigation (100% of evapotranspiration). Fruit water content decreased during the harvest window (April-July). The rainfed treatment had the highest maturity index, while the irrigated treatment had the lowest one. In the first year of this two-year experiment, at the last harvest date, the maturity index of fruits were 4.2, 4.0, and 3.4 for rainfed, deficit irrigation, and full irrigation treatments, respectively. Both extractable oil (mechanical extraction) and total oil (chemical extraction) from the rainfed treatments were higher than that of the other two treatments. The amount of oil extracted and extraction efficiency increased during the harvest period (April-July). The extraction efficiency was higher for rainfed treatment. Oil acidity increased during fruit ripening. No significant difference was observed between the peroxide values of the treatments and also polyphenol content. Chemical properties of olive oil are highly influenced by harvest time, while irrigation slows the ripening process of olive fruits.

Key words: Deficit irrigation, fruit water content, oil extraction efficiency, oil quality.

Introduction
Olive oil production is showing a significant growth in many regions of the world conducive for its production. The antioxidant content and other health benefits of olive oil make it preferable to consumers over other oils. Olive fruit, oil yield and quality are affected by olive cultivar 1, place of cultivation 2, degree of maturation 3, and irrigation 4. Compared to other horticultural crops, olive trees are highly drought tolerant. Therefore, traditionally olives are grown under rainfed conditions. Since olive trees response to additional water is significant, recently intensive commercial production, which requires significant water input (irrigation) to succeed, has become increasingly popular. However, in arid and semiarid regions where olives are grown, optimal use of the limited water is necessary.

In order to obtain good quality olive oil, it is important that the oil is extracted from undamaged fruits at optimal ripeness. The influence of ripening on olive oil quality and changes in chemical composition of extracted oil during ripening have been reported by several researchers 5-10. These studies reported that the best time to harvest olive is when olives are ripe, oil accumulation is complete and the oil is at its best quality. However, the degree of maturation of olive fruits varies, according to the growing area, olive variety, and cultural practices.

Olives harvested relatively early, yield less oil, which is lower in free fatty acids, than olives harvested late 6. During ripening, important chemical changes occur within the fruit, related to the synthesis of organic substances that may affect olive oil quality 11. Mailer 12 stated that in many cases oil quality shows higher difference between early and late harvested fruit than between the cultivars. Garcia et al. 8 studied the change in oil content and oil quality during fruit ripening, but only under a single water supply treatment. The few studies conducted so far under different water availability conditions have shown that low amounts of irrigation lead to less oil accumulation 13-16. High water application leads to difficulty, when extracting the oil and produces oils with a shorter shelf life 17. Considering the site and cultivar specific nature of olive oil production, it is important to understand the effect of irrigation regime and harvest time on olive oil quantity and quality in different olive production regions. In this study, physical and oil chemical quality parameters of cv. Corregiola were determined at different stages of ripening under three irrigation regimes in a semiarid region of Australia. This helps to understand the effect of irrigation and harvest time on fruit and oil quality in the region.

Materials and Methods
Experimental setup: The experiment was conducted on a 12 year old olive trees cv. Corregiola at the Wagga Wagga campus of Charles Sturt University (35°03′ S; 147°21′ E; 235 m asl), NSW (Australia) during the 2010/11 and 2011/12 seasons. Spacing was 5 m between trees and 7 m between the rows. There were 21 rows of olive trees with 9 to 24 trees per row. Olive cv. Corregiola was one of several varieties in the grove area. In this study, nine cv. Corregiola trees were randomly selected from all the rows and randomly assigned to the three treatments with three replications.
Water was applied using two drip irrigation laterals per tree row laid 50 cm on either side of the trees. Irrigation was controlled using solenoids fitted at the upstream end of each lateral. Pressure compensated drippers with flow rate of 2.3 L h⁻¹, and spaced 60 cm on the laterals were used to apply irrigation water to the trees. The three irrigation treatments were: I treatment (based on applying the full ETc requirement), D treatment (applying only half the ETc requirement during the pit-hardening period), and R treatment (not irrigating at all during the pit-hardening period).

The three treatments refer only to the water applied during the pit-hardening period. In the first year, due to sufficient rainfall, irrigation started only in January and ended in April. Rainfall and irrigation received by the three treatments are presented in Table I.

### Table I. Monthly and annual rainfall and irrigation during the experimental period for the three treatments.

<table>
<thead>
<tr>
<th>Month</th>
<th>2010/11 Rainfall (mm)</th>
<th>2010/11 Irrigation (mm)</th>
<th>2011/12 Rainfall (mm)</th>
<th>2011/12 Irrigation (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>September</td>
<td>74 R 0 D 0 I</td>
<td>25 R 11 D 11 I</td>
<td>25 R 11 D 11 I</td>
<td>25 R 11 D 11 I</td>
</tr>
<tr>
<td>October</td>
<td>135 R 0 D 0 I</td>
<td>20 R 44 D 44 I</td>
<td>20 R 44 D 44 I</td>
<td>20 R 44 D 44 I</td>
</tr>
<tr>
<td>November</td>
<td>84 R 0 D 0 I</td>
<td>148 R 64 D 64 I</td>
<td>148 R 64 D 64 I</td>
<td>148 R 64 D 64 I</td>
</tr>
<tr>
<td>December</td>
<td>148 R 0 D 0 I</td>
<td>65 R 4 19 D 37 I</td>
<td>65 R 4 19 D 37 I</td>
<td>65 R 4 19 D 37 I</td>
</tr>
<tr>
<td>January</td>
<td>44 R 39 D 78 I</td>
<td>72 R 0 D 37 I</td>
<td>72 R 0 D 37 I</td>
<td>72 R 0 D 37 I</td>
</tr>
<tr>
<td>February</td>
<td>160 R 48 D 96 I</td>
<td>51 R 0 D 20 I</td>
<td>51 R 0 D 20 I</td>
<td>51 R 0 D 20 I</td>
</tr>
<tr>
<td>March</td>
<td>50 R 24 D 48 I</td>
<td>193 R 4 6 I</td>
<td>193 R 4 6 I</td>
<td>193 R 4 6 I</td>
</tr>
<tr>
<td>April</td>
<td>27 R 0 D 23 46 I</td>
<td>8 R 0 D 12 24 I</td>
<td>8 R 0 D 12 24 I</td>
<td>8 R 0 D 12 24 I</td>
</tr>
<tr>
<td>May</td>
<td>27 R 0 D 0 42 I</td>
<td>0 R 0 D 0 42 I</td>
<td>0 R 0 D 0 42 I</td>
<td>0 R 0 D 0 42 I</td>
</tr>
<tr>
<td>June</td>
<td>26 R 0 D 0 17 I</td>
<td>0 R 0 D 0 17 I</td>
<td>0 R 0 D 0 17 I</td>
<td>0 R 0 D 0 17 I</td>
</tr>
<tr>
<td>July</td>
<td>32 R 0 D 0 42 I</td>
<td>0 R 0 D 0 42 I</td>
<td>0 R 0 D 0 42 I</td>
<td>0 R 0 D 0 42 I</td>
</tr>
<tr>
<td>August</td>
<td>41 R 0 D 0 27 I</td>
<td>0 R 0 D 0 27 I</td>
<td>0 R 0 D 0 27 I</td>
<td>0 R 0 D 0 27 I</td>
</tr>
<tr>
<td>Total</td>
<td>848 R 134 266 I</td>
<td>710 R 123 211 299</td>
<td>710 R 123 211 299</td>
<td>710 R 123 211 299</td>
</tr>
</tbody>
</table>

R = Rainfed; D = Deficit; I = Irrigated.

### Weather and irrigation:
Average annual rainfall in the region is 543 mm with maximum (54 mm) in September and minimum (35 mm) in February. During the two year experimental period, above average rainfall (848 and 710 mm) was recorded in the region after 10 years of below average rainfall. Long-term average annual evapotranspiration is 1446 mm with maximum (234 mm) in January and minimum (33 mm) in July. Long-term average maximum temperature is 22.5°C with the highest monthly value in January (32°C), and the lowest monthly value in July (13.1°C). Long-term average minimum temperature is 9.2°C with the highest monthly value in January (16.3°C), and the lowest monthly value in July (3.2°C).

### Determination of maturity index:
Maturity index (MI) was determined using a simple technique by observing the outer and inner colour change of the fruits. For this purpose, 100 fruits were harvested from each tree (3 trees per treatment) five times during the olive harvest period in the region (April-June). Each fruit was categorised in one of the seven scores based on the skin and pulp colour. Then, the MI was calculated as the weighted average colour score of the 100 fruits.

### Cold press or mechanical extraction of oil:
About one kilogram of fruit was harvested from each of the nine trees (3 treatments and three replications). The fruit was ground to a paste using a hammer mill. The sample was thoroughly mixed and 700 g of the pulp was weighed into a mixing jar, placed in the thermo-malaxer and allowed to stir for 20 min at 25°C. Boiling water (300 mL) was added, and the sample was stirred for a further 10 min. The sample was centrifuged for 1 min. The oily must was collected into a measuring cylinder; the pomace was rinsed with 100 mL of boiling water, centrifuged for 1 min, and the remaining mist collected again into the measuring cylinder. After allowing some time for the sample to settle, the volume of oil was recorded. The oil was transferred to a glass bottle and sealed under nitrogen until further analysis. For comparison with the chemically extracted (total) oil, this volume of oil was converted to mass basis using the density of olive oil (0.850 g cm⁻³) as:

\[ \text{Extracted oil percentage (\%) = \left( \frac{\text{cm}^3 \text{ of obtained oil} \times 0.850}{\text{Weight of paste}} \right) \times 100 } \]

### Determination of water content:
About 30 g of olive pulp prepared as above was transferred to a previously weighed Petri dish. The sample was dried in a dehydrator at 80°C for 24 hours, removed from the oven, placed in a desiccator, and cooled to room temperature. The dry weight of the sample was recorded, and the water content of the fruit was calculated as a percentage of the fruit weight.

### Total oil extraction:
Total olive oil content was determined using solvent extraction method. The dried pulp described above was reground and transferred to a cellulose extraction thimble. The oil was extracted overnight (16 hours) using a Goldfische extraction apparatus and hexane. The mass of oil was determined gravimetrically after removal of solvent. The oil content was expressed as a percentage of the dry weight of the olive fruit.

### Oil quality analysis:
Total polyphenol content was determined using a modification of the Gutfinger method, with caffeic acid as a standard to determine total polyphenol content. Induction time was measured using a Metrohm 743 Rancimat (Metrohm AG, Switzerland). Free fatty acids were determined by American Oil Chemists Society method (Ca 5a-40). The fatty acid profiles were determined by International Olive Council (IOC) method COI/T2.0/Doc.24, using gas chromatography with a SGE BPX70 capillary column (30 m, 0.25 mm, 0.25 µm film) and a flame ionisation detector. Results are expressed as a percentage of the total fatty acids. Peroxide value was determined using the ISO method 3690:2007. The results were reported as mEq of active oxygen kg⁻¹ oil.

### Statistical analysis:
Means were compared using ANOVA and Tukey’s HSD technique. Statistical significance was established at the p ≤ 0.05 level.

### Results and Discussion

#### Fruit water content:
In three of the five first harvest times of the 2010/11 season, the rainfed treatment (R) had significantly lower water content compared to the other treatments (Fig. 1). Little or no difference was observed between the water content of the deficit and full irrigation treatments. In 2011/2012, there was no significant difference between the fruit water content of the three treatments. A very high rainfall in March 2012 substantially increased the fruit water content. Due to low evapotranspiration, the fruit water content remained high during the following months. As a result, the average end-of-season fruit water content was
In 2010/2011, from the first harvest (4 April) to the last harvest, fruit water content is an indication of the effect of watering regime. In 2010/2011, and 55% in 2011/2012. This shows that fruit water content was higher in the second year than in the first year.

The variation of oil extraction efficiency with fruit water content at different harvest times for olives subjected to three irrigation treatments during the 2010/2011 and 2011/2012 seasons at Wagga Wagga, NSW (Australia).

Figure 1. The variation of oil extraction efficiency with fruit water content at different harvest times for olives subjected to three irrigation treatments during the 2010/2011 and 2011/2012 seasons at Wagga Wagga, NSW (Australia). WC = Water content, EE = extraction efficiency.

44% in 2010/2011, and 55% in 2011/2012. This shows that fruit water content is an indication of the effect of watering regime. In 2010/2011 season, from the first harvest (4 April) to the last harvest (4 July), fruit water content decreased from 52% to 41%, from 56% to 45%, and from 58% to 46% for non-irrigated, deficit, and irrigated treatments, respectively (Fig. 1). In 2011/2012, the water content over the harvest period decreased from 66% to 54%, 64% to 56%, and 64% to 58% for R, D, and I treatments, respectively. This shows that fruit water content was higher in the second year than in the first year.

Maturity index: The maturity index (MI) in 2010/2011 (Fig. 2a) clearly reflected the effect of watering regime on the fruit ripeness. The non-irrigated treatment showed consistently higher MI, while the fully irrigated treatment had the lowest MI and the partially irrigated treatment in between. Similar studies by Berenguer et al., 23, Gomez-Rico et al., 24, Koseoglu et al., 25, Ramos and Santos 26 and Toplu et al. 27 have shown that as the amount of applied water increases, olive maturity index decreases. Koseoglu et al. 25 noted that olives are assumed to be mature, when MI of 5 is achieved. In this study, it can be seen that this MI was not achieved for any of the irrigation treatments applied, even at the end of the harvest season. Although the irrigated treatment had consistently lower MI value, the difference was significant only at one sampling time.

Iniesta et al., 28 indicated that deficit irrigation does not result in earlier fruit ripeness for cv. Arbequina. In contrast, Motilva et al., 29 found a higher ripeness index under regulated deficit irrigation for cv. Arbequina. Toplu et al. 27 obtained significantly different maturity index values of 5.23, 4.85, and 4.32 for non-irrigated, irrigated at 50% ETc, and irrigated at 100% ETc, for cv. Gemlivo olive. Berenguer et al. 23 and Gomez-Rico et al. 24 also reported that the higher the amount of irrigation, the lower the maturity index values compared with rainfed olives. In general, additional irrigation seems to delay the ripening of olives.

Extractable and total oil content: The evolution of mechanically extracted (extractable) and chemically extracted (total) oil content of the fruits during the olive harvest window is presented in Fig. 3. Comparison of mechanically extracted oil and chemically extracted oil (Fig. 2) shows that the olive fruits potentially contained high amount of oil. The higher the fruit water content, the lower the effectiveness of mechanical extraction. Since irrigation does not increase fruit oil content, increase in oil yield with irrigation was obtained as a result of increase in fruit yield. Iniesta et al., 28 observed that deficit irrigated olives have lower total oil yield, but higher oil concentration compared to a control treatment receiving full irrigation. Fig. 3b shows that the total oil content during the second season (2011/2012) was very low. Garcia et al. 6 observed that total oil content of five olive varieties did not significantly change during the ripening stage. Garcia and Mancha, 29 also made a similar observation. This implies that just because more oil is extracted from relatively ripened fruits does not mean that there is higher total oil content.

Oil content in olives is generally either slightly affected 13, 24 or not affected 20, 31, 32 by irrigation. In this study, the total oil content was not significantly (P≤0.05) affected by the irrigation treatment, which shows that the irrigation treatment was not contrasting

Figure 2. Maturity index of olive cv. Corregiola subjected to three irrigation treatments during the 2010/2011 and 2011/2012 seasons at Wagga Wagga, NSW (Australia).
and Lavee and Wodner 34, who reported that application of fruit water content (Fig. 1) in the fruit caused low mechanical extraction of oil. Higher water content was an important factor in determining the amount of oil extracted from the irrigated treatments. This shows that fruit water content (enough to influence the oil accumulation. However, the irrigation treatments significantly affected the mechanically extractable oil of the fruits. Mechanically extracted oil was highest in the non-irrigated treatment, lowest in the fully irrigated treatment, and intermediate in the partially irrigated treatment. Higher water content was an important factor in determining the amount of oil extracted from olives. This result agrees with those of Morales-Sillero et al. 23 and Lavee and Wodner 34, who reported that application of irrigation causes an increase in fruit and oil yield, but a decrease in mechanically extractable oil. However, other studies reported no differences in oil content, when different irrigation regimes were applied 29, 32, 35. Lavee et al. 13 suggested that a possible explanation is that response of oil content might be cultivar dependent. Interestingly, in our study, the total oil content was also higher in the non-irrigated treatments compared to those which were irrigated, although the observed difference was lower than that observed for the mechanically extracted oil.

As can be seen from Fig. 2, the fruit from the different irrigation treatments showed different maturity levels with the irrigated treatment less mature than those which were non-irrigated. Koseoglu et al. 25 reported similar observation concluding that harvesting the olives at the same maturity index value would probably result in smaller differences in oil content between treatments, due to continuous oil accumulation for the period taken to reach a given ripeness index.

Free fatty acid: In the second year of the experiment, except at the last harvest, it was not possible to get enough oil (for chemical analysis) from the fruit samples due to low fruit yield, low oil content, and high water content. Therefore, unless stated, the following results and discussion are mainly from the results of the experiment done in the first year. The oil free fatty acid (FFA) content was well below the IOC limit of 0.8% extra virgin olive oil (Fig. 4a). There was no significant (P ≤ 0.05) difference between the three irrigation treatments in terms of free fatty acid content, although irrigated treatments resulted in slightly, but consistently lower free fatty acid content. Several reports 23-25, 27 observed that free fatty acid shows a steady decline with increasing amounts of applied water. However, Stefanoudaki et al. 36, Ramos and Santos 38, Patumi et al. 32, Dag et al. 38 and Vossen et al. 32 found that increased irrigation quantity increases the free fatty acid level of olive oil.

The general trend was that acidity increased during fruit ripening. Al-Maatih et al. 38 investigated the effect of harvest date on oil quality parameters in Jordan. It was reported that the free fatty acid increased from 0.35% for fruits harvested in October to about 0.8% for January harvest. The increase in FFA was mainly due to enzyme activity caused by olive tissue damage with ripening 9. This shows that FFA increases with maturity of the fruits. That might explain why the percentage FFA of the non-irrigated treatments was higher than those which were irrigated at all harvest times. The FFA at the last harvest of the 2011/2012 season was highest (0.52) for rainfed treatment and lowest (0.21) for the irrigated treatment. Irrigation affected maturity of the fruits which in turn can affect the FFA.

Peroxide value: Peroxide value is used as an indicator to reveal enzymatic and oxidative deterioration in oil 39. There was no significant difference (P ≤ 0.05) between the peroxide values of the treatments at all the harvest times (Fig. 4). Varying results were obtained from previous studies. While some researchers indicated that irrigation supplement increased the peroxide value 23, 24, others found insignificant changes 31, 32. In this study, the peroxide value was lower than the maximum level of peroxide permitted by international standards (20 mEq O₂.kg⁻¹ oil) (Fig. 4b). In a previous study conducted in the area, Mailer 32 reported 8 - 10 mEq O₂.kg⁻¹ oil for cv. Corregiola. Salvador et al. 38 showed that peroxide value decreases with fruit maturity. In our study, peroxide value showed only little variation over the five harvest events.

Induction time: Induction time, or oxidative stability of olive oil is influenced by many factors, the main being the fatty acid profile and the amount of antioxidants present. In this study, induction time did not show a consistent trend over the harvest period, indicating a slight increase later in the season in irrigated treatments, and a slight decrease in the non-irrigated treatments. These trends show that maturity level affects induction time. Normally, induction time gets shorter with maturity. Mailer and Ayton 40 found that cvs. Corregiola, Manzanillo, Nevadillo, and Paragon harvested late have lower induction time compared to those harvested earlier. The similarity of the trend in Fig. 4c and d, decreasing from the first to the second harvest and then slightly.
is known to decrease with the ripening process. It can be seen fruit maturity index during this period (Fig. 2). Polyphenol content which increased polyphenol concentration. This decrease could high and it declined sharply to a lower level at the second harvest April), polyphenol content of the fruits in all the treatments was lower than that of the other treatments. Patumi found the highest content of phenolic substances in the oil from the non-irrigated treatments. They attributed the difference in polyphenol content between the irrigation treatments to the amount of water applied; not to the degree of ripeness as they observed uniformity of ripeness among the treatments, but this was not the case in our study. Irrigation was stopped at the end of April (second harvest). This resulted in the decrease of soil and fruit water content, which caused increase in oil phenol content.

The unusually lower polyphenol content of the non-irrigated treatments compared to the irrigated treatments might be due to the relatively higher maturity of the non-irrigated treatments (Fig. 2). Tovar et al., Gomez-Rico et al., Koseoglu et al. and Vossen et al. found lower total phenol content, and as a result, lower intensity of bitterness in oils originating from trees receiving more water. These studies were conducted under the condition of higher water stress. Probably, in our study, the non-irrigated trees were not stressed enough due to high rainfall during the season. Maturity level, rather than irrigation, might have affected phenol content. Serman et al. reported polyphenol increase of 65% and 75%, when irrigation was reduced, respectively, by 58% and 67% relative to the fully irrigated treatment. Mailer indicated that polyphenol content significantly decreased with the maturity of olives. In this study, the partially and fully irrigated olives matured very slowly relative to the non-irrigated treatment, with end of season polyphenol content of rainfed treatments being significantly lower than that of irrigated ones. The decrease in phenolic concentration as ripeness advances was also shown by Tamendjari et al. Shibasaki also observed that total phenolic content of olive oil decreases during the harvest period from 413 to 253 mg kg⁻¹. Salvador et al. observed that polyphenol contents decreased slightly as fruits ripened. Polyphenol content from the last harvest of the 2011/2012 season was highest for the irrigated treatment (303 mg kg⁻¹) and lowest for the rainfed treatment (79 mg kg⁻¹).

Total polyphenols: There was no significant difference (P ≤ 0.05) between polyphenol content of the oil obtained from the trees subjected to the three watering regimes. At the first harvest (4 April), polyphenol content of the fruits in all the treatments was high and it declined sharply to a lower level at the second harvest (27 April) (Fig. 4d). This may be due to low rainfall in this month, which increased polyphenol concentration. This decrease could also be related to fruit maturity, as there was a sharp increase in fruit maturity index during this period (Fig. 2). Polyphenol content is known to decrease with the ripening process. It can be seen that the polyphenol content of non-irrigated treatments was significantly higher than that of the others during the first harvest. During the next two harvests, it was very close to the values of the other treatments. However, during the last two harvests, it was lower than that of the other treatments. Patumi et al., after comparing treatments irrigated with 0%, 33%, 66%, and 100% ETc, found the highest content of phenolic substances in the oil from the non-irrigated trees. They attributed the difference in polyphenol content between the irrigation treatments to the amount of water applied; not to the degree of ripeness as they observed uniformity of ripeness among the treatments, but this was not the case in our study. Irrigation was stopped at the end of April (second harvest). This resulted in the decrease of soil and fruit water content, which caused increase in oil phenol content.

Free fatty acid profile: The fatty acid profile is important in determining oil quality and stability. The fatty acid composition of olive oil is influenced by different factors, such as the variety of the olive tree, agricultural and climate factors. Table 2 shows that oleic acid (C18:1) was highest in irrigated treatments and lowest in the non-irrigated treatments. In all the three treatments, it was increasing with ripening of the fruits. Palmitic and palmitoleic acids decreased slightly with the ripening of the fruits as also observed by Shibasaki. There was no significant difference (P ≤ 0.05) between the treatments in terms of the fatty acid profile, except C18:1 (oleic) and C18:2 (linoleic) in the 2010/2011 season.
The effect of water stress on olive oil quality was not clear. Due to high rainfall in both experimental seasons, harvest time and ripening. Irrigation slows the ripening process slightly with the ripening of fruits. The analytical results show the water content levels in the olive fruits. The FFA content was highest in the ripe fruits, while the fatty acid composition changed with the water content levels in the olive fruits. The FFA content was highest in the treatment, which received the highest amount of water. The percentage of water in olive fruit considerably affects the extractability of the oil, although the water has no direct effect on the water. The oleic acid content was lowest in the rainfed treatment (73.2), and the highest in the irrigated treatment (77.6), while the linoleic acid content was lowest in the irrigated treatment (7.2), and highest in the rainfed treatment (11.0). However, in 2011/2012, there was no significant difference between the treatments. D’Andria et al., who conducted a similar experiment with four water application components with highest oleic acid content in the treatment, which received the lowest amount of water and the highest linoleic acid content. Serman et al. applied three irrigation treatments and found significant difference between the treatments, in terms of oleic and linoleic acid components with highest oleic acid content in the treatment, which received the highest amount of water.

Conclusions
The percentage of water in olive fruit considerable affects the extractability of the oil, although the water has no direct effect on the quality of the oil. When deciding on the optimal harvest time for the highest possible oil yield, it is very important to consider the water content levels in the olive fruits. The FFA content was highest in the ripen fruits, while the fatty acid composition changed slightly with the ripening of fruits. The analytical results show that the chemical properties of olive oil are highly influenced by harvest time and ripening. Irrigation slows the ripening process of olive fruits. Due to high rainfall in both experimental seasons, the effect of water stress on olive oil quality was not clear.

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References


