

## UNDERSTANDING OLIVE OIL YIELD (factors affecting crop and extraction)

The amount of oil a producer gets from an acre depends primarily on the tonnage yield of fruit per acre, which varies by year, fruit set, irrigation, pruning, age of trees, etc. This seems straightforward, but it must be noted that oil yield and fruit yield do not necessarily increase at the same rate. This is because olive trees have an ability to produce more oil with an increased leaf-to-fruit ratio; this partially makes up for lower fruit tonnage. In other words, there is not an exact straight-line correlation between fruit yield and oil yield. Oil yield also depends on the amount of oil contained in the specific olive variety and how easily it is extracted.

The amount of oil that a producer gets from a given amount of fruit depends on many factors:

- **Oil content of the fruit** – varies by year, amount of fruit on the tree, and variety
- **Extractability of the oil from the fruit** – varies by year, water content, fruit maturity, and variety
- **Extraction process** – varies by paste fineness; malaxation time and temperature; decanter efficiency, and/or the amount of time and pressure used on the press cake.

### Yield of olives per acre

Yields per acre can range from less than one to as high as 9 tons per acre (2-20 metric tons per hectare); a good consistent yield from year to year would be about 4 tons per acre (9 metric tons per hectare). Low yields usually can be related back to a lack of shoot growth the previous year from poor tree vigor. This can be caused by inadequate irrigation or dry farming, poor weed control, disease, very low fertility, or inappropriate pruning.

Low yields can also be caused by poor weather conditions during bloom, lack of chilling, frost damage, or inadequate flower pollination. Olives are strongly alternate bearing, so a low crop yield one year will likely promote more shoot growth, resulting in more flowers and higher yields the following year. High yields are produced consistently only from orchards that are very well managed (Table 1).



*Olive tree laden with a very heavy crop*

An orchard that yields twice the fruit that it did last year does not necessarily yield twice the amount of oil. Normally a doubling of fruit yield will only increase the total oil yield by about 75%. The range of oil content and extractability can be from 50% to 120% greater based on 100% more fruit. As an example, say your production increased from 2 tons/acre last year to 4 tons per acre and your oil yield was 45 gallons per ton last year. Last year you received 90 gallons of oil and would naturally expect to get 180 gallons this year (4 tons x 45 gallons/ton). Your actual range of total oil yield this year, however, from 4 tons of fruit would be from 135 gallons to 198 gallons. These yields all depend on the factors listed above.

**Table 1 ORCHARD YIELD PROJECTION SCENARIOS FOR OIL OLIVES**

Fruit Yield	Factors Affecting Yield
<b>1 TON PER ACRE</b> <b>2.24 METRIC TONS/ HA</b>	<ul style="list-style-type: none"> <li>Widely spaced orchard in the 5<sup>th</sup> – 6<sup>th</sup> year or older orchard with close spacing that is shading out in the lower portions of the trees.</li> <li>Poor irrigation, weed control, pruning and nutrient management.</li> <li>Excessively vigorous or weak growing conditions.</li> <li>Poor pollination conditions from rain, cold, drought stress, or hot-dry wind during bloom, or inadequate pollinizer trees.</li> <li>Alternate “off” year of production.</li> <li>Super-high-density orchard in the 2<sup>nd</sup> year.</li> </ul>
<b>2 TONS PER ACRE</b> <b>2.48 METRIC TONS/ HA</b>	<ul style="list-style-type: none"> <li>Widely spaced orchard in the 6<sup>th</sup> – 8<sup>th</sup> year or poor irrigation, weed control, pruning and nutrient management.</li> <li>Excessive shading. Alternate “off” year of production from very heavy production last year.</li> <li>Excessively vigorous or weak growing conditions.</li> <li>Poor pollination conditions from rain, cold, drought stress, or hot-dry wind during bloom, or inadequate pollinizer trees.</li> <li>Super-high-density orchard in the 3<sup>rd</sup> year.</li> </ul>
<b>3 TONS PER ACRE</b> <b>6.73 METRIC TONS/ HA</b>	<ul style="list-style-type: none"> <li>Properly spaced orchard in the 9<sup>th</sup> – 10<sup>th</sup> year with good irrigation, weed control, pruning and nutrient management.</li> <li>Probable maximum yield from a coastal hillside orchard.</li> <li>Some shading problems. Some poor weather during bloom or a lack of pollinizer trees.</li> <li>Super-high-density orchard in the 3<sup>rd</sup> year.</li> </ul>
<b>4 TONS PER ACRE</b> <b>8.97 METRIC TONS/ HA</b>	<ul style="list-style-type: none"> <li>Properly spaced orchard in the 10<sup>th</sup> year + with good irrigation, weed control, pruning and nutrient management.</li> <li>A great sustainable yield if everything is done right and nature cooperates.</li> <li>Trees have the correct vigor and growing conditions.</li> <li>Well managed super-high-density orchard in the 4<sup>th</sup> + years.</li> </ul>
<b>5 TONS PER ACRE</b> <b>11.21 METRIC TONS/ HA</b>	<ul style="list-style-type: none"> <li>Properly spaced orchard in the 10<sup>th</sup> year + with excellent irrigation, weed control, pruning and nutrient management.</li> <li>An excellent yield especially if it can be sustained each year.</li> <li>Alternate “on” year of production from a low yield last year.</li> <li>Perfect growing conditions and doing everything right.</li> <li>Very well managed super-high-density orchard in the 4<sup>th</sup> + years.</li> </ul>
<b>&gt; 6 TONS PER ACRE *</b> <b>&gt; 13.45 METRIC TONS/ HA</b>	<ul style="list-style-type: none"> <li>Properly spaced orchard in the 10<sup>th</sup> year + with excellent irrigation, weed control, pruning and nutrient management.</li> <li>Yield that probably cannot be sustained each year.</li> <li>Alternate “on” year of production from a very low yield last year.</li> <li>Perfect growing conditions and doing everything right.</li> <li>Excellent management in a super-high-density orchard in the 4<sup>th</sup> + years.</li> </ul>
<i>* Yields have been recorded in table olives in California at 12 tons per acre (26.9 metric tons per hectare). This is usually preceded by a light crop and followed by a very light crop.</i>	

**Yield of oil per ton**

The quantity of oil in the fruit is a built-in genetic factor, but it can vary from year to year due to tree vigor, crop load, fruit maturity, and fruit moisture content. Oil content varies by variety from less than 10% to about 30% on a dry weight basis. Since oil accumulation peaks when the fruit is quite mature, delaying harvest until the fruit is ripe assures the highest yield of oil, though it will change some flavor characteristics, and extractability if the weather is rainy.

The fruit’s water content influences the percentage of oil relative to moisture, so drier fruit will have a higher percentage of oil by weight. The extractability of the oil from the fruit is heavily



<b>Table 2. APPROXIMATE OIL YIELD FROM 1 TON OF OLIVES WITH DIFFERENT OIL CONTENT &amp; EXTRACTABILITY (% on wet weight basis)</b>	
<i>Olive Variety – Water Status - Ripeness</i>	<i>Oil Yield</i>
Green over-watered Sevillano	10 gal of oil/t 4 % = 37.9 liters
Ripe Sevillano - Green Ascolano	15 gal of oil/t 6 % = 56.8 liters
Very ripe Sevillano – Ripe Ascolano	20 gal of oil/t 8 % = 75.7 liters
Over-watered, green Arbequina or Manzanillo Very ripe deficit-irrigated Ascolano	25 gal of oil/t 9.5 % = 94.6 liters
Ripe over-watered Arbequina or Manzanillo Green over-watered Frantoio, Leccino	30 gal of oil/t 11 % = 113.5 liters
Very ripe Arbequina or Manzanillo – Green over-watered Mission - Ripe over-watered Frantoio, Leccino	35 gal of oil/t 13 % = 132.5 liters
Ripe Frantoio, Leccino – Green Mission Deficit-irrigated Arbequina or Manzanillo	40 gal of oil/t 15 % = 151.4 liters
Ripe over-watered Mission Ripe, deficit-irrigated Frantoio, Leccino	45 gal of oil/t 17 % = 170.3 liters
Ripe Mission, Picual	50 gal of oil/t 19 % = 189.3 liters
Very ripe, deficit-irrigated Mission, Picual	55 gal of oil/t 21 % = 208.2 liters

influenced by fruit moisture content, maturity, and many specifics of the extraction process such as paste fineness, malaxation time and temperature, and extraction machinery type. Some varieties give up their oil quite easily and others hold on to it as an emulsion (watery gel) that escapes with the fruit-water or pomace solids. It is difficult to extract the oil from fruit that has been over-irrigated and has a high moisture content. Fruit with low moisture has a higher percentage of oil and that oil is easier to extract. Table 2 indicates by variety, fruit moisture, and ripeness the approximate theoretical oil yield extracted from a ton of olives.

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*Thick, crumbly, dry paste from Frantoio variety olives that does not emulsify and separates easily. Note clean paddles due to coating of free oil*



*Wet, over-watered, very ripe Manzanillo paste that forms an emulsion between oil and water, which increases losses in the pomace or wastewater. Note paddles in the malaxator are covered with sticky paste.*

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