University of California Cooperative Extension

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Newsletter of Olive Oil production and Evaluation

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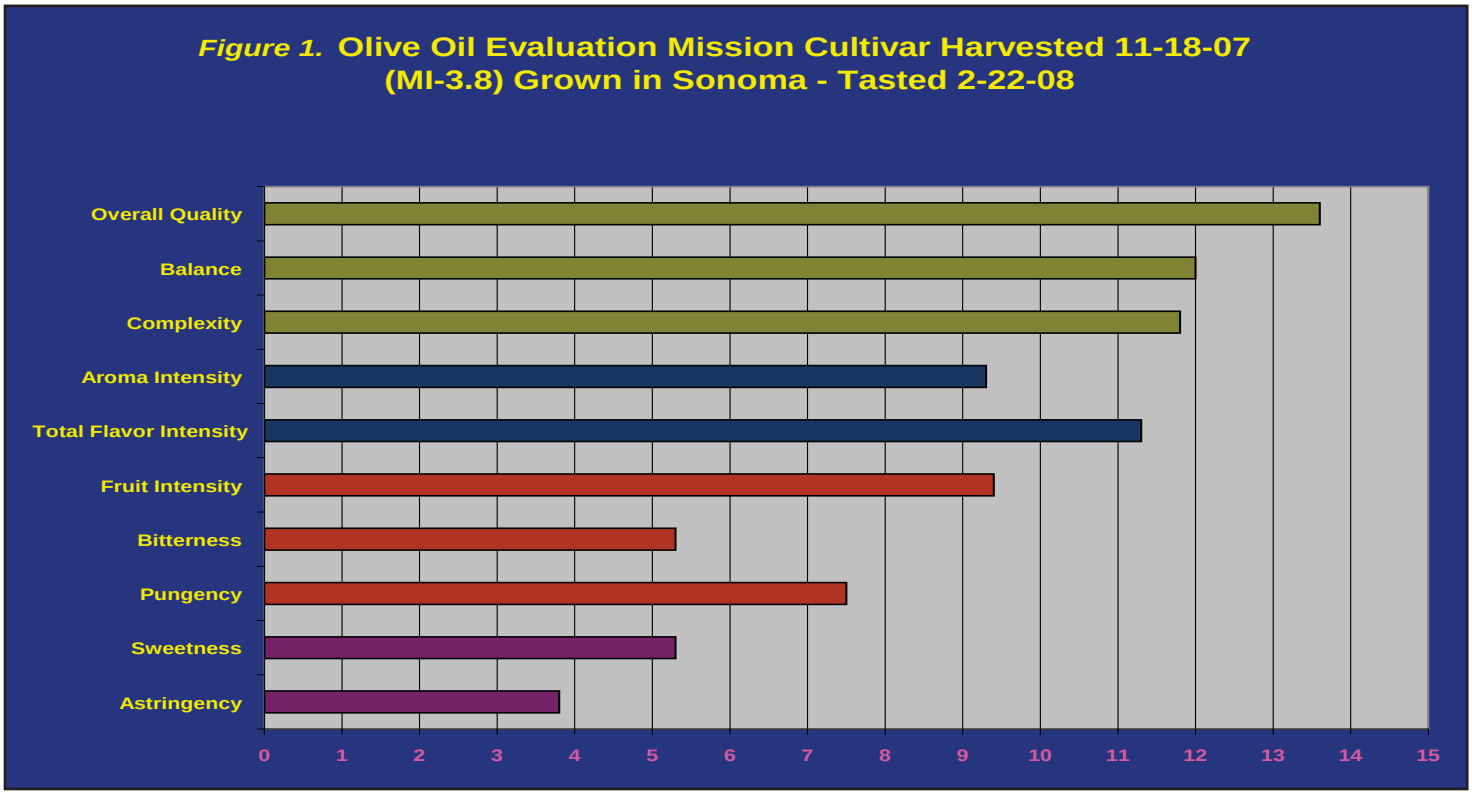
SENSORY DESCRIPTIVE ANALYSIS



Descriptive analysis is a sensory method by which the attributes of an olive oil are identified and quantified using specially trained sensory panelists. The analysis can include all aspects of the oil such as aroma intensity, bitterness, pungency, fruit intensity, total flavor, sweetness, astringency, color, texture, complexity, balance, finish, and overall quality (see figure 1). Normally it also includes the identification of defects, if any are present. It also should include the notation of the intensity of specific characteristics that describe the positive attributes of an oil in detail. These might include the typical flavors used internationally to describe oils, such as: ripe olive fruit, nutty, floral, buttery, tropical, banana and berry; or green olive fruit characteristics such as: fresh cut grass, artichoke, herbaceous, green apple, green banana, green tea, mint, eucalyptus, tomato leaf, spice, wood-hay-straw, or other (see figure 2). Sensory descriptive analysis precisely identifies and measures the perceived sensory properties of an olive oil using a trained panel of experts. The University of California Research Taste Panel, led by Paul Vossen, has been meeting about every two weeks for three years in Santa Rosa, California at the UC Cooperative Extension office. This panel has been using descriptive analysis to categorize olive oils and identify common characteristics by variety, growing conditions, location (terroir), fruit ripeness, and by processing method. In 2005 a new UC 15-Point Profile Sheet was developed for more detailed analysis of extra virgin olive oils. It uses a 15 point scale for positive attributes and it records the tasters' impressions of additional aspects, including the harmony and complexity of the oil. Data collected from olive oil characterizations done by the UC Research Taste Panel have been entered into a new File Maker database that can store and retrieve data on each oil that has been evaluated.

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In this issue

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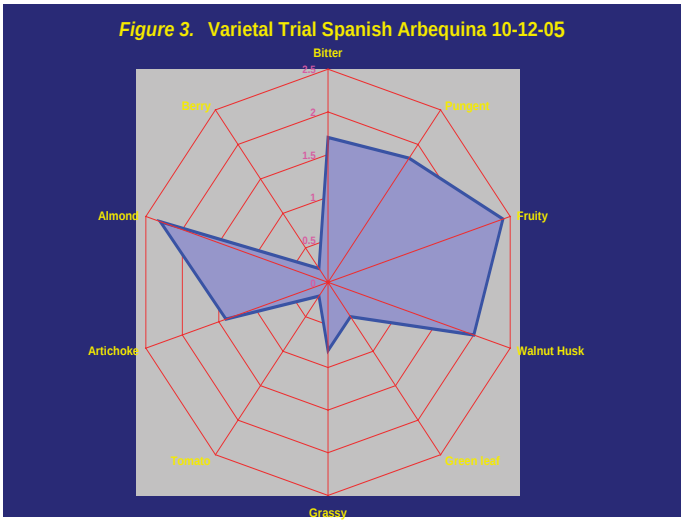
Send an email to Vicki Rios (vsrios@ucdavis.edu); please include your name, address and phone number. *Don't forget to tell your spam filter!*

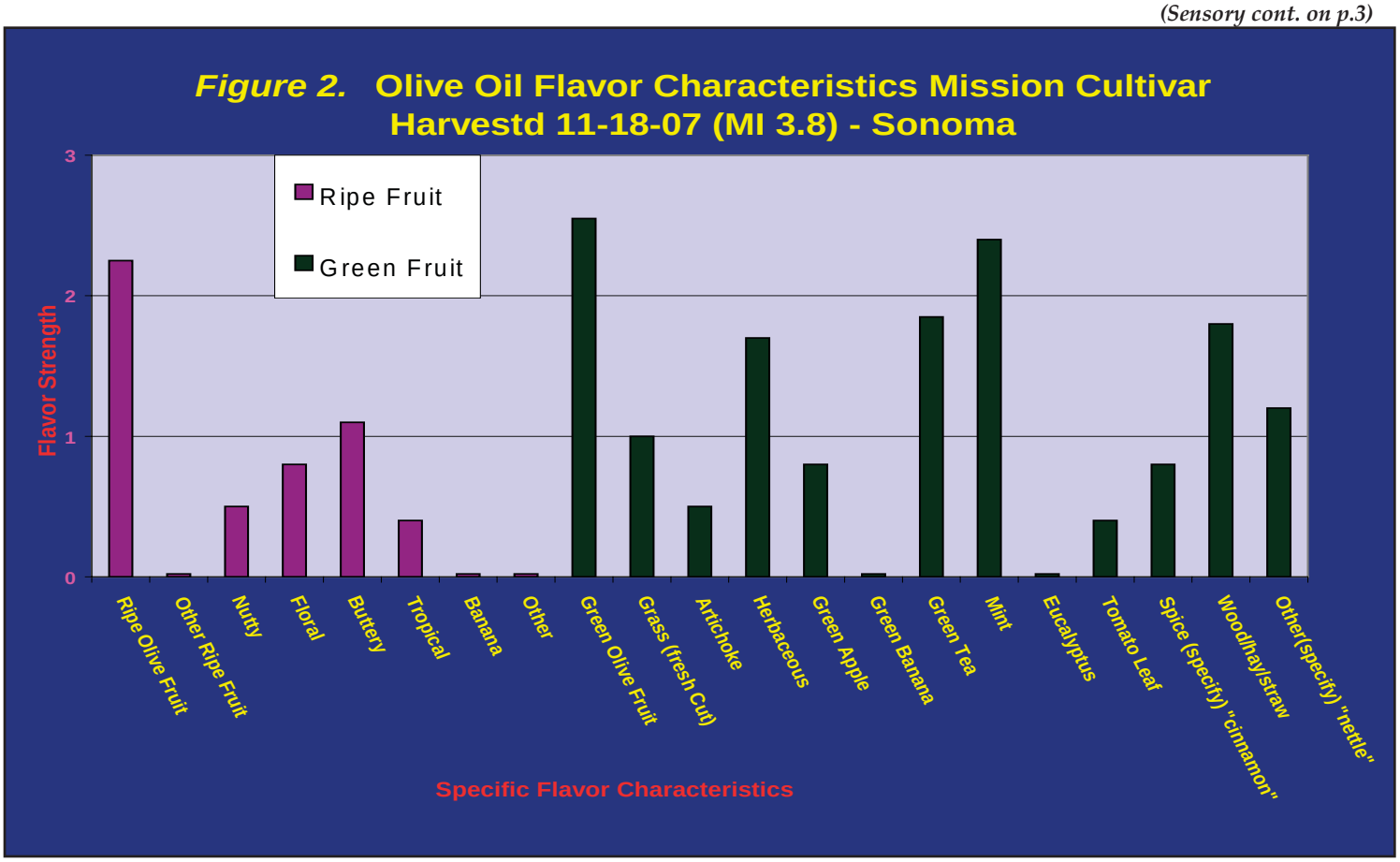
(Sensory, cont. from p.1)

Figures 1 and 2 are examples of bar graphs used to display the results. Similar work has been done in Spain, Italy, and Australia to characterize oils using a spider web type graph (see figure 3). A lot of work still needs to be done here in California to fine tune the methodology and to collect enough data on the influences of variety, growing region, processing method, etc. International cooperation in this effort is also very important in order to make sure we are using the same vocabulary to describe the flavors found in different olive oils. The panel evaluations go way beyond just identifying if an olive oil has a defect or not; the tasters also give a detailed descriptive analysis of an oil's positive characteristics. Like all panels a minimum of eight tasters is usually necessary to get a unbiased and statistically valid evaluation. Every olive oil has a unique sensory fingerprint. Qualitative aspects of an olive oil combine to define it by aroma, flavor, color, and texture, which differentiates it from others. Quantitative aspects define to what degree each characteristic is present in the oil being evaluated. For example, two oils may have very similar or the same qualitative descriptors, but differ significantly in the intensity of each, thus making them very different oils.



Descriptive analysis with a trained taste panel is a powerful tool that provides valuable information that cannot be obtained by any other analytical methods. For example an oil that is identified as "extra virgin" with a free fatty acid level below 0.4 and a peroxide level below 15 may be going flat, starting to turn rancid, and not appreciated by consumers. Or conversely, an oil may be characterized as having a large number of complex fruit flavors, adequate pungency, but excessively high bitterness that makes is unpalatable to most people. These oils might be able to be blended in with other oils or various

(Sensory cont. on p.3)



(Sensory, cont. from p.2)

means taken to avoid these problems in the future. Knowing the specific characteristics via panel descriptive analysis can help a producer select which varieties to grow, change irrigation levels on the trees, harvest earlier or later, or to manipulate the paste fineness, malaxation time and temperature, and or the oil storage conditions. It can help new producers learn how to evaluate their own oils, make better oils, and gain recoginition for the oils at competitions. It can also teach consumers about positive oil flavor characteristics, how to differentiate between olive oils in the market, and how to appreciate different oil flavors with different types of foods.

One of the most complex dilemmas we will be facing in the near future with our projected increases in olive oil production in California will be to differentiate our oils from similar priced imported products available in super markets. The flavor of our California oils will be the key differance and descriptive analysis the key tool used to help convince American consumers to buy the better product.

UC Production Course 2008 Information

The powerpoint presentations from the recent Olive Production for Oil short course in Lodi are available on my website at: http://cesonoma.ucdavis.edu You can view the following presentations from each of the speakers:

- The New Olive Center at the UC Davis Robert Mondavi Institute - Dan Flynn
- What is Happening in California and the Olive Oil World - Paul Vossen
- New Cost Studies for the Super-high-density Olive Oil System - Karen Klonsky
- Modern Olive Oil Production Systems in Spain - Joan Tous
- Harvest Machinery for Oil Olives - Louise Ferguson
- Olive Orchard Establishment - Joe Grant
- Irrigation Management Oil Olives - Joseph Connell
- Irrigation Quality for Oil Olives - Joe Connell
- Nutrient Considerations for Oil Olives - Joe Connell
- Orchard Floor Management for Olives - Tom Lanini
- Oil Olive Varieties - Paul Vossen
- Pest Control for Olives - Bill Krueger
- Olive Fly Control - Marshall Johnson
- Market Outlook for California Olive Oil - Alan Greene

Olive Oil Sensory Research at UC Davis

Professor Jean-Xavier Guinard from the UCD Food Science Department is leading two research projects designed to enhance the quality and economic viability of California olive oil. The project will develop sensory criteria for the evaluation of olive oil, and educate consumers on the characteristics, uses, and health benefits of California olive oil. The first research project focuses on the sensory properties of Extra Virgin Olive Oil. It entails the development of a descriptive analysis methodology, an investigation of the construct of sensory quality, as measured by members of your industry and by experts (IOOC Taste Panel), and a study of consumer preferences for olive oil. To this end, we are gathering a set of extra virgin olive oils that covers the range of sensory properties found in EVOO (from different styles, varieties and origins - local oils and imports). If you would like to contribute your oil(s) to this study in exchange for the results of the research, in the form of scientific publications as well as data files in which your product(s) would be identified, we would need 3 cases of 12, 375-mL bottles of oil or the equivalent total volume. We will be capping the number of products for this study at 25.

The second project investigates consumer perceptions of EVOO and it uses a combination of qualitative and quantitative approaches to understand perceptions, usage, attitudes, knowledge and beliefs of consumers toward EVOO. It involves substantially less tasting of the oils and for that project we are seeking a donation of 1 case of 12, 375-mL bottles of oil or the equivalent volume. Again, we would provide you with the results of the research in exchange for your donation.

If you are interested in participating in those important research initiatives, please contact researchers: Claudia Delgado (cdelgado@ucdavis.edu), Metta Santosa (msantosa@ucdavis.edu) or Jean-Xavier Guinard (jxguinard@ucdavis.edu)

What is Happening in Chile and Argentina?

I had an opportunity to travel to Argentina and Chile to do some work on olive harvester evaluation and to observe a portion of their industries. I was there in late February – early March during the harvest season for Manzanillo table olives, which would be equivalent to late August – early September here.

Argentina: Argentinian growers have planted about 250,000 acres of olives in the central and north west provinces. The primary area I observed was part of the Catamarca province near La Rioja. I must admit seeing some of the most beautiful orchards I have ever seen. Most of the orchards were very large – over 1,000 acres, had been planted by absentee investors, and were being managed by skilled agricultural technicians. Not much new planting is occurring at the moment, but there is certainly a lot more available land to plant even within most of the farms already growing olives. If they wanted to they could easily plant another 250,000 acres.

To their credit they have taken desert soils covered in scrub brush and cactus, applied water, and made olive trees grow to 14 ft tall and 12 ft wide (4.3 x 3.7 m) within 6-8 years. Most of the trees I saw in this part of Argentina were being trained into the open center form spaced at about 6 x 4 meters (19.7 ft. x 13.1 ft.). They were being hand pruned to thin out branches and they were being topped and hedged periodically with large mechanical saws.

Their production was consistently high at over 6 tons per acre in most years on most oil varieties. In some cases they were doing better than that. They had problems, however, growing Frantoio in that area probably due to the variable climatic conditions, but Coratina, Picual, Arbequina, Arbosana, Koroneiki, Manzanillo, and Barnea were performing very well. Very little of the new super-high-density system was observed or being contemplated there.

One of the primary reasons for going to Argentina was to assist Extension Specialist Louise Ferguson at UC Davis in evaluating an over-the-row harvester called the Colossus on large table olive trees. I also had the opportunity to observe the machine harvesting both Arbequina and Barnea trees for oil as they were getting it and the mill ready for oil harvest season. About 50 of these machines are being used now in Argentina, Australia, and Europe with success.

The Colossus is essentially an alternative method for harvesting large 14 ft (4.3 m) tall trees that were planted about 20 ft. (6 m) apart instead of using trunk shakers. The machine is large, heavy, and complicated. It is also quite sturdy and removes 95-99% of the fruit with efficiency. The machine we observed had been operating the last two years close to 24 hours/day for several weeks, requiring only periodic maintenance. It can only be used on well drained soils and level fields where rainfall and slope do not pose a risk to movement during the harvest season. The growers I talked to were very happy with their Colossus machines. The mills that I observed in that area of Argentina were quite large, but in proportion to the size of the very large ranches. All were using very modern continuous flow processing systems.

Chile: The industry in Chile is much smaller with about 25,000 acres planted into oil olives. About half of that was planted over the last 15 years into wider spaced orchards using Frantoio, Leccino, Pendolino, Picual, and Hojiblanca varieties. I observed one large organic orchard (2,000 acres) being planted to those same varieties at a spacing of about 20 ft. x 10 ft (6 x 3 m). The other half of the industry has been planted to Arbequina, Arbosana, and Koroneiki in the super-high-density system quite recently, all within the last five years. Many orchards are still being planted with plans to plant many thousands of acres more within the next few years – much like California. The new plantings of olives are going in from areas quite north of Santiago (La Serena) to quite south of Santiago (Talca) primarily in the western hills on very large 1,000 acre plus ranches. The orchards I observed were being planted where most other crops would not grow; on shallow soils onto berms with drip irrigation in areas with little annual rainfall. The cost of establishing a new super-high-density orchard in Chile is about $4,500 - $6,000, the first year, including the cost of the land.

Several new mills are being installed or are in the planning stages to accommodate the new plantings. All are ultra modern continuous flow systems. All of the oils I tasted in Chile were of excellent quality that could rival some of the best oils of the world.

Upcoming Educational Events

- Santa Rosa Junior College, Production and Evaluation Of Olive Oil, Section 9019, SUSAG 118 Thurs. June 19 & 26 6:00 to 9:00pm, Lark Hall, Rm 2070 or Friday June 20 & 27 8:00am to 2:30pm, Shone Farm, Thomas classroom, Call (707) 527-4685 or visit www.santarosa.edu http://www.santarosa.edu/app/getting-started

- Single Varietal Olive Oils for California : An Educational Tasting, Thursday July 17, 2008 6:00pm NovaVine, 6735 Sonoma Highway, Santa Rosa, email or call Lori @ldinatali@novavine.com or (707)539-5678

PUBLIC NOTICE:

Proposed US Standards for Grades of Olive Oil and Olive-Pomace Oil (Document ID: AMS-FV-07-0080-0007)

Comments due by August 1, 2008

1. http://www.regulations.gov
2. http://www.regulations.gov/fdmspublic/component/main?main=DocumentDetail&o=090000648060bd5f
3. http://www.ams.usda.gov/AMSv1.0/getfile?dDocName=STELPRDC5069526 -
   You may have to type in "olive oil standards" into the search box. Then click on the PDF document:
   DISCUSSION DRAFT FOR REVISION OF THE US STANDARDS FOR GRADES OF OLIVE OIL AND OLIVE-POMACE OIL

Regulations.gov
Your voice in Federal decision-making

Yes, the USDA is finally ready to implement standards for olive oil in the United States. This is your opportunity to comment on the regulation. The proposed standards are very much in line with the standards of the International Olive Council (IOC). The proposal defines the methodologies for both sensory and laboratory analysis. The nine proposed grades are:

1. US "Extra Virgin"
2. US "Virgin"
3. US "Lampanta Virgin" (not fit for human consumption)
4. US "Refined"
5. US "Olive"
6. US "Olive-Pomace"
7. US "Refined Olive-Pomace"
8. US "Crude Olive-Pomace"

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University of California Cooperative Extension
First Press
Newsletter of Olive Oil production and Evaluation
Special Report

Modern High Density Spacing and Mechanical Harvest: Options for the Future in California

The modern California olive oil industry has made enormous progress in the past decade and a half, going from a handful of small boutique growers in the mid-90's to over 650 producers including several very large companies. The production of olive oil is conservatively estimated to reach over one million gallons by the end of the decade.

Most of the growth in olive oil production and acreage in the past six years has been in super-high-density (SHD) plantings of Arbequina, Arbosana and Koroneiki. The SHD system has successfully addressed two of the problems that have bedeviled the olive oil industry since the beginning: the long period to full production and the high cost of harvest. A SHD orchard can be expected to produce a crop by three years of age and be in full production by five. The high cost of harvest is alleviated by the use of over-the-row mechanical harvesting machines. This greatly increases the speed and reduces the cost of harvest.

SHD production is not without its limitations, however. The olive cultivars that are suitable to the low vigor/high precocity needs of the system are currently limited to the three mentioned above. Work is being done developing new varieties, but large-scale availability is a few years away. SHD production also requires level or nearly level ground and very intensive management. Pruning, irrigation, fertilization, pest management: all of the cultural practices associated with olive orchards must be carefully manipulated to manage vigor and maintain productivity. The establishment costs for SHD are also high.

One unknown in the SHD system is the long-range prospects for the orchards. In a presentation in Lodi in April, Joan Tous of IRTA Reus, Spain, outlined some of the challenges and solutions. As the orchards age, the yields seem to level off and then decrease. Because the system is new, there is no experience with managing SHD plantings more than about fifteen years of age. In Spain, where the system originated, Dr. Tous said growers are experimenting with various approaches to revitalizing the orchards: removing every other row, severe rejuvenation pruning, and replacing the trees entirely.

Most modern oil olive plantings in California were done on what is referred to as modern high density (HD) spacing, with trees from 8 to 20 feet apart and rows spaced at 16 to 24 feet. Pruning was usually to an open vase, with some use of multiple trunks. Harvest was by hand, or assisted-hand using pneumatic combs, mini-shakers or other devices to speed the process. Collection was with nets on the ground or buckets. The cost of harvest by hand ranges from $300/ton to $600/ton, and more.

A side-by-side shaker harvester grabs the trunk of an olive tree while the catch-frame moves into place

An olive oil producer concerned with the bottom line does have another option that has been largely overlooked in the California olive oil industry: modern high density (HD) planting for mechanical shaker harvest. Shaker harvest is widespread in other parts of the world, but was not given much consideration in the early years of the California olive oil renaissance.

There are probably several reasons for this. Terrain may have been a factor: many of our early growers lived in the hilly areas of coastal California where access may have been an issue. There was also the strong influence of romance on the young industry; the image of a big noisy machine belching diesel fumes in the orchard didn't square well with *la dolce vita*. The technology was also probably a factor; the existing shaking equipment in California was mostly for nut crops and prunes, and would require some modification for olives. Since olive farming in California had been geared so long to table olive production, the challenge of harvesting physiologically immature fruit for table olive processing may have been a stumbling block. And finally, most of the early growers of oil olives in California probably underestimated just how badly the high cost of hand harvest would impact them.

The HD system presents some serious economic issues. A well-managed orchard can not reasonably be expected to yield any substantial crop until it is five or six years old, and will reach full production at eight to ten years. Clearly, the return on investment is going to be slower than SHD. And the disadvantages of hand harvest are obvious: cost is high and availability of labor is often an

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issue. But there are some important advantages to HD production as well.

The HD system is adaptable to any variety of olive. There are hundreds of olive cultivars to be found, producing an incredible array of olive oil flavors, and HD spacing will accommodate any of those varieties. California has the opportunity to produce innovative and enticing premium olive oils, blending varieties from all over the world. Since California produces a mere 1% of the US's consumption of olive oil, so there is no shortage of market out there. SHD density Arbequina will certainly be the dominant domestic olive oil but there is plenty of room in the marketplace for other varieties. The parallel often drawn with the California wine industry works well here: a consumer is most likely to start on something affordable and approachable. Branching out into more adventurous—and more expensive—bottles will come with time.

The HD system is also more forgiving; it is much easier to manage and requires less intensive inputs. Traditional olive tree spacing was huge—30 ft x 30 ft or more—because the trees were dry-farmed and each tree needed to mine a large area to get enough water to survive. Modern HD spacing is predicated on irrigation for the orchard, so the trees are much closer together, but the irrigation management is not nearly as critical as it is for SHD production. Sustainability is an important consideration these days, and HD olives have good sustainable potential. At a time when water is a critical issue for our state, it is prudent to think about the possibility of water shortages. Establishing trees with strong, extensive root systems might be good insurance in the event of future cutbacks.

Modern high-density spacing has been in use for many years so there is a lot of experience with the system. The economic viability of an orchard can be measured in decades; very high yields and easy management can be maintained for at least thirty years. In Europe, shaker harvest is used on orchards of all ages. Very large older trees may require some adaptation, but even if there is a reduction in harvest speed, it could well be offset by the very high yields that characterize well-maintained, older olive orchards.

The wrap-around umbrella-type catch frame is one option for collection with a shaker harvester.

All the advantages of HD production are eclipsed by the cost of harvest if mechanical harvest cannot be employed. Hand harvest is too expensive to be a desirable option, although it will always have a place in awkward terrain, for certain varieties and in very small-scale production. Mechanical harvesters can be configured in numerous ways. Because table olive harvest is another topic altogether, so we won't address the huge rotating spindle harvesters that are being experimented with for table olives. That leaves over-the-row harvesters (the standard for SHD production), Colossus (another over-the-row type—see the article on page 4), and trunk shakers.

Trunk shakers take many forms. Some are designed for large old trees and can grab the scaffold branches rather than the main trunk. The fruit in such cases is usually caught by nets spread on the ground. Since we are aiming for speed and efficiency, we will look at systems that integrate the collection system with the shaker. Nets on the ground are always a possibility, but then someone has to pick those nets up and tote the olives around, seriously compromising efficiency.

The most flexible style, because it works on a tree-by-tree basis, is the umbrella catch-frame. Various levels of automation exist, ranging from the completely integrated and mechanized umbrella that wraps itself around the tree, catches the fruit and funnels it to a bin, to the simple small umbrella catch-frame that gets pulled around the orchard by an ATV and is manually unfolded and folded.

The other approach is the side-by-side shaker system. This consists of two vehicles that drive down opposite sides of the row and interlock around a tree. One side grabs and shakes, the other side collects and conveys. This system is faster since it is continuous and there is no time spent in deploying the umbrella.

Leandro Ravetti of Modern Olives in Australia recently compared a number of different mechanical harvesters on Picual and Barnea trees, spaced about 13 ft x 20 ft. The five machines were an over-the-row New Holland/Braud grape harvester, an over-the-row Gregoire 113V olive harvester, a modified over-the-row spindle coffee harvester from Timbercorp/Haslett, the Colossus over-the-row spindle harvester and the COE/Haslett side-by-side shaker harvester.

The parameters that were evaluated were speed of operation, harvesting efficiency, trunk damage, canopy damage and hourly rate. The trial harvested trees of two different sizes: three-and-a-half-year-old trees that were just coming into bearing, and full-sized trees. The trees were trained to an open vase shape.

Only the Colossus and the COE were able to harvest the full-sized trees. Although the New Holland and the Gregoire were the fastest and had good efficiency in the smaller trees, the amount of damage to the canopies in the larger trees was high. The COE had the lowest level of canopy damage, followed by Colossus. The hourly rates for the equipment were very similar based on average contracting and operating costs in several groves in Victoria, Australia, in 2007.

Ravetti's conclusion was that over-the-row grape harvesters were an excellent option for first and second crops. For the second and third crop years, the Gregoire 113V with its greater headroom and the coffee harvester were reasonably effective, but they tended to max out on trees over 25m^3.

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After the third year, the best choices were Colossus and the COE side-by-side, each showing different strengths. Colossus had the highest fruit removal efficiency in almost all cases, with similar speed and canopy damage to the side-by-side shaker. The limitations of the Colossus are related to its size, difficulty of transport and cost. It is probably only practical in large-scale plantings. California's rainy fall weather may also be a problem with such a heavy machine.

The fruit collects in the valley formed by the shaker and collector and is conveyed to a bin.

The side-by-side shaker offered the most flexibility. It is easy to transport between groves but still provides good speed and removal efficiency with minimal damage. The cost of harvest (in AU$ in 2007) was approximately 0.05 to 0.08 per kilogram. That is approximately $52 to $84 per US ton (using the current exchange rate).

The side-by-side shaker may be a good option for the small and medium-sized growers in California. According to Matt Coe of Coe Orchard Equipment, there is quite a bit of latitude in orchard spacing with the side-by-side configuration. The minimum between rows is 17 ft but 20 ft is preferable. The space between trees can be little as 8 to 10 ft. High density orchards in California are often planted on 9 x 18 or 10 x 20 ft spacing, so these orchard spacings could accommodate a side-by-side shaker. The side-by-side shaker is also capable of operating in orchards with a substantial slope. The machinery is much less top-heavy than over-the-row configurations; if a tractor can negotiate an orchard, it should be fine for a side-by-side harvester.

Tree training is critical. Shaker harvest requires a single trunk of 36–42 inches for starters. Because the possibility of mechanical harvest was not a consideration when many growers planted their trees, the issue of training was almost entirely focused on light exposure and ease of hand harvest. As a result, many of our trees branch very low—18 or 24 inches—or have multiple trunks. Shaker harvest also requires a fairly upright structure: scaffold branches should be around 45 degrees.

Erick Neilsen of Erick Neilsen Enterprises is experimenting with his shaker design over the summer with the hope of doing some trial harvesting of oil olives this fall. According to Erick, there is very little overlap between the pistachio harvest and the olive harvest; it is worth experimenting to see if the same machines could work for both crops.

More information about the suitability of specific olive varieties is needed. To be a good candidate for efficient shaker harvest, a variety should have low removal force (the amount of force required to pull a fruit off the branch) and reasonably upright growth. Varieties with an extremely pendulous growth habit, for example, will be harder to shake efficiently. Some varieties are known for their low removal force; Picual is famously easy to harvest and very popular for shaking. Others, like Koroneiki, have very high removal force and is probably best left to the over-the-row beater bar harvester.

There clearly remains much to be done to determine the best practices for California HD production. We need to experiment with variety selection, tree training and orchard layout. Bill Krueger, farm advisor in Tehama and Glenn Counties, is planning an experimental orchard designed specifically for shaker harvest. Louise Ferguson, UCCE specialist based at Kearney Ag Center in Parlier, has also been doing research on mechanical harvest of olives for years.

California has finally earned a seat at the table as a producer of world-class extra virgin olive oil. We are making great single varietals and blends, applying our adventurous West Coast spirit to creating unique and exciting products. It is time to put that ingenuity to work on the practical and economic side of oil olive production. Modern high density planting of many different olive varieties, spaced and trained for shaker harvest, is an option well worth exploring.

—Alexandra Kicenik Devarenne

With thanks to Bill Krueger, Louise Ferguson, Matthew Coe, Erick Neilsen, Leandro Ravetti and Paul Vossen

For further reading:

"Olive Tree Density Debate" in *First Press Newsletter*, Vol. 2, No. 3, Spring '07
http://cesonoma.ucdavis.edu SpecialtyCrops/Olives.htm

The side-by-side shaker harvester moving into position on an olive tree