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BIGGER CROP – BUT NOT TOO BIG

It now appears as if this year's harvest will be excellent in more ways than one. The expectation was for a humongous crop, too big actually, coming off the worst yield ever recorded in the history of the table industry (23,000 tons) and poor fruit set in the oil olives from freeze damaged flower buds in March of 2006. Mid winter of 2007 was very cold in some places killing young trees, damaging others and again reducing fruit set. In the long run, this year's good, but not excessive set should help prevent the severe swings we would normally see from alternate bearing. Most of the coastal orchards I have seen this year have only a mediocre crop load. The young super-high-density orchards in the Sacramento and San Joaquin Valleys have good crop loads based on their age, but some sites only have about half a crop. Along with the good crop on trees this year that had almost nothing last year, we have an additional 500 acres coming into bearing for the first time. These trees are still young, but are expected to produce 4-6 tons per acre or an additional 100,000 gallons of oil that we did not have in 2005. The wild card will be the amount of fruit from this year's estimated 110,000 tons of table fruit that might get diverted into oil. It's an early guess, but I estimate this year's production will be about 500,000 gallons of olive oil.

Adulterated Olive Oil in the News

If you have not seen the New Yorker article of August 13 by Tom Mueller entitled "Slippery Business" you must read it (http://www.newyorker.com/reporting/2007/08/13/070813fa_fact_mueller). The author reveals case after case of fraud in the olive oil industry that would certainly make consumers think twice about what they are buying. Revealing fraud is detrimental if consumers react by not buying olive oil thinking that it just can not be trusted. Oils in the market that have been blended with "who knows what" are not good for the industry. The only potential benefit might be to producers who are doing the right thing – you – as long as you can prove it and promote your oils in such a way as to convince consumers to buy your oils instead of less trustworthy brands. The only practical way to do that is by taste.

Mueller spelled that out by indicating that the government sponsored regulatory taste panels of the world are our best asset against fraud. This was the original intent behind my work in forming the California olive oil taste panel. Another was to train producers, marketers, and consumers about the flavor characteristics of good olive oil, so they could not only produce better oils, but also teach their distributors, marketers, and consumers what to look for in excellent quality, non-fraudulent olive oils. Common supermarket brands are frequently quite awful and so defective in flavor that they would likely never pass an official taste panel evaluation as "extra virgin". This makes them suspect for having been blended with seed oils, refined oils, or pomace oils, yet an estimated 70 million gallons were sold in the US last year. I also have seen the surprised expressions of delight when people taste a great olive oil for the first time. Remember that 99.5% of the market is being met by imported oils right now. Therefore, I stress that we should take the high road and promote the excellent quality that we have. Let's be careful to turn consumers on to great California olive oils without turning them off to olive oil in general. I would also urge you to support an independent, government sponsored taste panel in the US and UC research into better laboratory chemical tests for detecting adulteration that can be part of the enforcement mechanism to help prevent the sale of fraudulent olive oils in America.

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A Review of Olive Research in Spain

Michelle M. Leinfelder and Paul Vossen

At approximately 195,000 square miles, Spain is not an expansive country in area, but its variability – from climate to topography to culture – resembles that of a land much grander. With the Pyrenees in the north, the Sierra Nevada's in the south, and its centralized capital on a plateau, Spain is the most mountainous country in Europe after Switzerland. As a peninsula, Spain is enriched with vast coastline, and its reputation for music, dance, and athleticism illustrates its impressive culture. Just as the Spanish climate, topography, and culture vary, so too, does its agriculture. For example, the dry Mediterranean regions near the city of Valencia are renowned for undulating citrus fields. By contrast, the region of Galicia, north of Portugal, is geographically isolated by lush, green hillsides, with varieties of apples, pears, and chestnuts adapted to the high annual rainfall. Spanish wine is also prized, and growing regions span from the Basque country in the north, through the central plateau of Castilla – la Mancha, to the southern region of Andalucía, as well as points east and west. All of these crops are important to Spain's agricultural industry, but the olive is an important crop on many levels.

Spain is a leader in olive production, and Spanish olive oil generally accounts for 30-50% of the world supply. Olive production in Spain is deeply rooted in the country's history, and today, it progresses into a modern, scientific world where experimentation and ingenuity improve its productivity, profitability, and influence on the broader environment. This article will describe what makes olive such an important crop in Spain, outline some of the current research taking place throughout the country, and provide information for a developing California industry.

The Olive as a Symbol

From historical times to the present, the olive has come to symbolize many virtues. Durable – living in poor soils and needing very little water – the olive tree is a symbol of strength and resilience. Olive branch coronets were awarded to winners in the early Olympic Games for their physical prowess. Mediterranean populations in the centuries B.C. understood the healthful properties of olive oil, using it as both an internal and external elixir. Worldwide religions have recognized the olive tree: awed by its longevity, viewing its fertility at an old age as magical, and considering the food and shelter it provides as benevolence from a god. Jews and Christians have further recognized it, using its oil in anointing ceremonies, burning the oil to give light, and having reference to branches as peace offerings in the Old Testament. And thus, for centuries, the olive has symbolized so much that is good.

Vast acreage of olives in Andalucia

The Olive and Culture

The olive is an important part of Spanish culture. The fruit is more than an appetizer or the palatable decoration in a cocktail. The olive needs no special occasion to warrant its display on the dining table. It is eaten daily – for breakfast, lunch, or dinner – and its oil is a staple in every kitchen – replacing butter, margarine, and other refined oils in dishes, dressings, and on bread. The olive tree also has its place in the culture. The countryside is a patchwork of olive orchards, young and old. Hillsides are speckled with trees planted and abandoned for steadier ground, and mountains exhibit the remnants of native stands. Olive oil mills are found even in small, remote villages, and so, the olive could be considered the lifeblood of Spanish culture. For this reason, the olive is also critical to the country's economy.

The Olive and Economics

Agriculture contributes approximately 3.9% to the Gross Domestic Product of Spain, where greater than one third of the land area is under agricultural production – roughly 44 million acres. Of this agricultural area, over 6 million acres are under olive cultivation. Most of the olives are processed into olive oil, making Spain the largest producer of olive oil in the world, followed by Italy, which has less than half of Spain's total area, and Greece.

With the three largest olive oil producing nations in Europe, it should come as no surprise that the European community contributes 79% of the world's annual olive oil. Various other regions with Mediterranean climates are responsible for the remaining yield in small quantities, with less than one percent coming from California. As the European community produces most of the world's olive oil, so too does it consume the majority at 71%. Nevertheless, as the health advantages of olive oil are learned, consumption worldwide escalates. Increased consumption in the United States, Australia, and Japan, for example, has resulted in increased importation, primarily from the European community. Thus, developing and improving the industry – through research and extension – is important for the Spanish economy.

Olive Research in Andalucía

Olive cultivation spans the Spanish Mediterranean coast, with dominant production in the southern region of Andalucía. In this region, the city of Córdoba is a hub for the olive industry, having the University of Córdoba and IFAPA – the Andalusian Institute of Agricultural Research – which both do research and extension in olive. For example, at IFAPA, Dr. Carmen del Río and Juan M. Caballero work on propagation and variety evaluations, and maintain the World Olive Germplasm Repository (WOGR). Their work in propagation investigates the effects of using shoots, root suckers, and micropropagation on tree characteristics and ultimately fruit quality. The variety trials are compared with other sites throughout Spain, Portugal, Italy, and Greece. The robustly-flavored 'Picual' is the choice variety of Andalucía and is used as the standard against which all other varieties are evaluated. The WOGR was initiated in 1970 and is continually being updated, having 408 varieties currently – 262 of Spanish origin. This number is perhaps only a fraction of the genetic resources available, as 1,500-2,000 cultivars likely exist worldwide. At the University of Córdoba, the work of Drs. Isabel Trujillo and Antonio Martín on olive DNA amplification identifies allelic characteristics, which further help to classify varieties.

Dr. Raúl de la Rosa is an olive breeder at IFAPA. A current priority of his program is finding varieties that are suitable for mechanical, over-the-tree harvesting of high-density, hedgerow plantings. In his trials, Dr. de la Rosa has found that the Spanish variety 'Arbosana' is smaller than 'Picual' and is high-yielding and precocious, producing well at densities over 800 trees per acre. Dr. de la Rosa, Dr. Lorenzo León – also of IFAPA, and Drs. Luis Rallo and Diego Barranco at the University of Córdoba are cooperating on a breeding project to develop new varieties with low vigor, small stature, and good oil quality. 'Chiquitita' is the first variety to emerge from this effort and was recently described by Dr. Rallo at the American Society for Horticultural Science conference in Scottsdale, AZ in July, 2007 (Rallo et al., 2007).

Jose Alba explaining oil quality to students

Verticillium wilt infects the xylem tissue and disrupts water movement, and symptoms range from chlorosis to tree death when the condition is severe. Drs. Javier Lopez, Miguel A. Blanco-López and Francisco J. López-Escudero of the University of Córdoba are investigating host resistance and integrated management as means of control. They have found that the 'Frantoio', 'Empeltre', and 'Koroneiki' varieties have exhibited some resistance characteristics. Integrated control studies include soil sterilization under plastic, organic soil amendments, and when necessary, fungicide application through drip irrigation lines.

Sustainable soil management is another course where research is in progress. Under many circumstances, olives are planted on sloping terrain with little done in terms of soil conservation. Many growers, however, have begun planting cover crops between rows to conserve valuable topsoil. Over-fertilization and soil salinization have also been problems in these arid regions. Researching appropriate fertilization schemes will improve production economically – by reducing fertilizer costs – and environmentally – by mitigating soil salinization and nutrient leaching into groundwater. Olive nutrition work is primarily being done by Ricardo Fernández-Escobar who recently documented that excess nitrogen fertilization can reduce oil quality.

Marino Uceda discussing oil milling principles

Two other very important centers for olive oil research in Andalucía are the Instituto de la Grasa in Sevilla and the Junta de Andalucía Research Center located just outside Mengibar near Jaén in the heart of the olive growing region. Drs. Marino Uceda (Jaén) and Jose Alba (Sevilla) lead practical research programs in olive oil evaluation. They teach a masters level course and have written many articles on the influences of fruit crushing on paste fineness, malaxation time and temperature on paste oxidation, processing equipment automation and various agronomic effects on oil quality. One of their recent projects has been to compare the chemical and sensory composition of olive oils made from the varieties at the Córdoba germplasm repository.

Olive Research in Catalonia

Though Andalucía leads Spain in total olive production, Catalonia is another important region for olive research and extension. In Catalonia – the northeast corner of Spain – there exists a network of government-funded research stations known collectively as IRTA, the Institute for Food and Agricultural Research and Technology. At the Mas de Bover Center, located outside the city of Reus, horticultural research specializes in Mediterranean fruits, including olive. Dr. Joan Tous and Agustí Romero lead the research in olive cultivation and olive oil processing focusing on various aspects of tree culture, including variety and rootstock evaluations, training systems, and planting density. Mr. Romero concentrates on olive oil evaluations and training sensory panels to the guidelines of the International Olive Council (IOC). As is the case with most agricultural commodities in developed countries, olive research in Spain has begun investigating the environmental ramifications of production and processing using sustainable practices. Juan Francisco Hermoso is leading this effort and also works closely with the local olive oil mills to help them increase efficiency and improve oil quality.

On-farm research takes place in the districts of Catalonia known as Terra Alta and Montsiá. The district of Terra Alta is drier than other regions closer to the coast, but is fed by the Ebro River – the largest and most important waterway of Catalonia. Water from the Ebro River is used to irrigate farms in Terra Alta, where one grower is cooperating with Dr. Tous on an irrigation trial comparing Spanish, Italian, and Greek varieties with 'Arbequina i-18®', the clonal strain of 'Arbequina' developed at Mas de Bover. 'Arbequina' is the most common variety in Catalonia, accounting for greater than 90 percent of the olive area. Though most olives in Catalonia are non-irrigated, many farmers in Terra Alta have discovered the benefits of applying water. Montsiá is a district south of Terra Alta, where the Ebro River divides into an expansive delta. In this district, growers struggle with *Armillaria* and *Verticillium*, so an IRTA trial currently investigates varietal resistance to those diseases.


Núria Mallen, Joan Tous, Agustí Romero and Juan Hermoso

While most operations in Catalonia are small-scale, family-owned farms, large operations growing olives in super-high-density hedgerows with straddle harvesters can also be found. Super-high-density plantings are precocious and reduce labor costs, but drawbacks include unknown length of productivity and tree lifespan. Reduced light and air penetration into a hedgerow canopy can result in non-fruiting wood and an environment more conducive to fungal outbreaks in the inner canopy. While certain varieties may have less vigor, which is more conducive to hedgerows, the use of dwarfing rootstocks might provide a better solution to problems of excess tree vigor. Graduate student Núria Mallen, is conducting rootstock research to evaluate vigor control for 'Arbequina i-18®'. Other advantages of rootstocks could be better disease resistance, cold hardiness, and drought tolerance. Preliminary results show that Spanish varieties 'Limocillo', 'Arbosana', 'Corbella', and 'Verdal de Manresa' and Turkish variety 'Izmir Sofralic', when used as rootstocks, could reduce the vigor of 'Arbequina i-18®' (Mallen, 2007). How these rootstocks influence other tree and fruit traits will be reported in the near future. California growers interested in hedgerow plantings should stay tuned to this work.


Evaluating the fruiting habits of Koroneiki

Conclusion

In Spain, the olive has its place in history, culture, and economics. Universities and government institutes advance the olive industry through research and extension in breeding and production methods. As their efforts continue, we in California should look to Spain as a model for our own, developing industry.

About the Authors

Michelle M. Leinfelder is a graduate of UC Davis (Crop Science and Management '01) and now a Ph.D student in the Department of Horticulture at Cornell University. Prior to beginning her doctoral program, she spent a year traveling on a research fellowship to study environmental and economic sustainability issues in horticulture. Three of those months were spent working at the Mas de Bover station of IRTA in Reus, Catalonia, Spain to study olive oil production. Paul Vossen studied for a year in Spain on a sabbatical leave in 2001-02 where he assisted on several short research projects with many of the researchers discussed. He also attended a Masters level course in olive oil production that is offered every other year in Córdoba and Sevilla.

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New UC Publication:

Olives: Safe Methods for Home Pickling. No. 8267. UC Division of Ag and Natural Resources
Free Download http://anrcatalog.ucdavis.edu/pdf/8267.pdf

OLIVE HARVEST EFFICIENCY

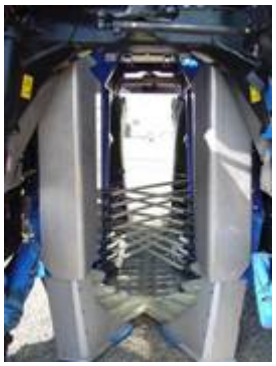
Fruit harvest efficiency depends on many factors such as: variety, fruit removal force, fruit maturity, crop load, slope of the land, tree size, tree spacing, tree age, quality of the equipment, experience of the workers, and tolerance for fruit damage. Hand harvest is the least efficient. Using poles or small machines such as gas powered mini shakers, pneumatic combs, or electric combs, with manual or power-assisted fruit retrieval from nets, works about the best for small-scale producers with young trees on steep terrain. Mini shakers + poles is twice as efficient as combs. Trunk shakers with or without catch frames are quite efficient in the high density system with large trees for moderate sized farms. They can harvest about 2-3 acres/day. The huge over-the-row Colossus olive harvesters used in Australia and Argentina are not available for custom hire and have not been compared to the other harvest methods. Modified grape harvesters are the most efficient for the super-high-density system and are applicable to large farms on flat land. Grape harvesters can harvest about 7-10 acres/day and are available for custom hire.

Hand = $400 to $2,000 per ton

Comb – Shaker – Pole = $200 to $800 per ton

Trunk Shaker with Nets = $125 to $200 per ton

Wrap Around Trunk Shaker = $75 to $150 per ton



Grape / Over-the-row / Straddle = $40 to $50 per ton

Colossus / Over-the-row Straddle - Australia and Argentina = unknown cost per ton

UPCOMING EDUCATIONAL EVENTS

- **Olive Oil Production, Processing, and Evaluation (SusAG 118)**
  November 1, 8, 15, 17, & 29, 2007 - Santa Rosa Junior College - www.santarosa.edu
- **Sensory Evaluation of Olive Oil – September 28 and 29, 2007 at UC Davis**
  Register at: www.extension.ucdavis.edu or call 800-752-0881
- **Olive Oil Production Short Course – sometime late winter or early spring 2008**

Sponsored by the Robert Mondavi Institute, UC Davis Plant Science Dept., and UC Cooperative Extension

Super-high-density Cost Study 2007

The University of California Department of Agricultural Resource Economics (Karen Klonsky and Pete Livingston) along with several University of California Cooperative Extension Farm Advisors (Joseph Connell, William Krueger, and Paul Vossen) just revised the 2004 super-high-density production cost study for olive oil production. Several farms were involved in providing information about their cultural practices and costs. This cost study does not reflect the specific costs or practices of any one specific orchard. Some costs and practices may not be applicable to your situation. The full document can be downloaded at: http://coststudies.ucdavis.edu.

SAMPLE COSTS TO PRODUCE BULK OLIVE OIL - SUPER-HIGH-DENSITY ORCHARD - SACRAMENTO VALLEY - 2007

• Culture & Pest Control (pre & post harvest) ($180/ton)	~ $ 900/acre
• Harvest & Fruit Transport ($80/ton)	~ $ 400/acre
• Overhead (office, taxes, insurance, & repairs) ($60/ton)	~ $ 300/acre
• Capital Recovery (buildings, equipment, irrigation system, depreciation, establishment loan interest) ($160/ton)	~ $ 800/acre
• Capitol Recovery (land) ($72/ton)	~ $ 360/acre
TOTAL APPROXIMATE COSTS	**~ $2,760/acre**
	~ $ 552/ton
	~ $ 13/gallon

These costs are based on several assumptions: 110 acres in production; land cost $5,000/acre; 670 trees/acre; fruit yield of 5.0 tons/acre; oil extraction of 42 gallons/ton producing 210 gallons/acre. Accumulated establishment costs are $8,334/acre at the end of the fourth year, after subtracting income from production the 3rd and 4th years. Costs include: land preparation, trees, planting, irrigation, fertilization, weed & disease control, harvest, insurance, taxes, repairs, and capital recovery (depreciation and interest) on buildings, equipment, irrigation system, and land.

The costs do not include fruit processing into oil, bulk oil storage, bottles, bottling, labeling, boxes, oil storage, transport, or marketing, which alone (without the oil) have been roughly estimated to be $30 per gallon. Paying a distributor and slotting fees for retail sales could add another $30 per gallon. That translates to a cost of $9.65 for a ½ liter bottle of oil. Add on some profit (40%) and the retail price becomes $13.51. Note: This is an excellent quality product with sensory characteristics of very fruity, fresh, crisp, olive oil – unlike most of the old, fermented, rancid, or flat imported olive oils being sold in most US markets.