Orchard Management

Soil Characteristics for Maximizing Olive Quality

Research

Agromillora Olive Tree Improvement Program

Olives and Olive Oil

Interview: Dan Flynn of the Olive Center, UC Davis

Cultivation

Olive Tree Yield Estimation Method
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FOR THE PRODUCTION OF California Extra-Virgin Olive Oil

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**Arbosana Clone i-43**
Late maturing, high productivity fruit. Very good (19-20%) oil yield efficiency. The oil has a unique fruity flavor with strong character, bitterness and high levels of polyphenols. The tree is the most dwarfing of all the SHD varieties and should be planted closer together.

**Koroneiki Clone i-38**
Greek variety, originally cultivated on the plains, lower hillsides and coastal areas of Crete where the climate is relatively warm. Adapts well in high density orchards, early producer. Very small fruit size. Excellent oil quality with very high polyphenols. Fruit yield is high with a slight tendency to alternate bearing.

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California Olive Ranch offers a “welcome home” to the fruit of super high density olive growers. Our grower supply agreements offer you:

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California Olive Ranch is the first and largest marketer of Super High Density grown olive oil in the United States. We manage the most successful California Arbequina, Arbosana, and Koroneiki retail brands. While making up over 35% of the extra virgin California olive oil production, we have sold through our inventory each year.

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Alan Greene, 530-846-8000 or e-mail at cor@cal-olive.com
The olive industry in California continues to grow at a tremendous pace. The ideal growing conditions in our state, coupled with the growing demand in the U.S. for both high-quality extra virgin olive oil and locally produced products means that California olive oil is thriving and the future for this product is exceptional.

However, in the midst of this growth and demand come challenges. We were hoping that by now the USDA would have determined its standards for olive oil labeling. This essential regulation would bring our country in line with others. The process, which began in 2004, continues. Recently the USDA released a version of the ruling for public comment. On page 31, we provide you with the web site address where you can view the standards in their current form. We encourage you to do so.

The delays from Washington have been balanced with progress in Sacramento. The California Legislature is embracing the need to change the existing definition of extra virgin olive oil. The bill, SB–634, establishes standards in our state consistent with the IOC (International Olive Council). This welcome regulation passed the State Senate unanimously and awaits the Governor’s signature. While only enforceable in California, given the dominance our state has in the U.S. market, it will impact the entire country. We urge you show your support for this bill by writing to the key sponsor, Senator Patricia Wiggins, 2nd District, at the address on page 32.

Another example of the industry’s growth and establishment of infrastructure is the recent opening of the UC Davis Olive Center at the Robert Mondavi Institute. This world-renowned University has a long history of research and development in the field of olives and is adding their know-how and reputation to our expanding olive oil market. Such is the importance of this crop to our state that next to the grape, the olive is the second crop for which UC Davis has established a research entity at the campus. We enthusiastically welcome their participation. In this issue, we interview Dan Flynn, the Executive Director of the Olive Center, to learn more about the Center’s plans.

We hope you enjoy the articles in this expanded issue (32 pages!). As always, we welcome your input, suggestions and comments.
Soil mapping is still not a common practice in many countries and generally has an academic-university approach that sometimes does not focus on olive growers’ practical needs.

Although the effect of soils on yields has been widely discussed and accepted by the agricultural community, detailed studies of soil characteristics nevertheless remain under utilized.

Figure 1 - Map showing different soil types that will permit a selection of management techniques and sectorized irrigation.
During my experience in Australia I noticed the emphasis that different state governments place on carrying out soil mapping as a requisite to new horticultural developments. Soil mapping not only helps to minimize the environmental impact of crops on existing natural resources, but also helps farmers to make optimum use of water and soil, while also designing and managing crops (irrigation, fertilizers, and management) in accordance with the type of soil.

**BENEFITS OF SOIL MAPS**

Soil mapping as a means of gaining in-depth knowledge of the agronomic potential of different areas and their limitations prior to purchasing a farm is a tool for price negotiation. For instance, if a 988 acre farm has 247 acres with saline problems and another 123 acres with surface water tables and compacted clay, the price of those 370 acres should be negotiated at a lower price than the rest.

Soil mapping prior to crop planting helps to identify different soil types and their distribution on a farm, in order to:

- Determine the type and intensity of soil amelioration as needed by each type of soil.
- Identify and mark the areas of the farm with soil limitations (i.e., high clay, sodicity or alkaline content, drainage problems, acidity, etc.).
- Implement a specific fertirrigation program for each type of soil.
- Select the irrigation system (drip, sprinkle, microjets, etc.) and its characteristics (precipitation).
- Design the installation of the irrigation system in keeping with different soil types (Irrigation management units, IMU), to make irrigation sectors independent and irrigate in accordance with soil and plant characteristics.
- Install soil moisture monitoring units in each IMU.

One of the purposes of soil mapping is to avoid grouping different soil types together (Photos 1 and 2), since this will lead to management problems and eventually affect yields.

Once planting has been carried out, soil maps make it possible to:

- Establish links between the type of soil, plant vigor, production and oil quality.
- Adapt management techniques as required.
- Redesign irrigation systems in some cases.
- Apply certain aspects of precision agriculture to reduce olive-grove variability.

**CONCLUSION**

Farmers, technicians and oil-mill owners are well aware that different soil types have a strong bearing on oil yields and therefore on a project’s feasibility and economic potential.

*Photos 2 and 3 – Different soil types require different management in order to reduce olive-grove variability, maintain yields and increase crop quality.*
Substantial investment is required to establish plantations and an oil mill (posts, installation of irrigation systems, planting material, processing machinery, etc.), but soil characteristics, variability and effect on crops are often ignored although they account for only between 1 and 2% of project costs.

The need for soil studies is usually taken into account after planting has taken place, when yield problems arise (growth, low quality, production, etc.). Such problems are often difficult and costly to solve.

Information on a holding’s different soil types enables selection and use of specific management techniques for each soil-plant association. The benefits for production and oil quality will clearly be reflected in an increased rate of return on investment.

“...the need for soil studies is usually taken into account after planting has taken place, when yield problems arise. Such problems are often difficult and costly to solve.”
In recent years the increased demand for olive oil, stemming from its positive effects on health and the profitability resulting from the use of super-intensive technology, have led to a substantial increase in the number of acres given over to olive-tree orchards in Spain. The acreage currently stands at nearly 6,175,000 acres, 90% of which are in southern Spain, mostly in the provinces of Andalusia, La Mancha and Extremadura (Figure 1).

Of all olive-growing regions, Castilla La Mancha has the highest rate of new orchards that have not yet begun to produce (Table 1). Although they are not typical olive-growing areas, provinces such as Navarra, La Rioja and Castilla y León also show high percentages of new olive orchards. These regions view olive oil production as an opportunity to take advantage of the marketing channels opened up in the agrifood sector by other commodities such as wine, and unique brands of olive oil with distinguishable flavors. New consumers are attracted to the establishment of new appellations of origin.

The main limitations for quality olive production in these regions relates to temperature. Low temperatures can pose problems during both the growth period and the winter resting period. During this period temperatures between 14°F and 23°F cause damage to younger, thinner branches and shoots, while temperature lower than 14°F can kill thicker branches and even the entire tree above ground.
“Although they are not typical olive-growing areas, provinces such as Castilla La Mancha, Navarra, La Rioja, and Castilla and León also show a high percentage of new orchards”

![Olive Orchard Acreage in 2005](image)

When an olive tree begins its growth period, temperatures slightly below 32ºF cause serious damage to shoots, killing off buds and young leaves. During flowering, temperatures around 32ºF have a negative effect on flower organs, leading to the incomplete formation of flowers. Subsequently, during the olive growing and maturing stage, temperatures under 32ºF damage the fruit, reducing yields and particularly the quality of the oil obtained from such olives.

Shorter duration of low temperatures and lower severity, can reduce the damage caused. Nevertheless, although frost is a totally random phenomenon in terms of both frequency and intensity, we can take a number of measures to seek to minimize the effects of frost during the establishment and development of an orchard.

**CHOOSING A PLOT**

To prevent radiation frost, it is advisable not to plant in the low areas of valleys, since this is where the densest masses of cold air gather. Ventilated slopes are preferable to closed or shady plains.

**PLOT EXPOSURE**

An olive orchard’s exposure is defined by the slope and orientation of the growing area, changing the amount of

<table>
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“These regions view olive oil as an opportunity to take advantage of the marketing channels opened up in the agrifood sector by other commodities such as wine”
ROW ORIENTATION
In super intensive olive orchards, trees are arranged following a well-defined layout; modifying the orientation of planting lines leads to variations in the energy received by trees. A north-south orientation therefore maximizes trees’ light interception. Moreover, if planting follows the slope lines, this favors the passage of cold air to lower elevations.

CHOOSING THE RIGHT VARIETY
Of the three varieties adapted to super intensive cultivation, Arbequina is the most cold-resistant, followed by Arbosana and Koroneiki. In cold regions such as Aragón, La Rioja, Navarra and Castilla y León it is advisable to rule out the use of the Greek variety Koroneiki and to plant Arbosana only in the warmest plots with the best exposure. It is also important to bear in mind that Arbosana olives reach maturity in mid-December, a month later than the Arbequina variety, and at a time when many of these regions have already had their first frosts.

PLANTING FRAMEWORK
If we take into account that an olive-tree’s height should not be higher than 7.5 - 8.2 feet due to the limitations imposed by harvesting machines, in northern Spain the distance between rows in Arbequina orchards under irrigation should be about 13 ft. This can be reduced to 9.8 ft - 11.5 ft in southern regions such as Andalusia, since as we get closer to the equator the sun’s arc becomes more pronounced and rays of light are more perpendicular, so the shadows cast between rows are reduced. The distance between Arbequina trees within rows is kept indistinctly at a little over 5 feet to allow the formation of a central axis. Given that its growth is less vigorous, with the Arbosana variety the distance can be reduced to 4.0 - 4.4 feet.

PLANTING SEASON
To avoid the risk of spring frost, the best time to plant is at the end of April. It is best to avoid the months of July and August due to the adverse effect of high temperatures on young trees. Planting in September through October is advisable in rain-fed areas when water needs are lower due to milder temperatures.

“Of the three varieties adapted to super intensive cultivation, Arbequina is the most cold-resistant, followed by Arbosana and Koroneiki”
USE OF TREE PROTECTORS
The increased temperature produced the greenhouse effect of protectors can be useful in maintaining enough temperature difference with the exterior and protect trees from certain frosts. Protectors are also a very useful means of controlling weeds and in the tree’s growth process, since they limit the growth of suckers at the bottom of the tree and often lead to savings in the number of branch ties to be effected.

SOIL MANAGEMENT
Because radiation frosts are caused by soil heat loss, tilled soil carries a greater risk of frost than an untilled flat soil. It is important to ensure that orchard soil is kept free of vegetation during the frost season, so mowing permanent ground vegetation on the plot is advisable.

OLIVE-ORCHARD IRRIGATION
If we bear in mind that the resistance to cold of olive-tree tissue is inversely proportional to its water content, it follows that inducing the right amount of water stress is advisable prior to the cold season. The weekly water dosage should be reduced as of September so that water stress, hand in hand with shorter days and the first cold days of the fall season, can act as a stimulus to harden olive-tree tissues.

FERTILIZING AN OLIVE-TREE ORCHARD
Nitrogen fertilization should be cut back as of August, since it encourages plant growth and this can jeopardize trees in cold temperatures. Phosphate and potassium fertilizers in balanced

"If we bear in mind that the resistance to cold of olive-tree tissue is inversely proportional to its water content, it follows that inducing the right amount of water stress is advisable prior to the cold season"
doses with nitrogen help to strengthen trees’ resistance to cold. It is especially important to add potassium if trees are heavily laden with fruit, since nutrient reserves tend to fall to very low levels. Potassium is of fundamental importance in regulating trees’ water needs since it facilitates the opening and closing of stomas, trees provided with enough potassium will increase their defenses and resistance to cold. Organic dressing can also offset the effects of low temperatures in that it helps to increase soil heat storage.

**OLIVE-TREE HEALTH**

Olive trees weakened by pests, disease or nutritional imbalances will be the first to show the effects of frost damage. Disruptions to a tree’s normal physiological development lead to a lower accumulation of glucides (carbohydrates) and salts in cells, thereby reducing the affected olive tree’s resistance to cold. Treatment with copper is an effective means of preventing fungi diseases such as wilting, and helps with an olive tree’s hardening if applied in suitable doses after harvesting.

“Olive trees weakened by pests, disease or nutritional imbalances will be the first to show the effects of frost damage.”
A Gift From The Gods

Athena, the Greek goddess of wisdom, is said to have gifted mankind with the perfect tree: the olive tree. This is the perfect time to plant the perfect tree—the olive oil market in California is booming.

With the help of Sunridge Nurseries and our technologically advanced, high density trees, you too can quickly turn marginal land into profitable orchards. We offer NursTech certified plants (Arbosana 1-43, Koroneiki 1-38 and Arbequina®), three decades of experience, and our personal assistance in securing long-term processing contracts for your fruit.

Call us today to find out how to turn Athena's gift into pure profit.
As a pioneer company in implementing the super-intensive olive-tree growing system, Agromillora launched a genetic improvement program designed to produce new varieties adapted to super intensive cultivation in 1997. Three main varieties, Arbequina, Arbosana and Koroneiki, currently make up the basis of such planting. The aim of this program is to enlarge the collection of existing varieties thus increasing the income-earning potential of super-intensive crops in various geographical areas and different soil and climate conditions. The program’s specific focus is on increased tree yields and reprococity and enhancement of olive oil quality, and improved resistance/tolerance to biotic and non-biotic factors.

“The program is based on directed breeding of different parent stock and selection of the seedlings with the desired characteristics.”

M. Cunill, S. Duran, M. Mestre, and M. Bordas
R&D Department, Agromillora Catalana, S.A.
“Six genotypes were obtained with higher average lbs/tree yields than the Arbequina and Arbosana reference varieties, in addition to 4 genotypes yielding more lbs of oil per dry matter/tree.”

Our plan is based on directed breeding of different parent stock and selection of the seedlings with the desired characteristics. During the first two-three years a pre-selection of potentially productive breeding material was conducted, focusing on morphological traits such as strength, appearance, growth habit and shortening of the juvenile period. During the three to four years elapsed since the germination of these trees we have characterized the first offsprings in line with the following parameters: resistance to olive leaf spot (Spilocaea oleagina), fruit-bearing precocity, alternation, yield, fatty content, and oil quality. The results of such characterizations have made it possible to select the best breeding materials.

Since the launching of the program 10 years ago we have obtained 1,163 genotypes stemming from 45 cross breedings of more than 30 parents. The first breedings carried out in 1997-98 led to the pre-selection of 41 genotypes out of 290. Charts 1 and 2 show the results of the genotypes with the best yield behavior: lbs of fruit per tree and lbs oil per dry matter/tree in 2004 and 2005. Six genotypes were obtained with higher average lbs of
fruit per tree yields than the Arbequina and Arbosana reference varieties, and four genotypes yielding more lbs of oil per dry matter/tree.

The pre-selections have been propagated and planted in experimental fields in different domestic and foreign geographical areas (Italy, Tunisia, France, USA and Chile), where evaluations will be conducted to determine agronomic behavior. These tests will enable us to assess oil yield and quality and gather information to classify the genotypes on the basis of different characteristics: adaptation to climate and soil (limestone and salinity) conditions and resistance or tolerance to diseases and pests (tuberculosis, wilting, olive leaf spot, etc.). In three to five years, our goal is to have new olive-tree varieties to tackle the challenges currently facing olive growing.

“These tests will enable us to assess oil yield and quality and gather information to classify the genotypes.”
Differentiate your olive oil

The Alfa Oliver 500 olive oil extraction system helps producers tailor olive oil production by maximizing the natural qualities of each crop. Alfa Laval supplies complete Olive Oil processes from .5 tph to 12 tph. Customized “plug-n-play” module options include:

- Washing system: A dry washer that removes leaves, twigs and soil from olives without using water
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- Malaxer: These covered holding tanks continuously agitate paste at controlled temperatures to provide the correct amount of antioxidants and best possible flavor
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For more information on the Alfa Oliver and our complete range of olive oil processing solutions, please contact Cosimo Pecchioli at cosimo.pecchioli@alfalaval.com or +1 916 335 8862.
Olive growing is going through a process of change worldwide. Innovation has become a vitally important concern for a sector that has long been at a standstill and affected by crises and ongoing economic difficulties.

The modern cultivation techniques used in the super high density (SHD) system are being rapidly disseminated and becoming statistically significant, both in countries where olive-growing is a traditional crop such as Spain, and in a series of new and interesting productive areas (Chile, Portugal, Morocco, the United States, etc). Only Italy, beset by a number of traditionalist, policy-setting and economic difficulties, has been left behind, watching from a distance and facing the risk of losing its role as the world’s leading producer of olive oil.

There can be no doubt that the country at the forefront of this innovative olive growing system is Spain, which following 15 years of researching and experimenting by private entrepreneurs, has developed a new, modern and efficient approach to olive growing.

It is particularly in recent years, however, that SHD olive cultivation has grown most, and not just in numbers: in terms of agricultural science, production techniques are being continuously improved by adapting them to different productive conditions throughout the world.

Leading harvesting-machine manufacturers have been quick to understand the importance of this new trend and are constantly improving their technology, particularly in regard to models designed specifically for olive harvesting.
Super High Density Plantation

From the standpoint of olive varieties, much research is being done in public-sector centers such as Cordoba University in Spain and in private-sector companies such as Agromillora, who in conjunction with researchers and sector professionals around the world are conducting a major research and development program on new varieties and clones of internationally used Spanish varieties to assess their adaptability to the SHD system. This aspect is extremely important, since the greater the number of varieties available, the more the SHD system will be in a position to meet a wide range of production demands by diversifying olive quality.

On comparing traditional and super high density olive growing, the SHD system’s technical and agricultural superiority provides obvious, major economic advantages. SHD cultivation, which is based on a high density of trees per acre, depends on optimum soil use, greater genetic efficiency of olive varieties and adaptability to high mechanization, which in turn lead to a drastic cutback in agricultural management costs, particularly as regards pruning and harvesting. Furthermore, on extending the comparison to olive oil quality, there can be no doubt that the SHD system is more efficient and provides greater potential for improving oil quality than traditional methods.

That is particularly true at harvesting time because of harvesting speed, timely harvesting when different olive varieties are ripe, and immediate milling. The advantage of the SHD system lies in the use of mechanical harvestors which are swift and highly efficient. In fact in some growing areas it is possible for just two operators to harvest up to nine tons of olives per acre in a matter of two to three hours. (Editor’s Note: In California we witnessed five to six tons/acre in under one hour).

That remarkable harvesting capacity makes it possible to pick large quantities of olives with a perfect degree of ripening even on large-scale plantations, and in some cases olive processing can be carried out immediately, since it is becoming increasingly common in SHD plantations to build on-site olive oil mills.

In SHD plantations different varieties are planted separately, harvested separately and processed and stored separately, so as to make blending easier in keeping with each company’s marketing requirements. This makes it possible to produce oils covering the entire scale of fruitiness, ranging from light to medium to intense, and to be in a position to meet all consumer and market demands.

In the near future, as more olive varieties become available, the SHD system will also help to further optimize olive oil quality, since it will be possible to produce high quality extra virgin olive oil with lower management costs, while also providing each country, region and even farm, with a more distinctive characterization and differentiation, and therefore to market their blends on international markets.

Another very important consideration that closes the cycle is the choice of processing system. The final chemical and organoleptic characteristics of olive oil depend on several factors: the production ecosystem (soil and climate) olive varieties (whose physical state and degree of ripeness also vary), and milling techniques and systems, which have a bearing on the oil’s chemical and organoleptic profile. A careful, professional choice of the most suitable processing system based on the productive environment, the varieties used and market needs, makes it possible to change the oil’s sensory profile by emphasizing certain characteristics or diminishing others in order to maximize oil quality, and therefore economic benefits. Leading manufacturers of oil mill machinery have become aware of the potential of SHD olive growing and are focusing increasingly on designing machines that combine high productivity with a high-quality end product.

We will now analyze the oil produced by three clones of the three varieties being used in super-intensive olive growing: Arbequina Agromillora (Nurstech) Selection, Arbosana I-43 and Koroneiki I-38. The following charts show the chemical, organoleptic and sensory characteristics of each oil. The three oils sampled, which were produced in Spain during the 2007 harvest, were made using optimum technical criteria, particularly as regards harvesting, which was carried out with the right degree of olive ripening and milled immediately.

Based on the great importance and strong influence of milling and extraction/pressing techniques on organoleptic-sensorial characteristics and on the final quality of the olive oil produced, uniform samples have been examined in reference to the main processing parameters (paste temperature and whisking time, etc.)

Chemical studies were conducted in Spain by specialized laboratories,
whereas the sensory analysis was carried out by professional Italian tasters under my supervision.

**Description Of Oil Characteristics And Sensory Attributes**

**ARBEQUINA AGROMILLORA (NURSTECH) SELECTION**

On visual inspection, the oil obtained from the Arbequina variety (Agromillora Selection clone)—the main Spanish super-intensive variety—is a light yellow with green tints. In terms of smell it has a fairly clean and persistent fresh fruitiness with evident herbaceous tinges, whereas, conversely, in taste sweet sensations prevail: apple, olive and ripe tomato, together with almond and hazelnut, are more prevalent than the fresh-green sensations of artichoke/cardoon, olive and green tomato. Astringency is also light, and bitterness is soft, with optimum overall harmony.

It is a decidedly pleasant olive oil, which by virtue of its delicate nature is also well balanced.

Its markedly neutral, light characteristics make Arbequina Agromillora (Nurstech) Selection a “universal” oil. This is particularly interesting from a strictly commercial standpoint, because it can meet the needs of most markets throughout the world. It is also an “ideal” base for making a wide range of products creating blends with other intensive olive oils, even those with opposite characteristics.

The “natural” affiliation of Arbequina oil to the “light fruity” category has also been verified in chemical analyses through the relative values of the percentage of oleic acid (71.10%) and above all total polyphenol content (167 mg/kg *), which is not very high.

The polyphenol content could give this monovariety oil limited stability over time. From the professional and oil quality point of view, however, specific deficiency can easily be corrected by blending it with fairly low percentages of other particularly intense oils rich in phenolic substances (Koroneiki).

From the gastronomic point of view, “pure” Arbequina oil lends itself to all dishes that require a delicate condiment, and is therefore ideal on broiled and charcoal-broiled fish, salads, cheeses and fresh pasta.

**ARBOSANA I-43**

On visual inspection, the oil obtained from the Arbosana variety (clone I-43) was a yellow or golden color with green tints. In terms of smell it clearly demonstrated a green tomato fragrance with an herbaceous background.

In terms of taste it showed a medium harmonious fruitiness with an optimum balance between green/fresh and sweet/mature sensations.

A perception of artichoke, green olive and fresh herb was intrinsic, together with olive and ripe tomato against a
Arbosana I-43 green and spicy sensations (fresh intense perceptions dominated by herb, olive and green tomato) and a clear after-taste prevalence of bitter and tart notes (artichoke-cardoon and green wood). Its spiciness was very strong, while bitterness was potent and persistent on the palate. This oil has a strong personality and a very particular taste, and for this reason and its rather “extreme” characteristics, does not have a particularly high level of harmoniousness. This general appraisal changes on examining its chemical values.

The high oleic-acid content (78.18%) and above all the high concentration of polyphenols (600 mg/kg*)—natural anti-oxidant substances—make the olive oil from this variety truly excellent as compared to the other two we have examined.

Strictly from an oil-quality point of view, Koroneiki oil is an outstanding “blending” oil and therefore has the capacity, in small percentages, to “revitalize” any type of oil through a “natural” injection of aromatic, anti-oxidant substances.

At the same time, it can be highly appreciated in demanding markets that are used to “intensely fruity” olive oils.

The sensory analyses show that the three olive oils produced using the varieties currently in use in the SHD system are clearly distinguishable from each other and, by virtue of their organoleptic characteristics, can cover the entire range of fruitiness.

In fact, in the case of the Arbequina variety, which is considered a light fruity oil, a medium intensity can easily be obtained in some production ecosystems using certain milling techniques.

The use of just three varieties to meet productive and market demands throughout the olive-growing world may be considered rather limited, but it is worth pointing out that fortunately the system is already self-sufficient with these varieties alone.

To understand this concept better, we can refer to the example of the three primary colors (yellow, blue and red) which of themselves are enough for the NTSC system, in use in all video systems (televisions, screens, etc.) to recreate a virtually infinite range of colors. Similarly, by blending the three oils using different percentages of each and/or optimizing milling and extraction techniques, one can produce a large, diversified range of oils.

In conclusion, we will describe some examples of particularly interesting blends of oils of the three varieties.

A small percentage of Koroneiki added to an Arbequina base makes a very interesting oil. By progressively increasing the blending percentage, a medium-light fruity oil can be turned into medium-intense, with the possibility of producing a full commercial range.

In the specific case of the three varieties under study, which in themselves are high-quality oils, it is not difficult to produce high-level blends that can compare favorably with world-class extra-virgin oils.
For instance, a “prototype” based on Arbequina with a fairly consistent percentage of Arbosana and a smaller amount of Koroneiki leads to a truly complex, extraordinary medium-intense fruity oil with great harmony and optimum balance, making for a really excellent oil that can hold its own in the most prestigious contests around the world.

It should be emphasized that such results can only be achieved by optimizing the entire process through appropriate plantation and crop management, using the latest milling techniques and painstaking, professional oil-quality management.

These technical considerations, which are difficult to achieve through traditional olive-growing methods, are easily implemented “naturally” through the SHD system.

The above is confirmed through an analysis of chemical values regarding acidity and the number of peroxides (oxidation ratio). These specific values, unlike others stemming mainly from the variety of olive, the production ecosystem and the milling system, can be directly and strongly influenced by the physical state of the olives on processing. The three oils analyzed reflect the highly uniform and particularly low values that characterize high-quality products. This is the last important confirmation of the effectiveness of the SHD system and its superiority over the traditional system, especially as regards its highly efficient, clean harvesting and effective approach to olive tree health management.

CONCLUSIONS:
After analyzing the chemical, organoleptic and sensory characteristics of the three oils, we can say that under optimum conditions and taking excellence as a benchmark, all three meet all the requirements needed for high quality, and not only show the same standard of quality but are superior in the main to the oils produced through traditional olive growing methods.

However, the biggest difference that has led to a genuine technical and economic revolution in the sector is that, due to the drastic reduction of management costs, olive oils produced using the SHD system can be marketed at lower price levels that are acceptable to most consumers while still providing growers with satisfactory profit margins. In fact in some cases certain olive oils from well structured large-scale olive holdings in favorable agricultural areas can be marketed at similar or very slightly higher prices to those sold by major distributors of current “commercial” oil brands.

Their quality is so obviously superior to that of mainstream commercial brands that it can be noticed by the average consumer. A reasonable sale price would make it easy to promote “real and genuine” extra virgin olive oil on world markets.

Editor’s Note: Arbequina (Nurtech) Selection will be available in North America for planting in 2009.
March 6, 2008 Interview with Dan Flynn of the Olive Center at the Robert Mondavi Institute for Wine and Food Science, UC Davis.

Recently, Olint Magazine sat down with Dan Flynn, the Executive Director of the Olive Center at the Robert Mondavi Institute, UC Davis, and asked him a few questions about the direction of this exciting new project.

OLINT: Hello, Dan, and congratulations on the opening of the Olive Center! To start, please give us a brief overview: What is the Robert Mondavi Institute?

Dan: Well, Robert Mondavi Center (RMI) for Wine and Food Sciences is the new home for the University’s viticulture and enology program and the food science and technology program, brand new facilities for both of those departments, which are major departments here (at UC Davis). And the wine program is obviously really well known. Mr. Mondavi donated a large sum of money to construct these new facilities. He felt he had benefited quite a bit from the University of California at Davis with his business, and he wanted to give back, so that’s what led to that. The UC Davis Olive Center is also under the RMI, although it is not part of either of those departments. But it’s one of three centers under RMI and the newest Center. So that will be our home when we move in a few months.

OLINT: The collaboration between the University of California, most notably UC Davis, and the olive industry is a long and rich one dating back to the late nineteenth century. So as we begin a new chapter in this relationship, what will be the role of the RMI Olive Center?

Dan: The roles that we have are education, research and outreach, to put it simply. On the education side we do things like short courses. We have one coming up that will be a two-day short course on growing olives for olive oil production, which we are doing in conjunction with others affiliated with the campus. There’s the possibility that we’ll have a general education course dealing with olives, olive oil
and horticulture. On the research side we are responding largely to the industry and will be driven by the needs of the industry, and it’s going to be funded by the industry because that’s how we need to support ourselves. We already have a number of projects that we are engaged in on the research end. Then on outreach we do things such as— I’ve gone around and met with various people around the state involved in the olive business. We have a course, basically short seminars with the culinary Institute of America where we will discuss the olive industry in California and some of the points of olive oil tastings. We have hosted delegations from other countries to come here and learn more about the California olive industry. We just had a group from Sicily a couple of months ago. So, in a nutshell, that’s what we are all about: Education, Research and Outreach.

OLINT: My next question comes from a comment you made recently at a seminar, and that is, Why the Olive Center? Why not the “Carrot” or “Tomato” Center?
Corto Olive is one of several family-owned agribusiness enterprises that blends our Italian heritage with a 50-year reputation as California producers of superior quality processed foods. Beginning on the terraced hillsides of Tuscany, the Cortopassi family has been producing olive oil for generations. The combination of our olive oil heritage and extensive agricultural land holdings in the heart of California’s rich Central Valley inspired Corto Olive to become the premier producer of premium quality olive oil in America.

Contact us regarding sales and grower processing contracts. We also offer trees and cultural expertise to our growers through our related farming company, Lodi Farming, Inc.

Lodi Farming, Inc.
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Corto Olive
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www.corto-olive.com
Dan: The olive has a really special place in the history of the University going back to 1899 when we came up with the first safe canning process for California olives. That relationship has extended for more than one hundred years. And I think it's an indicator, first of all, of that special place in the University's history that we had an olive center, but also it indicates that the olive industry is in an important phase at this time with the olive oil sector growing very rapidly and our established table-olive sector looking at innovating and reducing their production costs. Both of those sectors have indicated that they could use the University's expertise. So, we have the expertise here in a number of disciplines. The Olive Center is going to bring more people in, and we will be well suited to meeting the needs of this industry.

OLINT: You already touched on my next question: What are the objectives and goals of the RMI Olive Center? You mentioned education, research and outreach; would you elaborate a bit on what are the immediate goals versus the long term goals?

Dan: On the research end, one thing we'd like to do is a survey of the olive producers in California and to really get a firm handle on what the numbers are, where the growth is, what type of varieties are being planted, what type of yield is coming out of those orchards. We are also looking at doing a sensory panel that would evaluate olive oil quality, and it would have a research focus and be one of the few such panels in North America. We are also looking at solid waste coming out of the olive mills and the opportunities that it presents. It's an issue that every olive producing nation faces and we are looking to come up with innovative approaches for using that by-product.

OLINT: This leads to a question I was going to ask you a bit later, but I will ask it now: How has the environmental movement impacted olive oil production, and what is the RMI Olive Center doing to meet some of those challenges?

Dan: You mean the environmental impact of the olive waste?

OLINT: Yes. I suppose the biggest one would be the effluent, but is there anything else you might want to elaborate on?

Dan: Well, it varies by the part of the state in terms of the rules that govern how you deal with the waste. Many producers are spreading it back out into the orchards; some are looking at using it as cattle feed, which has a lot of opportunities in the Central Valley given the growth of olive production here and the fact that there is a lot of cattle. But in whatever way that we deal with this, we must make sure that we deal with it in a sustainable matter and one that is economically viable for the producers. So that is where we will be steering our focus.

OLINT: So the Olive Center is working on tackling that challenge?

Dan: Yes, we did an initial step, a survey of all the literature that's been written on this topic and have summed that all up and have gotten a good handle on what other nations are doing. Some of it is different from California in that we generally use a two-phase (milling) process here in our production; whereas, there are some three-phase processes elsewhere, but I think it probably makes sense to look at the advantages of two-phase versus three-phase in terms of the waste produced and seeing if one has advantages over the other. But I think producers will have their own views on which process is the best in terms of olive oil quality.

OLINT: We look forward to that information. Okay, what are the biggest challenges ahead for the olive industry and by extension the olive center?

Dan: I would say one challenge is educating the public in the aspects of olive oil quality, appreciating the high-quality that is being produced in California. Another challenge will be to have waste management methods that can be handled on site as much as possible so that producers reduce their transportation costs and, therefore, keep production costs low. I think another challenge will be in addressing the competition of imports in both olive oil and table olives and insuring that "The olive industry is in an important phase at this time with the olive oil sector growing very rapidly and our established table-olive sector looking at innovating and reducing their production costs."
we are all competing on the same plane and by the same rules.

**OLINT: What do you think the industry lacks in terms of research right now?**

**Dan:** I’ve gotten the sense by talking with a lot of people in the industry that they could use... A lot of them don’t have scientists or, at least, a broad range of scientists on their staff, so the University can fill that role. We have a lot of scientists here interested in looking at issues related to olives and olive oil, so I think that is one of the areas where we can be of service. Also some consumer based research would be helpful to the industry and getting a sense of what the consumer likes, what styles of olive oils they appreciate. Also with table olives, it’s an issue. I think that’s another area where we can have a role in doing that kind of consumer feedback through sensory panel research here, to start with, then see what the consumer thinks about the same product.

**OLINT: Do you think this research will be driven and originate from the University, or will it be the role of the olive industry to suggest or to promote that as well, or all of the above?**

**Dan:** Yes, I think the industry will be a driver of the research we do, because they know best what their needs are and they have the resources to try to get answers to the questions they want answered. So, yes, I think the industry primarily will be the driver, but as the University scientists here get into this topic more deeply, they will probably have their own interests to explore. As they find things out in a lab, it might steer them down a course that could come up with a great innovation, so both will be working, but primarily, research will come from the industry.

**OLINT: As I am sure you are aware, Spain has the Instituto de la Grassa (Fat Institute), which has about 100 PhDs working on olive oil related projects. Do you think the RMI Olive Center will reach that level one day?**

**Dan:** Right now, that is hard to say since we are just starting out, but from the projections that I hear, California is on a steep growth curve, and we’re going to be growing rapidly, and as the industry grows, I think our efforts and personnel devoted to this will grow as well. I don’t know how the Instituto de la Grassa is funded, so the model may not apply readily to California. But I can say that with the establishment of the UC Davis Olive Center, we are steering more of the University’s resources toward this topic, toward the needs of the industry, and so it’s going to be an improvement over all the great work that has preceded us. We are going to be adding to it and sort of jump-starting that a bit.

**OLINT: Do you think the RMI Olive Center will transfer information to and from other olive centers around the world?**

**Dan:** Yes. Our goal is to work with all the academic resources out there in the world, and there are a number that have been at this for a long time, and we have a lot to learn from them. And also in the “new world,” in Australia and South America where there are fairly
OLINT: UC Davis has been very successful in terms of providing research for the wine industry, do you think the RMI Olive Center can do the same for the olive industry?

Dan: Absolutely. I think we are already making a lot of headway in that regard. When Paul Vossen really got into this topic close to twenty years ago, there wasn’t a whole lot being said or written about California olive oil. Through his work and others, now suddenly it’s a whole different ball game, and it has some parallels with the wine industry. Forty years ago there were not that many wineries in California; now there’s hundreds, maybe thousands. Twenty years ago there were only a handful of olive oil producers; now there’s four hundred plus. So through the growth, we’ve earned a reputation in California of producing high-quality oil, and we’ve improved our quality very quickly to the point now where we are winning awards around the world for the olive oil. So, just like that judgment in Paris in 1976 where California beat-out some French wines, it could have the same parallel here, and we are already seeing signs of it: California olive oils are being stacked up against the world’s best. For an industry that’s just had its main growth really in the last fifteen years or so, that’s quite an achievement.

OLINT: That’s impressive. What do you think about the high level of mechanization in the super high density (SHD) olive orchard system?

Dan: From what I understand about a lot of different crops, mechanization has helped California reduce its cost and compete internationally, and that seems to be what’s happening with the olive orchards. And the quality has stayed very high, even with mechanization and possibly as a result of it, because you get the trees harvested quickly, and the oil is milled rapidly thereafter. That’s going to lead to very high quality olive oil. So, hopefully, what that means for California is that mechanization is going to lead to more jobs in this sector because there is going to be more of a desire to put in orchards in areas that are not really suited to any other agricultural crop, particularly a high value crop like olives. And so, overall, it seems it’s done some good for California agriculture. At the same time, there will always be a place for hand harvested olives and for more traditional styles of making olive oil, and both of the sectors can co-exist and actually grow and help each other grow as the industry grows.

OLINT: There are some people who are skeptical about this trend in olive oil, and it seems to me the fact that the University of California would create an Olive Center would somewhat assuage that fear. But what is your feeling for the long term as far as olive oil is concerned: the demand for, the health benefits, etc?

Dan: Well, it seems to be on an upward curve, where it’s growing, I read the other day, like twenty percent a year. So that’s good. As people become more conscious of quality and their diets, that’s only going to be good for olive oil. As demand grows, I think the olive center will grow, but also, putting that aside, there’s lots of potential with the existing demand for California to take more of a market share. And it will be up to the industry to make that case to the consumer, but the Olive Center can help the industry in terms of helping them get ever-higher quality, ever-more efficient production, more environmentally sensitive practices in the orchard, and so I think one can say that the prospects are really positive and rosy for the future of California.

OLINT: How Can growers and producers best utilize the resources at RMI Olive Center?

Dan: First of all, they can log onto our website at olivecenter.ucdavis.edu. They can see the information that we have and learn more about what we can offer. They can also call me directly if they have questions related to their business, and I will try to put them in contact with the right person the University has here. And we’ll also be out there going to the events that the producers go to, meeting them face-to-face and talking to them directly. There are a lot of ways for people to plug into this. If they have some research needs, we would like to hear about them. If they have ideas for educational offerings, we would like to hear about those. And I think it’s going to be a real collaborative process: we are not going to be dictating to the industry on what we are going to do; we’re going to work really closely with the industry to determine how best to serve them.

OLINT: Well, that about wraps it up. Thanks for your time, Dan.

(Editor’s note: Dan Flynn can be reached by phone at (916) 825-7536.

Robert Mondavi passed away on Friday, May 16, 2008, at the age of 94)
1. Introduction

Olive Tree Yield Estimation Method

Olint Crop Estimation Method (OCEM)

Xavier Rius
Agronomist. Director of Agromillora Australia, Pty

Using a 12” x 12” square as a measuring unit

1. Introduction

Olive growers need to be able to predict the percentage of oil (%) and the total crop yield (lbs/acre) in a given block. Although it is still common to estimate yields subjectively by sight by walking through an orchard, nowadays a more precise estimate is needed for planning purposes.

Accurate estimations of crops and oil percentages are of use to:

- Olive growers, for a prior idea of how many tons of olives and pounds of oil (money) will be harvested, and in case of prior contracts, to ensure the amounts specified to oil mills are obtained.
- Oil mills in the planning and logistics of the production process (blocks to be harvested, storage-tank availability, staffing needs, etc.), so as to reduce the time lapse from harvesting to the initiation of processing, thus enhancing oil quality. This aspect is of greater importance to oil mills that work for many olive growers, each of whose crop has to be processed individually.
- Sales departments, marketing and distribution channels.

2. Method

2.1. DETERMINING SAMPLING POINTS

To avoid human influence and ensure sampling is representative, it is important to use a totally random sampling system that provides each section of a tree (position) the same probability of being chosen.

The “position” for measuring with the square consists of the row number, the tree number on the row, the side of the tree’s axis (left or right area), the side of the row (front or back), and the tree height (high, middle, low).

There are various ways of obtaining a random number to select the measuring position with the square:

METHOD

- Number boxes from 1 to 5
- Place in box No. 1: balls featuring all the row numbers on the block (for instance 1 to 60)
- Place in box No. 2: balls featuring all the numbers of the trees on the row (for instance 1 to 200)
- Place in box No. 3: pieces of paper with the words “left” and “right”
- Place in box No. 4: pieces of paper with the words “front” and “back”
- Place in box No. 5: pieces of paper with the words “high,” “middle,” “low”

For example: Box No. 1 gives us the number: 23
Box No. 2 gives us the number: 133
Box No. 3 gives us the word: “right”
Box No. 4 gives us the word: “front”
Box No. 5 gives us: “low”
The square should be placed on row 23, tree 133, right side of the tree, front area and low. Repeat this process for as many measurements as are needed for the sample.

- Software programs (Excel) and/or tables can be used to choose random numbers and relate them to the position of the square.

2.2. DEFINITIONS

- Width of block in yards = W
- Length of block in yards = L
- Total area of block in acres = ST = W * L
- Tree separation within rows in yards = Sa
- Row separation in yards = Sh
- Average number of olives = X, as determined by field samples
- Average olive weight in ounces (1) = Y, as determined by field samples

1 Note: Bibliographical data can be used to begin with: Arbequina: .07 oz, Arbosana: .06 oz, Koroneiki: .04 oz, then make a history of the block under study over time.

- Number of trees per row = A = (L / Sa) + 1
- Number of rows in the block = R = (W / Sh) + 1
- Non-productive distance between trees in yards = D
  This value will vary, ranging between 0 and 0.4 yards depending on orchard management (growth vigor, pruning)
- Effective row length in yards = Lef
  Lef = L - ((L / Sa) -1) * D

- Effective canopy height in yards = Aef
  Aef = Total hedge height - Height of low area - Height of top area
  Aef = AT - Ab - At
  AT = The total hedge height will vary depending on orchard management and varieties: 2 - 3 yards
  Ab = The height of the low area is the distance from the ground to the first branches. Values: 0.45 - 0.65
  At = The height of the top area is the distance from the top part of the hedge to the tree’s olive-bearing area; due to the effect of toppings values range from 0.3 to 0.5 yards

- Effective leafy surface olives in the block: sq.yds = Sef = Lef * Aef * 2 * H

- 2P is the depth of vegetation from the planting line to the lane (one side only) in yards: this value will depend on growth strength and management, values ranging from 0.5 – 0.8 yards.

2 Note: Measuring the number of olives with the square: the square and depth from the beginning of vegetation to the planting line (P) are measured within a volume of area. This is why we refer to the effective leafy volume of olives rather than effective leafy area of olives, although the final result will not change.
• Effective leafy volume of olives in cubic yards = $V_{ef}$
  $$V_{ef} = S_{ef} \times P$$

• Number of measuring squares:
  $$(12" \times 12" \times P)$$ in $V_{ef}$
  $$Nc = V_{ef} / 0.09 \times P$$

• Total pounds of olives in the block = $Lbs_T$
  $$Lbs_T = (Y \times X \times Nc) / 1000$$

• Pounds of olives per acre ($A$): $Lbs_A = F \times Lbs_T / ST$

Note: The actual yields reaching the oil mill can be reduced on the basis of the harvester Factor; $F$: 0.85 – 0.97, depending on harvester efficiency.

2.3. ESTIMATION PERIODS
It is preferable to make 3 estimations during the growth period so as to be able to compare and adjust previous estimates:

**30 days after fruit setting**
- Count the number of olives set in each square and work out the average = $Y$
- Select the average olive weight at harvest on the basis of the historical data for the block (over several years). Bibliographical data can be used as a starting point:
  - Arbequina: .07 oz
  - Arbosana: .06 oz
  - Koroneiki: .04 oz

  Total pounds of olives per block = $Y \times X \times Nc$ ; $Y \times 0.07 \times Nc$

**90 days after fruit setting**
- Count the number of olives in each square and work out the average = $Y$
- Calculate average olive weight = $X$; Collect 100 olives in total (the proportional part for each measuring square). If 20 squares are measured in each block, this works out at 5 olives per square

**One week prior to harvesting**
- Count the number of olives set in each square and work out the average = $Y$
- Calculate average olive weight = $X$; Collect 100 olives in total (the proportional part for each measuring square). Total pounds of olives per block = $Y \times X \times Nc$

2.4. DATA ANALYSIS
A random size sample $n$ is taken from a population that is normally distributed from average $U$ where the random variable $t = (X - U) / (s / n^{1/2})$ has a t-Student distribution with $n-1$ degrees of leeway and the reliability (%) that the average number of olives of any sampling point $U$ in the field will fall between these two values.

$$X - t_{\alpha/2} \times (s / n^{1/2}) \leq X \leq X + t_{\alpha/2} \times (s / n^{1/2})$$

$t_{\alpha/2}$ of the t-Student tables: depends on the desired degree of reliability

$n$: size of sample

$X$ and $s$: calculated average and standard deviation stemming from the sample obtained.

Another statistical application is that if we know the % degree of reliability and the acceptable error of the sample average, we can work out the approximate number of samples needed to meet these requirements.

The standard deviation ($s$) needs to be estimated, or the values of other years need to be used.

$$N = (t_{\alpha/2} \times s / E)^2 \quad E = \text{maximum estimation error}$$
Keen interest in the SHD olive orchard system in both Oregon and Georgia lead to plantings in both states this year. Oregon’s first large scale orchard in the Medford, OR area was planted this summer. Several smaller plantings in the Willamette Valley near Portland were also completed during the summer. Alma, Georgia in the Southeast section of that state saw its first orchards planted during the summer with more scheduled for fall, 2008.

Parties interested in planting SHD olive orchards in the Willamette Valley, OR and Georgia should contact the following people: Ken Durant, Durant Vineyards, Dundee, OR (503) 864-3785, and Shawn Davis, Southeast Bark & Blueberry Farms, Alma GA, (912) 449-6869.

The USDA posted on line (on the internet) the most recent revisions of Standards For Grades Of Olive Oil And Olive Pomace Oil. The proposed revisions are now posted on the USDA website at the Federal Register. The period for comment ended August 1, 2008. To view comments to the current notice, please visit the following website: http://www.regulations.gov/search/index.jsp and search for “U.S. Standards for Grades of Olive Oil.”

**Practical Example Of Crop Estimation Based On The Values Entered (In Orange)**

**OLINT CROP ESTIMATION METHOD (OCEM)**

**Enter Values In Orange**

**Measure Square Position** | **Number of Olives**
---|---
Position 1 | 11
Position 2 | 19
Position 3 | 21
Position 4 | 21
Position 5 | 22
Position 6 | 22
Position 7 | 33
Position 8 | 20
Position 9 | 23
Position 10 | 21
Position 11 | 21
Position 12 | 21
Position 13 | 21
Position 14 | 21
Position 15 | 21

Average: 21.30

Standard Deviation: 10.41

Number of square measurements: 10

95% Reliability Range of No. Of Olives Value: 14.22 28.38

**Range of Crop Estimation**

<table>
<thead>
<tr>
<th>Pounds of olives block</th>
<th>Pounds of olives per acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>22,899 Lbs/Block</td>
<td>2,640 Lbs/Acre</td>
</tr>
<tr>
<td>45,700 Lbs/Block</td>
<td>7,905 Lbs/Acre</td>
</tr>
<tr>
<td>1,780 Lbs/Acre</td>
<td>14,22</td>
</tr>
<tr>
<td>7,905 Lbs/Block</td>
<td>28.38</td>
</tr>
</tbody>
</table>

Editors note: Sample numbers were converted from metric, there may be slight errors.
Researchers at the Monell Chemical Senses Center team in Philadelphia have reported in the *Nature Journal* that an ingredient in good quality olive oil acted as an anti-inflammatory. The active ingredient is called oleocanthal and is found in greater concentrations in fresher olives.

It was found to inhibit the activity of enzymes involved in inflammation in the same way as ibuprofen and other anti-inflammatory drugs. “It seems plausible that oleocanthal plays a causal role in the health benefits associated with diets where olive oil is the principal source of fat,” said Paul Breslin, the report’s co-author.

Claire Williamson, a nutrition scientist at the British Nutrition Foundation cautions that, “Olive oil contains a range of bioactive compounds, but we are not entirely sure what they do.” Furthermore, she adds, “to say [olive oil] mimics a drug is taking it one step further and needs more research.”

### California Attempts to Define Olive Oil With Senate Bill SB-634

A proposal was introduced into the California Senate (SB-634) that would update and codify the existing definition of extra virgin olive oil. The COOC and UC Davis Olive Center worked to modify the existing law and used the existing criteria from the IOC standards for Virgin, Extra Virgin and Pomace olive oil. The law would apply to all virgin, extra virgin and pomace oil sold in California.

While the law could technically only be enforced in California, it would impact all olive oils being sold within the United States. The State Senate voted unanimously in favor of SB-634, which now must be signed by the Governor.

We encourage you to voice your support by contacting the Honorable Patricia Wiggins, State Senator 2nd District, State Capitol Room 4081, Sacramento, CA 95814, or by fax: (916) 323-6958.

### OLIVE OIL ‘ACTS LIKE PAINKILLER’

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It was found to inhibit the activity of enzymes involved in inflammation in the same way as ibuprofen and other anti-inflammatory drugs. “It seems plausible that oleocanthal plays a causal role in the health benefits associated with diets where olive oil is the principal source of fat,” said Paul Breslin, the report’s co-author.

Claire Williamson, a nutrition scientist at the British Nutrition Foundation cautions that, “Olive oil contains a range of bioactive compounds, but we are not entirely sure what they do.” Furthermore, she adds, “to say [olive oil] mimics a drug is taking it one step further and needs more research.”
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