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Notes from Spain: A Summary of the V World Avocado Congress

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The V World Avocado Congress was held from 20-24 October 2003 at the Torremolinos Convention Center near Malaga, Spain. At the center grounds, overlooking the Mediterranean Sea, avocado industry leaders from six continents gathered to compare notes, present scientific papers, and discuss how to improve all aspects of avocado culture and marketing. This congress, like those of the past in South Africa, California, Israel, and Mexico showcased some of the best research carried out over the last four years.

The avocado congress took place over a four day period in Spain's Costa del Sol region. The Spanish avocado industry consists of roughly 22,000 acres in the southern provinces of Malaga and Granada. Like coastal southern California, the region is under intense suburban development as it is a seaside getaway for both Iberians and Northern Europeans. The congress divided presentations amongst several topics including; marketing, irrigation, pests, mineral nutrition, genetics, post-harvest handling, nutrition, nursery practices, industrialization, disease, avocado culture, and eco-physiology. In addition to scientific presentations at the Convention Center, one day was dedicated to tours of packing houses, nurseries and groves throughout the region.

MARKETING

The country reports and marketing presentations reinforced the notion that avocados have evolved from an exotic niche product to a major economic force in the agricultural sector of many countries. Growers who are familiar with the current planting boom in California, and have heard stories about impressive new plantings in Chile will be interested to learn that similarly expansive planting cycles are occurring in other places as well. New plantings in Africa, Latin America, Oceania, and Asia are going in, and 'Hass' is the preferred variety.

In New Zealand per-capita avocado consumption increased from 250 grams in 1990 to 1.6 kg today (Cutting). During that period avocado plantings increased to 4,000 hectares, 60% of which are less than 6 years old. This southern-hemisphere country depends heavily on counter-seasonal farm exports to northern markets. Currently avocados are New Zealand's 3rd most important fruit export group. Most New Zealand avocados are exported to Australia, with smaller volumes destined for Southeast Asia and North America. Growers in Australia have developed an aggressive promotional campaign including television, radio, print and point of-sale components. This campaign based on the phrase '"ave an avo today" is as professional in presentation as any ads seen in California (Allen).

Peru has experienced even more spectacular growth rates than New Zealand. After observing the success of Chilean growers, they have developed a 'Hass' industry based exclusively for export. Although Peru has a relatively high avocado consumption rate (when compared with world standards) and a long history of avocado production, the sector is dominated by low-value native varieties. Traditional Peruvian avocado production has been in small family holdings, primarily under rain forest conditions. In contrast, 'Hass' plantings have been developed on a large scale in desert areas with no rainfall, little temperature variation, and abundant groundwater (the result of Andean run-off). 'Hass' production in Peru has increased from 25 hectares in 1994 to 2,200 hectares today. Although phytosanitary barriers currently prohibit shipping to the United States, Peru may be of particular interest to California growers because their 'Hass' season most closely coincides with our own, with peak harvest occurring between March and September.

In Spain, the only European country with an economically significant avocado industry, the growing region competes for coastal ground with pressures from urban growth and the tourist industry. The European avocado market can be very volatile as fruit is shipped there from Mexico, Peru, Chile, Israel, South Africa, and Kenya. Historically very little information has been shared between production regions. This began to change at the 1999 Avocado Congress in Uruapan, Mexico when the International Avocado Society, at the insistence of Gabi Naamani from Israel and Chris Keevy from South Africa, formed the Avocado Marketing and Promotion Working Group (AMAPWG). This group meets annually to discuss the European market situation. Since 2001 they have exchanged, compiled, and disseminated information on crop size, harvest rates, and shipping plans. At the Malaga conference shippers agreed to begin assessing themselves 2.5 eurocents per 4-kilo tray for promotional activities in Europe. This modest sum represents an important step forward in voluntary cooperation for these countries. In addition to this development, Robert Jupe from the United Kingdom gave a presentation on the first trans-national mandatory promotional assessment in the European Union for produce. The program he described concerned endive grown in France, Belgium, and Italy that is marketed throughout Europe.

PESTS

A lot of work is being done in Mexico on avocado specific pests. This work is being carried out both for simple taxonomic identification as well as searches for possible predators of currently known avocado pests. In one study headed by Johansen Naime, 85 different *Thysanoptera* species were identified in Mexican avocado orchards. 'Hass' avocados were found to be more susceptible to and host a greater variety of thrips than either 'Colin' or 'Fuerte' trees. Of these 85 species, ten are natural thrips predators. In another two-year study headed by Johansen, eleven genera of thrips were identified in avocado groves, representing 53 species. Of these, 27 species pertained to franklinothrips, and 12 to scirtothrips. Three predators were identified, *Franklinothrips lineatus, Scolothrips sexmaculatus, and Leptothrips mcconnelli.*

In addition to thrips, persea mite is also being studied extensively in Mexico. Rogriguez has identified 24 mite species amongst eight families in Mexican avocado orchards. He

is studying both the damage incurred as well as predator-prey relationships. Coria Avalos did a study finding no correlation between fertilizer programs and thrips damage levels. Of particular interest to California growers, Rodgriguez Jimenez studied Mexican Fruit Flies and found that eggs deposited in 'Hass' avocados are suffocated as the skin wound heals, making 'Hass' avocados a non-host of Mexican Fruit Flies. This study is important in its implications for the future use of fruit flies as quarantenary pests. In addition to work in Mexico, G. Waite gave a presentation on the damage caused by fruit spotting bugs in Australia.

IRRIGATION and CULTURAL MANAGEMENT.

Fewer presentations were given concerning irrigation, mineral nutrition and cultural management than in other disciplinary areas. One study done in Spain by Jose Maria Farre contrasted drip irrigation with micro sprinklers. In this study trees were irrigated with six drippers or one microsprinkler over a six year period. No significant difference was found in tree growth during the first two years. In the last four years, potential crop yield and tree efficiency was significantly higher with micro sprinklers. This difference was attributed to the larger wetted area than in drip irrigated blocks. During the discussion period, some Israeli attendees mentioned that in Israel some plantings have upwards of 800 drippers per acre.

F. Gardiazabal from Chile presented a paper on determining the crop coefficient (kc) of Hass avocados in Chile. In the experiment trees were irrigated with 90, 100, 110, and 130 percent of evapotranspiration as determined by the modified Penman-Monteith method. In the project, trees irrigated with 90% Etc had a 21 % fruit decrease and 35% decrease in potential profits (based on size curve projections), than trees which received 110% Etc. This study corroborates California research that has shown remarkable yield increases at 130% Etc. vs. 100% or 90% (Francis, CAS 1997).

D. Medina (A-133) presented a study on the use of dendrometers to manage irrigation in avocado groves. Dendrometers measure the natural contraction and expansion of branch diameter throughout the day. Though the evidence of their effectiveness is inconclusive, these tools are being used to indicate periods of water stress and excessive water availability in avocado trees.

Most of the fertilizer information came out of Mexico with very little new information for California growers. Ben Faber and Gary Bender gave presentations on the use of organic mulches under California conditions.

A lively discussion on pruning techniques took place with no single technique coming out on top. This topic is hotly debated throughout the world and is currently the subject of much research. Growers research pruning in order to rejuvenate older groves, lower cultural costs, and increase per-acre production. Regarding the subject of pruning, some information on the use of growth regulators (currently prohibited on avocados in California) to increase yields while reducing vegetative growth was presented (Mena). Professor McNeil from Cal Poly, San Luis Obispo presented his research which shows no statistically significant benefits from the use of frost protective sprays in avocados. E. Guirado of Spain presented the results of cincturing to increase avocado production

which demonstrated no statistical differences between the cinctured and non-cinctured trees. Several presentations were given on nascent organic sectors in the avocado industries of Spain, Mexico, Australia, and the United States.

GENETICS AND BIOTECHNOLOGY

The genetics portion of the congress focused on two distinct areas, the identification and preservation of avocado varieties, and the ability to genetically transform avocados. In Ghana and Taiwan, where avocados are minor crops, scientists are seeking to genetically identify the diversity within the domestically available genepool. K. Taah presented a paper where University of Nottingham students used molecular markers to identify the races (Mexican, Guatemalan, or West Indian) to which different avocado specimens pertained. In Taiwan Professor Chiang used random amplified polymorphic markers to identify levels of genetic diversity in their germplasm bank orchard. Ben Ya'Acov gave a talk on his explorations in Costa Rica in search of avocado relatives. He also presented a paper on the current status of Israel's germplasm bank where 200 trees are kept, representing 148 different accessions.

In-vitro culturing of avocado specimens in laboratories has allowed plant breeders to accelerate avocado propagation when contrasted with traditional seedling methods. Tissue culture of avocado has been difficult to achieve. Professor Vidales Fernandez from Uruapan reported on his early experiments with different growth media and the difficulty in reducing necrosis to levels under 90%. Significant progress has been made since those early days as improvements in light, growth medium and temperature have been discovered. J.L. Fuentes from Cuba presented data showing that he had achieved an 80% success rate tissue culturing 'Hass' avocados. In Mexico, Maria Palomares has studied how long such tissue cultures can be stored while still being viable. The goal of her research was to develop an alternative to orchard-based germplasm banks to a smaller, laboratory setting. Palomares found that while decreasing light and space to slow growth, she could maintain 80% viability over a 90 day period.

Professor Litz from the University of Florida reported on some gene manipulation that he has carried out with the goal of introducing specific desired traits into avocados. Although these genetically transformed shoots failed to develop adequately on their own (they would often develop without either shoots or roots resulting in less than 6% viability) Litz developed a form of micro grafting on to Lula and Booth in-vitro cultures with much better success (viability of 70%).

Mary Lu Arpaia from California and S. Kremer-Köhne from South Africa gave presentations on the avocado breeding programs they conduct. The development of new commercial varieties is a long and difficult process. Breeders must take into consideration such myriad factors as taste, size, pit size, skin colour, productivity, and rootstock compatibility. Varieties that demonstrate tremendous potential as juvenile trees may under perform as adults. Great tasting fruit may bruise easily or have a short shelf life. Growers familiar with California's breeding program will be familiar with the new varieties presented in Spain, including 'Harvest,' 'Gem,' and 'Lamb Hass.'

POST HARVEST

As the avocado industry continues to globalize at a staggering rate and as more avocados are traveling over greater distances to markets, proper post-harvest handling is an important subject. Much of the information demonstrated in the post-harvest presentations is of only peripheral value to California growers, where most avocados are consumed within one 1,000 miles of the production area. One exception is the Sinclair pressure tester presented by Yasmin lonides. These tools offer a nondestructive, quantitative way to measure ripeness and have been utilized on a limited basis in the United States. As demonstrated by California Avocado Commission research, fruit displayed at proper ripeness levels in the retail market leads to increased sales.

Countries where the export sector is of much greater importance than in California are investing heavily in post-harvest research. South Africa continues to perfect its maturity indices for different varieties (Kruger) while New Zealand researchers are learning how to apply research done in other countries to their own conditions. The New Zealand 'Hass' season stretches from August through December (late winter through mid-summer). Growers there found that new-crop fruit (that harvested in winter) can be stored at lower cold storage temperatures without suffering chilling damage than old-crop summer fruit (Dixon). These findings differ from the author's experience in Mexico where new crop fruit (that harvested in Summer) must be stored at higher temperatures than old crop winter fruit. New Zealand is also at the forefront of developing dynamic controlled atmosphere storage as an alternative to the current static controlled atmosphere models (N. Lallu). In their research, gas levels within the sealed containers could be changed en route to the final destination in order to further extend the post-harvest shelf life of avocados.

One product that radically alters fruit ripening is 1-methyl cyclopropene (1-MCP). Several presentations were given at the congress on this product and how it is being used. A 1-MCP application at 200 parts per billion (ppb) was found to effectively double shelf life of 'Hass' avocados between removal from cold storage and readiness to eat. (Lemmer). The same study discovered that a 200 ppb application level of 1-MCP lengthened the time for 'Edranol' avocados to fully ripen after being removed from cold storage by 600%. A study by S. Ochoa in Mexico found that treatment rates of 400 ppb could lengthen shelf life by 12 days, while Ocina's work showed that a 200 ppb application lengthened ripening time by four days (A-95). Presentations were also given on the use of ripening chambers to reverse the effects of this product. Because of the wide variance of effects on shelf life at very small doses, the improper handling of 1-MCP could damage the market if customers are unhappy with an extended ripening period.

NUTRITION

Only one paper was presented during the congress in the section on nutrition. One interesting comment made during the nutrition section was that dieters in Australia who included daily avocado servings as part of their diet lost as much weight as those who did not include avocados. What the researches also noted was that dieters with

avocado in their daily menus were more likely to remain faithful to the diet, and less likely to cheat. The nutritional benefits of avocados are incorporated into promotional programs in both Australia and Chile. A recent television program broadcast in Japan highlighting the health benefits of avocados resulted in a tremendous increase of avocado imports.

DISEASE

In the disease portion of the congress, the most attention was paid to fungi and their control. One presentation by G. Avila Quezada described the early development stages of a quantitative model to correlate Anthracnose levels visible in a grove at time of harvest with post-harvest ripening problems. This research could be valuable to subtropical avocado producing regions were Anthracnose is a constant problem during the rainy season.

One soil borne fungus that is particularly problematic in Spain is *Rosellina necatrix* (white root rot). This disease, which was first isolated in Spain in 1987 was found in 39% of 481 groves investigated by Lopez Herrera. Although *Rosellina necatrix* is also found in Mexico and Israel, it has not developed into as devastating an epidemic as it has in Spain. *R. necatrix* kills trees more quickly than *Phytophthora cinnamomi.* Studies on the effects of solarization and chemical controls have met with only limited success. Fifty-five *Phytophthora* resistant rootstocks from the University of California breeding program were inoculated with *R. necatrix* all of which died within the first year. Current investigations are focusing on breeding programs with material from escape trees in infested groves.

Kromer Kung gave an impressive presentation on the *Phytophthora cinnamomi* resistance breeding program at Merensky laboratories in South Africa. They are in the process of releasing three *P. cinnamomi* resistant rootstocks that they have studied over the last several years. The breeding program is a slow and arduous process. Each year they evaluate 6000 seedlings in an inoculation bed, from which 0-15 will demonstrate sufficient resistance to be worthy of further study. In the program breeders are taking into consideration both *P. cinnamomi* resistance as well as rootstock/scion compatibility with 'Hass' avocados as measured by tree vigor and crop yields. The three most promising rootstocks are Merensky 2, Merensky 3, and V100.

INDUSTRY TOURS

Wednesday 22 October was dedicated to field tours of the local avocado industry. Congress attendants were placed onto busses and given tours of nurseries, groves and packing sheds. At each of these stops the gracious hosts gave a tour and answered a myriad of questions. Two nurseries on the tour were Brokaw España and Viveros Blanco. Because it was early Fall the nurseries were in between the seasons of shipping out large trees and planting seed. At the nurseries attendants were shown germination beds, grafting techniques, and given an overview of the process involved in producing clonal rootstocks. Several California attendants noted that Spanish trees were grafted much higher than nursery stock from California. Current demand for

avocado trees indicates that the 22,000 acre Spanish industry is growing. In addition to avocados, cherimoya and mango trees were also in the nurseries.

The grove that the author's group visited compares favorably with well managed avocado groves in other parts of the world. The mainly 'Hass' planting had a crop of roughly 15,000 Ibs./acre and, though early in the season, had a large amount of fruit 8 oz. and larger. The terrain was hilly providing for good cold air drainage in the winter, with vegetables mainly farmed on the valley floor, including artichokes, celery, and hothouse tomatoes. Like southern California, this part of Spain provides fresh vegetables to Northern Europe for much of the winter. In addition to avocados, plantings of mango and cherimoya trees were also common in the area.

Three packing sheds that the groups visited were *Frutas Montosa, Reyes Gutierrez,* and *Traps.* There are several avocado handlers in Spain organized both as cooperative and private enterprises. Fruit is snap harvested in the field and placed into 17kg field boxes. Long stems are often left on the fruit, to be later clipped in the packing sheds as they roll across the grading line. 'Bacon' avocados were being packed on the mid-October day of the tour. In addition to local product, imported avocados from Chile, Mexico, and Peru were also prevalent in local supermarkets. Important markets for Spanish avocados include France, Germany and the United Kingdom.

CONCLUSIONS

This is a period of great excitement for national avocado industries world-wide. Record markets are fueling planting booms in California and other areas as well. High per acre returns compared with other commodities allow avocados to compete for coastal farm ground in Spain. Chile, Peru, Ghana, Kenya, New Zealand, and Australia are all going though planting cycles. 'Hass' is the preferred variety in these new plantings.

Advancements have been made in avocado promotions and cooperation between growers in different countries. Ad campaigns in the United States, Chile, New Zealand, and Australia have helped to make the avocado as recognizeable as any other fruit in those countries. The Hass Avocado Board for the United States market and the Avocado Marketing and Promotional Working Group for Europe are two organizations where international cooperation is most visible. Both organizations are in their earliest phases of development. This progress must continue if avocados are to remain a viable commodity as more countries and growing regions expand their plantings and work to overcome phytosanitary barriers that exclude their products from certain markets.

'Hass' avocados have come to dominate the industry for a variety of reasons. They maintain a good flavour over several months of the growing season. Their pebbly skin resists bruising, fungal pathogens and some insect damage. They produce adequately when compared with other varieties and their black colour helps to camouflage many blemishes that would be more visible in green-skinned avocados. The tendency toward monoculture 'Hass' production world-wide presents a number of challenges that could make the avocado industry particularly susceptible to a possible future pest or disease infestation. Mexican research into avocado pests demonstrates just how limited our understanding of the insect world is. In some studies 'Hass' trees were shown to be

significantly more susceptible to insects than other avocado cultivars. The Spanish experience since 1987 with white-root rot illustrates the destruction that previously unknown diseases can engender. Dependence on a single rootstock or variety could set the industry up for disaster. Progress has been made in identifying genetic diversity within avocados. Improvements in tissue culture techniques promise to speed up breeding programs and help preserve avocado germplasm.

The 2007 World Avocado Congress will be held in Chile. As the venue moves to its fourth continent and the International Avocado Society marks 20 years since the first congress in South Africa, it will be interesting to see how the industry evolves. How far will the current worldwide planting boom extend? How will markets react to increased volume? What new diseases or pests will be identified? What problems will the emerging field of biotechnology solve? How will genetic diversity in avocados be maintained? What new cultural management tools will be developed? How will advances in the field of post-harvest management affect the handling of avocados? What new varieties will rival the current 'Hass' standard? The answers to these questions are important to California growers and will impact our decisions in the years to come.

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