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University of California County Cooperative Extension Program Formal Needs Assessment

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Tulare County

approved:
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1-26-10

December 1, 2009

The position of UCCE Horticulture Advisor for Orchard Crops and Systems in Tulare County will be responsible for development of research and educational outreach programs to address clientele needs of the nut and fruit industry. This position will specifically address the needs of pistachio, almond, walnut, pecan, dried plum (prune), and olive growers in Tulare County. A multi-dimensional, multi-disciplinary program will be developed to address diverse clientele needs within the context of orchard production systems, and emphasizing the strategic vision of the UC Department of Agriculture and Natural Resources. An initial survey of grower challenges and consequent priorities and needs had been developed and is addressed in the following needs assessment.

1. Nut, Olive, and Dried Plum Production

Tulare County comprises over 3 million acres (4863 square miles) ranging from the 14,000 ft peaks of the Sierra Nevada in the east to the fertile central valley in the west. Tulare County is the second largest producer of agricultural commodities in the United States, producing over 240 agricultural products with a total gross production value of over $5 billion in 2008. The county boasts a growing population of nearly 400,000 and agriculture is the largest private employer in the county. Farm employment accounts for nearly 25% of all jobs in Tulare County. (Tulare County Farm Bureau, Tulare County Commissioner/Sealer)

In 2008 fruit and nut commodities (including citrus, grapes, fresh fruits, etc) were valued at over $1.8 billion and pistachios and almonds were featured on the county's top 10 million-dollar crop lists. Additionally, production of deciduous fruit and nut tree nursery stock represented 4.3% and 4.1% of Tulare County's total nursery production in 2007 and 2008, respectively. The vast majority of orchards utilize conventional management practices; however, Tulare County does have 35 acres of organic olives and 379 acres of organic nuts. The approximate total bearing and non-bearing acreage of nut, olive, and dried plum production in Tulare County are 84,951, 12,744, and 3,977 respectively (Table 1). The total planted acreage of nut crops is distributed as follows: walnuts (35.1%), almonds (32.6%), pistachios (31.5%), and pecans (0.87%). In 2007 and 2008, the individual crop values of walnuts, almonds, and pistachios in Tulare County were each over $75 million (Table 2). Though pecans only represent a minor fraction of the total nut acreage, the total value of pecans in Tulare County is approximately $2.5 million (Table 2). (Tulare County Commissioner/Sealer)

1.1 Walnut

Walnuts represent 32% of the bearing acreage of nuts, dried plums and olives in the county (Table 1). In 2008, 28,410 acres of walnuts were on record in Tulare County (Table 1), with a total tonnage of 27,500 worth over $8.2 million (Table 2). California walnut production has increased markedly from 1996 to 2009 (Fig 1) (USDA-NAAS, 2009 CA Walnut Objective Measurement Report). In 2008 Tulare County contributed approximately 6% of the state walnut production. Walnut orchards are generally located on the eastern portion of the valley in Tulare County and are irrigated with pumped ground water. Walnuts are less tolerant of saline and sodic soils than pistachios and

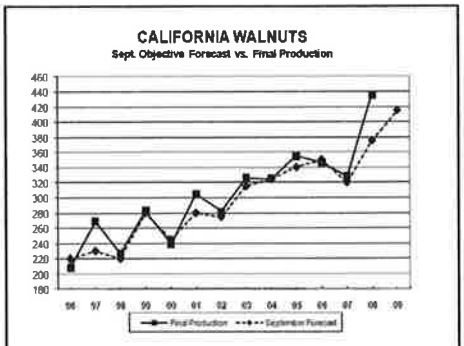


Fig 1. California Walnut Production

therefore benefit from the higher quality of groundwater available on the eastern side of the valley. Furthermore, walnuts are generally flood-irrigated and less tolerant of drought than other perennial crops (ie. almond, pistachio, olive).

1.1.1 *Analysis of Needs of Walnut Growers*

Determination of walnut growers' needs is an ongoing, evolving process, with the majority of information gained from direct interactions with growers, PCAs, attendance on the summer 2009 walnut Farm Advisor tour, meetings with Extension Specialists (Bruce Lampinen), US Forest Service entomologists (Steve Seybold and Andrew Graves), UC Faculty (Marshall Johnson, Entomologist and Rick Bostock and Themis Michailides, Plant Pathologists) and UC Farm Advisors (Bob Beede, Janine Hasey, Brent Holtz) and an IPM Advisor (Walt Bentley). I have experienced a rapid introduction to walnut production both because walnuts claim more acreage than all other crops under the Orchard Systems position in Tulare County (ie. nuts, olives, and dried plums), and a new insect/disease complex on English walnut has been identified in the county. To date, I have had more requests for farm calls to walnut orchards than to any other crop outlined under the responsibility of the position.

The California Walnut Board and Walnut Commission highlights a list of industry priorities including development of rootstock diversity for disease resistance, breeding of new varieties for late flowering, early harvest, high meat yield, and light color, and implementation of practices for reduced pesticide use. My recent interactions with walnut growers and Pest Control Advisors (PCA) have elucidated the need for enhanced outreach and education on effective timing of sprays for integrated control of insect pests of walnut while protecting natural predators. Growers are interested in reducing pesticide use both to save money and meet industry goals of reduced chemical inputs; however, they seek guidance on strategic applications timed to target multiple pests. For example, growers treating for excessive scale invasions would benefit from deploying insecticides concurrent with timing of codling moth flights, thereby concurrently targeting both the scale and the codling moth with one application.

Additionally, we are seeing a surge in ten-lined June beetle (TLJB) damage in walnut and almond orchards, as is typical after several years of draught. Management strategies for TLJB are currently not available, in part due to the lack of knowledge of the insect's ecology and life cycle. TLJB damage is most severe in orchards on sandy soil or in sand streaks; however, incidence of damage does not necessarily correlate to heightened insect populations. Anecdotal evidence suggests that irrigation practices may mitigate adverse effects of TLJB (personal observation, and Marshall Johnson-personal communication), with moist conditions or high water potentials suppressing the insect. Additionally, I have noticed that TLJB larvae are often associated with root and crown galls on walnut trees infected with *Agrobacterium tumefaciens*, suggesting a potential complex enhancing tree decline. Research progress on control of TLJB is thwarted by the fact that the insect has a two year life cycle and larvae are difficult to excavate in quantity for *in vitro* experimentation. Larvae also burrow deep in the soil, providing a challenge for application of insecticidal products to the target.

Fig 2. A) Walnut twig bark beetle point of entrance, B) Symptoms of Thousand Cankers Disease on English Walnut (Tulare, County)

A potential emerging challenge for walnut growers is the new finding of Thousand Cankers Disease in Tulare County, caused by the pathogen *Geosmithia* sp. Thousand cankers disease is an emerging disease responsible for decline and death of ornamental eastern black walnut (*Juglans nigra*) in Colorado and other western

states, and *J. californica* and *J. hindsii* in California (Tisserat et al 2009). Both the fungal pathogen and the insect vector, walnut twig beetle, were observed within the National Germplasm Repository's Juglans collection at Winters, CA. The beetle is native to California, Arizona, New Mexico, and Mexico, but the origin of the fungus is unknown. The disease is behaving like an exotic based on its aggressiveness; however, the fungus is not able to infect trees without the association with the walnut twig beetle, presumed to be a casual pathogen vector. The disease is considered a threat to the commercial black walnut industry in the east and mid-western United States; however, the impact on the California English walnut industry is known. The pathogen has now been documented in Tulare County on both the Tulare cultivar of English walnut and on the hybrid Paradox rootstock (Fig 2 A and B). Other putative isolations of *Geosmithia* sp. have been made from black walnut in unmanaged orchards in Tulare County. The impact of the disease on agricultural walnut production is unknown; however, more information on the disease etiology is needed to better understand direct and indirect consequences to commercial walnut growers and nurseries. Direct impacts may include, but are not limited to, tree decline and loss of productivity due to infection. Indirect consequences of the disease may be related to regulatory actions imposed to prevent transmission of the disease to black walnut in natural and commercial systems (ie. forestry for furniture production in mid-west).

With the advent of the new thousand cankers disease on walnut is a need for outreach of information for proper disease diagnosis. Unfortunately, the symptoms of thousand cankers look somewhat identical to those of the common shallow bark canker on walnut. The mass media publication of information on thousand cankers disease has fostered grower confusion and resulted in my making several farm calls to orchards based on misdiagnosis.

Another unique challenge to walnut growers is that the longevity of orchards often results in orchard inheritance and consequent management by widows and adult children who have no experience with the crop. Over the course of several farm calls, I have had the opportunity to meet several growers (often female) who have inherited old walnut orchards. Generally my farm calls are 5-10 years too late and the orchard is suffering from irreparable damage, such as extensive infection by wood decay fungi. If walnut prices decline further in 2009 and in the future (Section 6.1), many of these orchards are likely to be sold or left completely unmanaged. Though I perceive a "need" in this sector of the clientele, I am not yet certain or aware of a "want" of programming and outreach.

1.2 *Almond*

Almonds represent approximately 30% of the total combined acreage of nuts, olives, and dried plums in Tulare County, and approximately 32.6% of the total nut acreage. Utilization of California almonds has increased dramatically over the past 20 years (Fig 3). Over the past 20 years, Tulare County has produced between 1.5 and 2.6% of the total almond tonnage over eight San Joaquin Counties (Almond Board of California) (Fig 4). Almond production in Tulare County has remained consistent over the past 20 years, while total production in neighboring counties has generally increased at a faster rate than in Tulare County (Fig 4 and Fig 5). For example, over the past twenty years, Fresno and Kings Counties exhibited over a 4 and 6 fold increase in production, respectively (Fig 4 and 5). In 2007 and 2008, the almond value in Tulare County was $119.126 million and $76.365 million, respectively; however, decreased crop value in 2008 was related to a decline in almond prices (Table 2) and not reduced production.

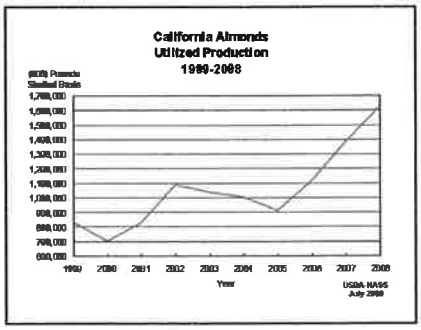


Fig 3. California almonds, utilized production.

1.2.1 *Analysis of Needs of Almond Growers*

My preliminary assessment of almond grower needs in Tulare County is the result of several farm calls, generally with orchard managers, independent crop consultants, and PCAs. Additionally, I attended the Almond Pest Management Alliance meeting at Kearney Ag Center in early Nov 2009, thereby initiating my education on integrated pest management in almond systems. In December 2009 I will have the

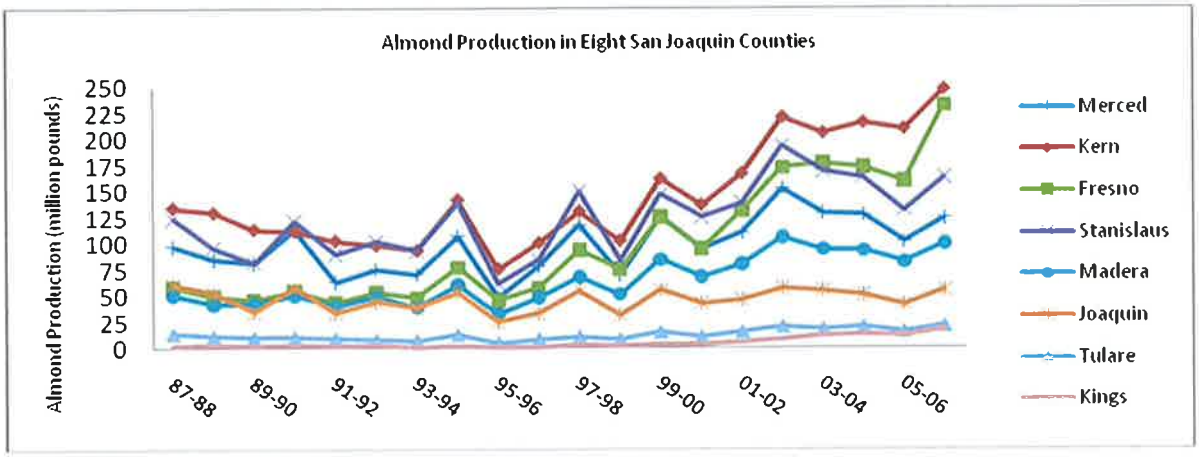
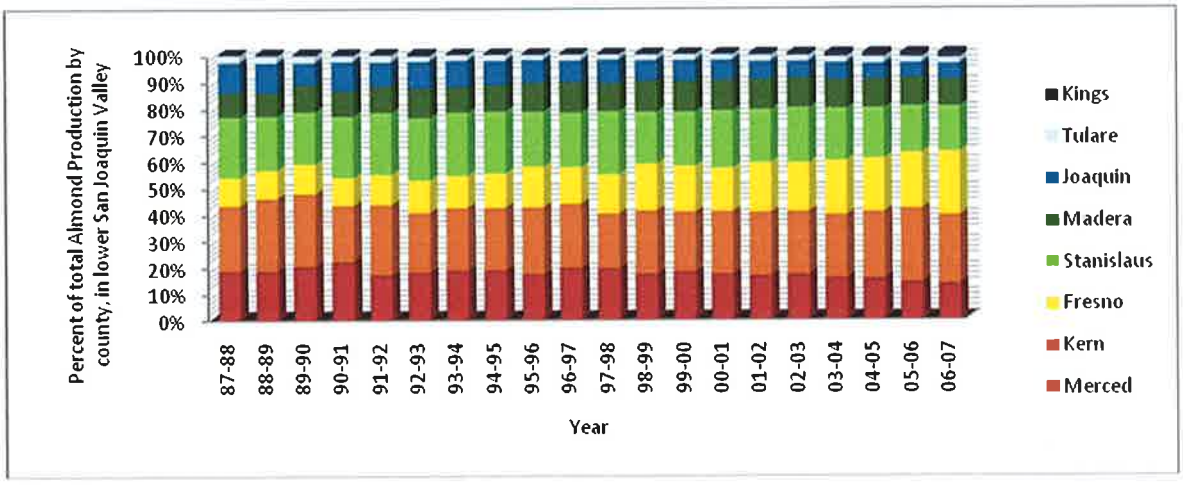


Fig 4. Annual almond production in eight counties in the southern San Joaquin Valley (California Almond Board)

opportunity to meet with growers and industry representatives at the Almond Industry Conference and be exposed to research objectives at the December almond workgroup meeting.

After several draught years and restrictions of water use, problems relating to irrigation are becoming more common in almond orchards. Similar to walnut orchards, after two drought years, ten-line June beetle larvae have done extensive damage and growers express frustration for lack of control strategies. A consequent concern is the promulgation (by word of mouth) of suggested efficacy of expensive, organic fertilizer products for management or control of ten-line June beetle larvae in otherwise conventional systems, underscoring the need for basic research on biology, etiology, and control of the



pest on almond and walnut.

Fig 5. Percent of total almond production by county in southern San Joaquin Valley. (California Almond Board)

Growers are also facing several new putative diseases of almond. Foamy canker and lower-limb dieback are just two examples of new almond diseases of unknown cause. In response to this concern, I gave a talk on diseases and arthropod pests of almonds at the Almond Pest Management Alliance meeting and was able to follow up with PCAs on field calls to aid in field diagnoses and familiarize myself with new diseases. Multiple PCAs have expressed a greater need for assistance with disease diagnosis than with insect identification, many confessing that microscopic organisms are intimidating to work with. Growers and PCA's would likely benefit from more multi-disciplinary, integrative outreach programming that targets field and home-laboratory diagnosis of pathogens. For example, hull rot on almond can be differentiated from lower-limb dieback simply by incubating affected twigs in moist plastic bags and looking for sporulation. Hull rot is caused by the same fungus as bread mold (*Rhizopus* sp.); therefore, any grower or PCA can be taught to identify it in their own home. Similarly, wilts caused by fungi and bacteria can be differentiated by placing affected tissue in a cup of water and looking for macroscopic bacterial ooze.

Though food quality and safety is a top concern to all food producers, the direct correlation between navel orangeworm incidence and *Aspergillus flavus* contamination heighten the risk of aflatoxin accumulation in the commodity. While CA supplies virtually 100% of the domestic almond market and over 80% of the world market, pressure to continue meeting regulatory thresholds for aflotoxin is a major concern. Additionally, almond export to European countries is on the rise and EU standards require a lower maximum aflatoxin level than US standards for the domestic market.

Because of the inherent reliance on honeybee health for almond pollination, challenges to the bee industry directly impact almond growers. New disease complexes, such as colony collapse disorder, and mite resistance to acaricides threaten sustained colony health. Additionally beekeepers, almond growers, and orchard managers are concerned about pesticide toxicity to bees and are interested in improved integrative pest management for preservation of honeybee health.

1.3 *Pistachios*

The California pistachio industry harvested its first crop in 1976, with a total of 1.5 million pounds produced on 4,350 acres. In just over 30 years, California pistachio production has escalated to over 150,000 planted acres and over 400 million pounds of annual production (California Pistachio Board). In Tulare County, bearing pistachio acreage in 2008 was 23% of total bearing nut acreage; however, almost 10,000 non-bearing acres were reported (Tulare County Ag Commissioner Report), suggesting an advent of significantly more pistachio production in years to come. Tulare County pistachios had a value of over $78 million in 2007 and 2008, and the price of pistachios has remained over $3000/ton since 2005 (Table 2). Pistachio yields are enhanced on deep, calcareous and boric soils, characteristics of the western side of the San Joaquin Valley (Pistachio Production Manual). Additionally, the root systems of pistachios are adapted to survive long periods of drought and appear to tolerate alkalinity and salinity well. Pistachios are likely best adapted for cultural and economic success during the current draught and shortage of surface water for irrigation.

1.3.1 *Analysis of Needs of Pistachio Growers*

To date, my understanding of the needs and challenges of pistachio growers is based on interactions with growers via farm calls, meetings with Louise Ferguson (Extension Specialist) and Lynn Epstein (UCD, Professor Plant Pathology), and reading of the literature. In January 2010 I will assist with running the Statewide Pistachio Day and have the opportunity to meet more growers, industry representatives, and UC Farm Advisors.

Growers' main challenges with pistachio cultivation are related to basic, innate tree physiology, including the fact that it takes around seven years for trees to become productive and annual production is not stable due to the alternate-bearing nature of the crop. Additionally the apical dominance in pistachio renders it difficult to train the trees and strategically manage older orchards to stimulate production of fruiting wood.

While pistachios have often been planted on former cotton land, soil populations of *Verticillium* may emerge as a future disease challenge. Management of persistent soilborne pathogens in a post-methyl bromide era may necessitate screening of rootstocks for *Verticillium* resistance. Also, the increased use of groundwater for irrigation results in salt accumulation and a consequent need for rootstock development and long-term soil salinity management.

1.4 *Pecans*

The United States is the world's largest producer of pecan, a nut crop native to North America (California Pecan Grower's Association). Pecans are commercially grown in 14 states and the first commercial pecan orchards in California were established in the Visalia/Clovis area of Tulare and Fresno Counties (California Pecan Grower's Association). Currently, 19% of California's bearing pecan acreage is in Tulare County (Table 1). Pecan acreage in Tulare County is currently recorded at 706 acres, representing only 0.8% of the total county nut acreage, but valuing over $2.5 million (Table 1 and 2). The crop is alternate bearing and the market exhibits a strong inverse correlation between production and price received by growers (Fig 6)(USDS NASS). In 2009, the pecan crop is on its on-cycle with national production estimated at 309.2 million pounds. Due to high production, prices are assumed to be down (Fruit and Tree Nuts Outlook). California orchards have had their highest production per acre for the last three years (California Pecan Grower's Association), and the success of California's pecan crop is attributed to crop thinning, hedging, and the registration of new pesticides for aphid control, the main pest of pecan.

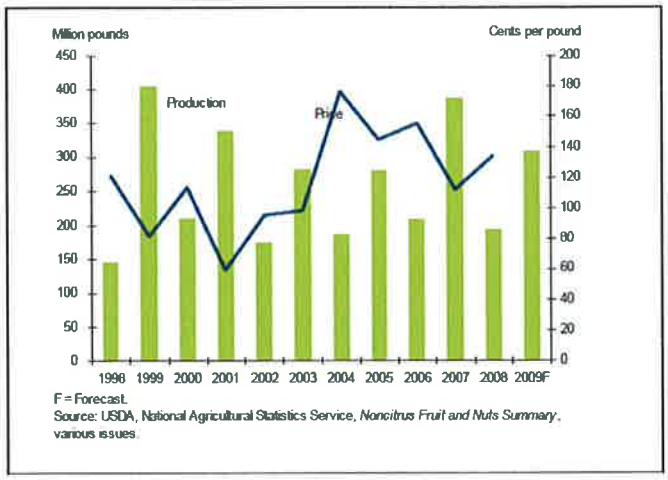


Figure 6. US Pecan inverse relationship of production and price; illustration of alternate-bearing affect on production.

Pecans are grown in diverse geographic areas on the west coast, ranging from Mexico in the south to the Chico-Orland area in the north. The cost of growing pecans in California is more expensive than in other states, generally due to the cost of land, water, labor, and energy. In the southeast 100% of the water is supplied by rainfall, whereas western areas rely 100% on irrigation water. Though the costs of production are higher in California than in other pecan-producing states, California growers have received the highest price for the crop over the last 5 years. (California Pecan Grower's Association)

1.4.1 *Analysis of Needs of Pecan Growers*

Given that pecan acreage is only 0.8% of the total nut acreage in Tulare County, it is not surprising that I have not yet been asked on a farm call to visit a pecan orchard. Pecan growers have similar challenges and concerns as pistachio and olive growers in that the crop is alternate-bearing. A trend toward planting new varieties (reduced reliance on native seedlings) has helped reduce the major difference in

annual yields due to alternate-bearing. Additionally, new varieties have better nut quality and are easier to shell than the native varieties. Aphids are the only main pest of pecan in CA, and they are controlled by insecticidal sprays. Pecan growers share similar challenges with other fruit and nut growers in Tulare County, including need for irrigation water and high labor costs.

The pecan market is perhaps more unpredictable that that of all other nut crops (California Pecan Grower's Association). Unlike walnuts, almonds, and pistachios, virtually none of the U.S. pecan crop is exported, and approximately 25% of the U.S. consumption of pecans are imported from Mexico. The pecan industry is the only nut industry lacking a generic promotion program. The pecan industry also lacks a large co-op or processor/sheller that controls more than 15% of the crop (ie. Diamond Walnut or Blue Diamond Almond) (California Pecan Grower's Association); therefore, pecans don't receive the level of market promotion enjoyed by other nut crops in the United States.

1.5 *Dried Plums (Prunes)*

Approximately 4% of the total nut, dried plum, and olive acreage in Tulare County is represented by dried plums (Tulare County Ag Commissioner/Sealer) (Table 1). Tulare County had just under 4,000 acres of dried plums on record in 2008, with a total value of over $10 million (Table2). Dried plum acreage has remained relatively stable with only 337 non-bearing acres on record in 2008 (Tulare County Ag Commissioner/Sealer). The price of dried plums has also remained stable for the past 5 years (Section 6.1). Growers and packers have expressed concerns of competition from South America—mainly Chile. Both growers and packers have suggested that the imports are of lower quality than the CA crop.

1.5.1 *Analysis of Needs of Dried Plum Growers*

In mid December I will be meeting several Tulare County prune growers and have also arranged to visit an experimental plot in Glenn County that was established by Bill Krueger and Franz Niederhauser (Farm Advisors). The plot includes examples of several pruning strategies, from traditional hand pruning to machine pruning. Growers in Tulare County have expressed interest in adapting the mechanical pruning techniques because data suggests higher yields may be obtained with the mechanical pruning techniques than with traditional hand pruning. The combined increase in yield and reduced labor costs may enhance the profitability of growing prunes. In mid-December I will attend a two-day dried plum workgroup meeting at UC Davis to additionally familiarize myself with the needs and culture of the crop.

1.6 *Olives*

Tulare County had approximately 12,792 acres of olives on record in 2008 with a total value of $45.5 million in 2007 and $21.3 million in 2008 (Tulare County Ag Commissioner/Sealer). Olives are alternate bearing; therefore, yield will vary greatly from year to year. Acreage of olives in Tulare County is on the decrease, particularly as a result of the severe crop loss in 2009. Olives are grown on the east side of the county, generally in the cold pockets in the citrus belt. Many citrus growers diversify their operations with olives. Native to arid climates, olives perform best on well-drained soil. Olive growers in Tulare County produce both table olives and oil. Table olive growers do supply some fruit for oil production; however, growers entering the ultra-high density planting systems are typically new to olive cultivation in general.

1.6.1 *Analysis of Needs of Olive Growers*

As a consequence of crop failure three of the last four years (Adin Hester, personal communication), growers' main concerns focus on ensuring a harvestable, profitable crop in the immediate future to preserve the US component of the table olive market. With the recent crop failure, olive acreage is on the decline, thus enhancing the risk of losing the US table olive market to subsidized foreign olives. As olive orchards are removed in Tulare County, remaining growers express increasing concerns of meeting the necessary fruit volume to sustain the processing companies and the market. Growers are currently working with insurers to implement insurance policies in 2010.

The olive crop was a disaster in 2009, with approximately 85% crop loss resulting from a combination of frost and high temperatures during bloom. Though harvesting would increase financial losses, growers still have to get the fruit off the trees, as sanitation is imperative for management of olive fruit fly. Consequently, growers are anxious to see the development and implementation of mechanical harvesting equipment that does not adversely affect the quality of the picked fruit.

The main plant health challenge for olive growers is the olive fruit fly. Fruit fly populations are being monitored in Tulare County and several entomology labs, both USDA and UC Riverside, are investigating biocontrol options. The main disease challenges on olive include peacock spot and olive knot. Both are controlled by sprays; however, we may see a surge of disease in 2010 if we have an El Nino year with heavy winter rainfall. With several draught years and olive crop failures, several growers may have gotten away with reduced winter copper sprays; therefore a wet winter may result in higher disease incidence in unprotected orchards.

2.1 *Program development*

A research and extension program will be developed around the present needs and concerns of the commodity crop growers and associated industries within Tulare County. The program will be multi-disciplinary and adaptable to the dynamic needs of clientele. Dissemination of outreach and extension information to PCAs (279 PCA's registered in Tulare County at present) promote an exponential increase in information transfer to growers, particularly those that do not attend workshops or request farm calls. Both the research and extension components of the program will rely on collaborative interactions between colleagues with USDA, University of California faculty at Riverside and Davis, UC Extension Specialists and fellow Farm Advisors, as well as with the associated boards of relevant commodities.

Initially I will work on four research programs with levels of involvement ranging from support scientist/cooperator to primary investigator. These programs will directly relate to five of the crops under the responsibility of the Horticulture Advisor position.

2.1.1 *Mechanical Harvest of Olive*

Hand harvesting remains the highest cost in California black ripe table olive production: at 5 tons/acre and $750.00/ton, when paying $350.00/ton for hand harvesting, harvest costs constitute 39% of the total production costs per acre and 47% of gross return per acre. These hand harvest costs will eventually render table olive production unprofitable. (Louise Ferguson, Extension Specialist). Research on mechanical harvesting olives has been underway for over 10 years and recent data suggests that mechanical harvesting techniques can be implemented without loss of fruit quality. In 2008, mechanically harvested olives were statistically similar to hand-harvested olives with respect to aesthetic appearance of fruit. Consequently, Louise Ferguson and colleagues believe that one more year of field data is needed to corroborate these findings and facilitate implementation of harvest mechanization in the industry.

In cooperation with Louise Ferguson, Jean-Xavier Guinard (UC Davis, Food Science), Uriel Rosa (Agricultural Engineer), Karen Klonsky (Agricultural Economist), Kitren Glozer (UCD Project Scientist), and Bill Krueger (Farm Advisor), I will assist on field studies designed to investigate harvester efficiency, tree training and pruning techniques, and use of abscission agents to facilitate implementation of mechanical harvesting.

Duration of goal: Medium term (2-3 years)

ANR Core Agricultural and Natural Resource issues/visions addressed in research project include:

- Productivity and efficiency of agriculture
- Sustainable use of natural resources
- Economic success in global economy
- Sustainable, safe, and nutritious food production

2.1.2 *Screening of dried plum rootstock for disease resistance and cultural characteristics*
A review of prune rootstock performance in controlled trials has not been conducted since 1987 and many new prune varieties are now available for screening. The California Prune Industry primarily relies on 4 rootstocks for plantings within the state of California. I will provide a supporting role in the screening of rootstocks at two locations, one in Butte County and one at Wolfskill Experimental Orchard near Winters, CA. Rootstocks will be screened for sensitivity to bacterial canker, oak root fungus, and brown line susceptibility as well as rated for suckering and anchorage. If any rootstocks show promise of disease resistance, I may participate in replicated greenhouse studies to determine level of resistance under controlled conditions. Identification of rootstocks with disease resistance will address long term goals of reduced pesticide and fumigant use, thereby directly promoting soil microbial diversity as well as water and air quality.

Duration of goal: long term (present- 10 years)

ANR Core Agricultural and Natural Resource issues/visions addressed in research project include

- Productivity and efficiency of agriculture
- Land Use (ie. microbial biodiversity)
- Air quality
- Water quality
- Economic success in global economy
- Sustainable, healthy, production.

2.1.3 *Implication of Thousand Cankers Disease on commercial English Walnut*

The recent finding of thousand cankers disease and associated walnut twig beetle in Tulare County underscores the necessity to better understand the disease etiology and assess potential impacts of the disease on the commercial walnut industry. Thus far I have isolated the pathogen from both English walnut (Tulare cultivar) and Paradox rootstock in Tulare County. While the pathogen has thus far only been observed on declining English walnut, the role of tree health and physiological stress on disease predisposition is unknown. Because the disease is new, the exact future trajectory of thousand cankers disease research in Tulare County is yet unknown. Initially I will continue working on my ability to identify symptoms, isolate the pathogen, and identify the insect vector. Additionally I will continue to survey for the disease and generate a culture collection to capture the genetic variability of the

pathogen in Tulare County. My work will be in collaboration with Rick Bostock (Plant Pathology/UCD; Chuck Leslie and Dan Potter (UCD Plant Sciences); Ed Lewis (UCD Nematology); Steven Seybold (USDA Forest Service); and Ned Tisserat (Plant Pathology, Colorado State University), Mary Louise Flint (Entomology, UCD), and Janine Hasey and Carolyn Debuse (UCCE). I am a cooperator on two grants submitted to the Walnut Research Board for investigation of this disease.

Duration of goal: long term (present- 3 years)

ANR Core Agricultural and Natural Resource issues/visions addressed in research project include:

- Productivity and efficiency of agriculture
- Invasive Species/Pest Management
- Economic success in gloabal economy

2.1.4 *Ten-lined June Beetle Management*

In collaboration with Marshall Johnson (UC Riverside, Entomology) I will initiate investigation of the impact of soil water potential on ten-line June beetle activity. By combining Marshall's expertise in entomology and my expertise in soil physics, we will focus on the impact of soil water potential on ten-line June beetle activity with the ultimate goal of developing cultural and chemical management strategies for the larvae. In the short term (6 months) I will conduct laboratory experiments to correlate soil moisture content with water potential in various soil texture classes utilized for greenhouse experiments at Kearney Ag Center. I also seek to develop an experimental system for measurement of ten-lined June beetle respiration. Measurement of *in vitro* larval respiration may then be utilized as a dependant variable for screening efficacy of insecticides and manipulation of irrigation rates/frequencies, etc.

Duration of Goals: 6 months-2 years

ANR Core Agricultural and Natural Resource issues/visions addressed in research project include:

- Productivity and efficiency of agriculture
- Invasive Species/Pest Management
- Sustainable use of natural resources (ie. water management)
- Soil Quality
- Economic success in global economy
- Sustainable, healthy production

2.2 Program development-extension

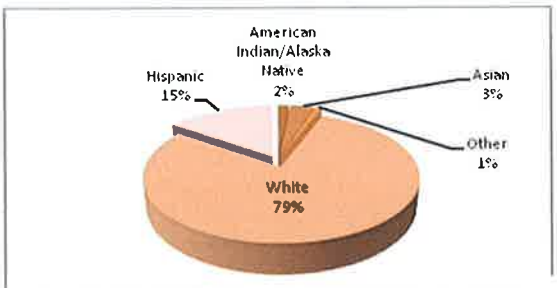
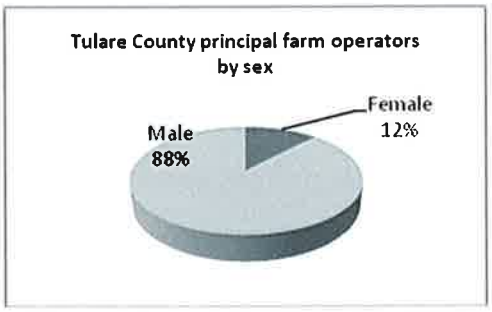


Fig7. Distribution of Tulare County farm Operators by Race

Clientele include growers, hullers and processors, nursery representatives, private consultants and PCAs, and other associated industries. The average age of principal farm operators in Tulare County is 58.1 years, and 79%, 15%, 4%, 2% of operators are White, Hispanic, Asian, and Native American/Alaskan, respectively (Fig 7). By sex, 88% of principal farm operators in Tulare County are male (Fig 8). (2007 Census of Agriculture, Tulare County). Over the next

two years I plan to continue meeting clientele directly on farm calls and by participating in meetings of commodity groups, Farm Bureau, field days, workshops and short courses. In early 2010, I will help organize Statewide Pistachio Day and the Tri-County Walnut Day and will increase my level of participation each year under the mentorship of Bob Beede (Farm Advisor, Kings County). As I continue to learn the culture of the 6 crops under the responsibility of my position, I have organized visits to Farm Advisors in neighboring counties and have invited Extension Specialists, USDA scientists, and UC Faculty to join me on "team" farm calls. These team farm calls have been beneficial to growers and have served as excellent mentorship opportunities for me, especially as I develop background in entomology and horticulture. In order to extend the "reach" of extension on these farm calls, I am often organizing the attendance of several local growers, associated PCAs, and orchard managers.

In addition to designing formal talks/seminars for meetings, I have been learning the techniques for inclusion of video footage and survey tools in powerpoint presentations. I have also been working with colleagues to get presenters' powerpoint files converted to pdf for web-based availability to growers; we plan to implement this idea for the 2010 Almond Pest Management Alliance meeting.



3.1 *Program Support*

Initially I have agreed to be a collaborator on two grants submitted to the Walnut Marketing Board, and one grant submitted to the UC Olive Research Committee. As I develop my program over the next two years I will take the lead in requesting funding from various groups including the California Almond Board, Walnut Marketing Board, the California Pistachio Commission, UC Olive Research Committee, and the California Dried Plum Board.

4.1 *Bibliography*

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5.1 *Tables*

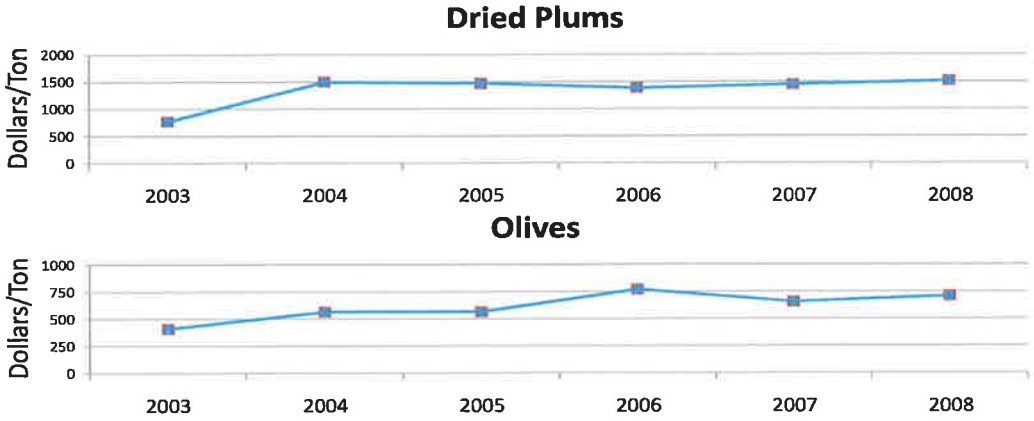
Table 1. Tulare County Permanent Crop Acreage 2008

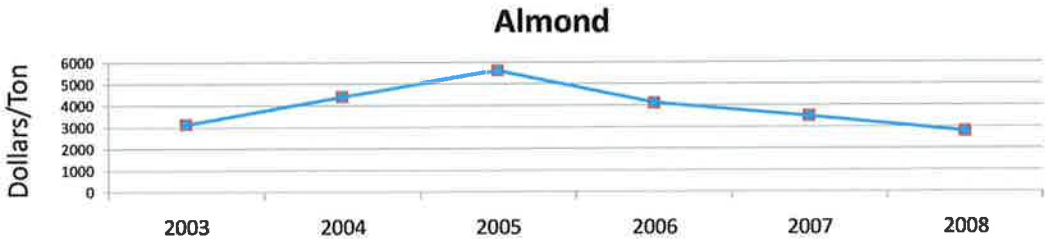
Crop	Bearing Acreage	Non-Bearing Acreage	Total Acreage
Walnuts	27, 200	1,210	28,410
Almonds	24,800	1,550	26,350
Pistachios	16,100	9,360	25,460
Olives	12,600	192	12,792
Dried Plums	3,640	337	3,977
Pecan	611	95	706
Total	**84,951**	**12,744**	**97,695**

Table 2. 2007 and 2008 Tulare County Crop Value

Crop	Year	Harvested Acreage	Tons/Acre	Total Tonnage	Value/Ton ($)	Total Value ($)
Walnuts	2008	24,800	1.11	27,500	2,990.00	82,225,000
	2007	22,100	0.96	21,200	3,690.00	78,228,000
Almonds	2008	27,200	2.15	58,500	1,310.00	76,365,000
	2007	25,900	1.81	46,900	2,540.00	119,126,000
Pistachios	2008	16,100	1.21	19,500	4,030.00	78,585,000
	2007	12,800	1.94	24,800	3,200.00	79,360,000
Olives	2008	12,600	1.81	22,800	935.00	21,318,000
	2007	11,500	4.18	48,100	946.00	45,503,000
Dried Plums	2008	3,640	2.22	8,080	1,360.00	10,989,000
	2007	4,440	1.52	6,750	1,440.00	9,720,000
Pecan	2008	611	1.42	868	2,790.00	2,422,000
	2007	584	1.18	689	3,860.00	2,660,000

6.1 Recent Prices of Relevant Commodities




Almond
Dollars/Ton
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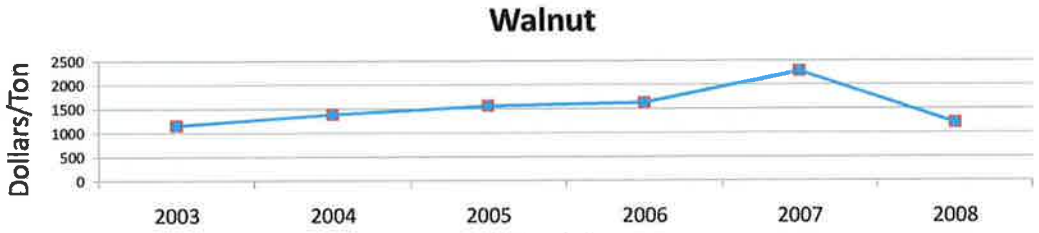
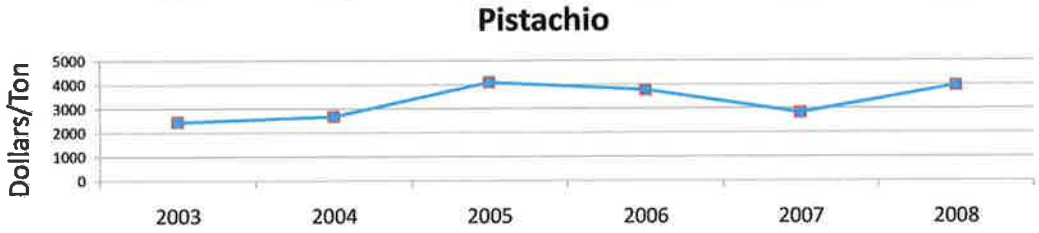
5000
4000
3000
2000
1000
0
2003
2004
2005
2006
2007
2008


Walnut
Dollars/Ton
2500
2000
1500
1000
500
0
2003
2004
2005
2006
2007
2008


Pistachio
Dollars/Ton
5000
4000
3000
2000
1000
0
2003
2004
2005
2006
2007
2008