Macadamia Cultivars and Cultural Practices

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Macadamia Species

- **"Smooth-shelled Macadamia"** (*Macadamia integrifolia* Maiden & Betche), 3 leaves at the whorl, smooth leaf edges
- **"Rough-shelled Macadamia"** (*M. tetraphylla* L. Johnson). 4 leaves at the whorl, tiny spines along the leaf edges
- **Hybrid forms** exist between the two species. These can have 3 or 4 leaves at the whorl

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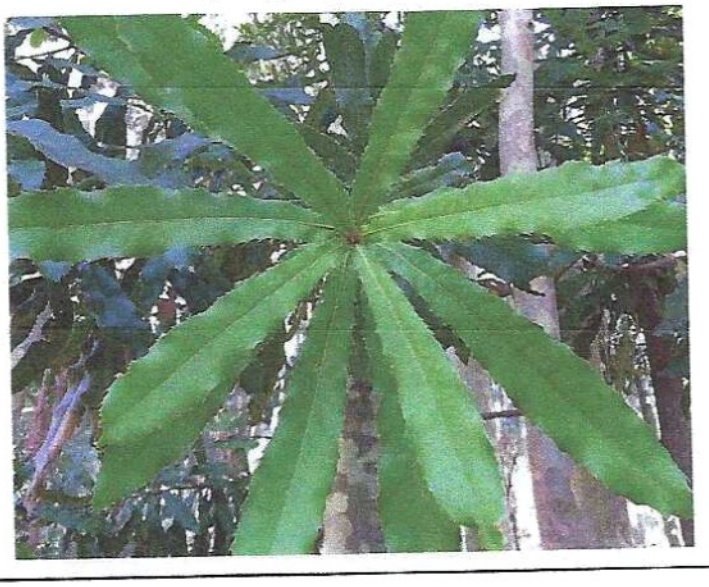
Macadamia tetraphylla



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- **M. integrifolia in Hawaii** are deep fried in coconut oil

- **M. tetraphylla in California** are dried under low heat. They have a higher sugar content and many people prefer their taste.

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Cultivars Used in California

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- Most cultivars grown in California are derived from *Macadamia tetraphylla* or *M. tetraphylla* x *integrifolia* hybrids .
- *Macadamia tetraphylla* seems to be more tolerant of cold temperatures than *M. integrifolia*.
- Hybrid cultivars have generally been more productive in California than those derived from *M. integrifolia*, though the 'James' is an exception.
- *Macadamia integrifolia* cultivars usually bloom in mid-winter in California. Flower production and pollination are low in cold years resulting in poor yields.

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What is Australia looking for in new varieties?

- Open growth habit, robust
- Resistant to wind damage
- Tolerant of poor soil nutrition
- No sticking nuts
- No pre-germination on the tree
- Tolerant of major pests and diseases
- Short harvest season
- Consistently high yields
- Begin harvesting by the third or fourth year
- **Sound kernel recovery in excess of 36%**
- Sensory quality acceptable to consumers
- Regular round NIS
- Husk separates readily
- First grade kernels over 96%

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Flavor differences

- ***Macadamia tetraphylla*** cultivars produce nuts with a high carbohydrate content, sweeter flavor, and a lower oil content than those from *M. integrifolia*, though they are more difficult to process and stabilize for shipping and storage.
- The flavor of California produced macadamias is excellent, and it is a major advantage for growers. The sweetness of California grown macadamias is well suited for various confections.

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Dorado

- **M. integrifolia**. Originated in Hawaii. Introduced by Rancho Nuez Nursery.
- Medium-sized, uniform nuts, 7/8 to 1 inch in diameter.
- **Kernel averages 35% of nut**, oil content 75%.
- Tree medium-tall, upright, attractive. Begins to bear after 5 years, self-harvesting, cold resistant.
- **Very productive, often yielding 65 or more pounds of nuts per year.**

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James

- **M. integrifolia**. Originated in La Habra Heights, Calif.
- Medium-sized, uniform nuts, about 1 inch in diameter.
- **Kernel averages 40 to 42% of nut**, quality high, flavor very good, oil content 75%.
- Tree very tall, columnar, precocious, often producing after 2 or 3 years. Self-harvesting.
- **Yields more per acre than any other California cultivar, 60 or more pounds per tree when mature.**

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Beaumont

- **Hybrid**. Originated in Australia. Discovered by Dr. J. H. Beaumont. Introduced in 1965 by the California Macadamia Society.
- Round, medium to large nut, 65 to 80 per pound. Shell medium-thick,
- **Kernel 40% of nut**, with a high percentage of grade A kernels.
- Some nuts may split on the tree and be ruined.
- Texture and flavor very good.
- Tree upright, ornamental. New leaves reddish, flowers bright pink, borne on long racemes. Nuts drop over a long period. Recommended for home gardens.

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There can be a problem with Beaumont

- They are known to be **a stick-tight variety%**
- **Knocking them down with a pole will also knock down a lot of immature nutes**
- Use a maturity test: put one pound of nuts in shell (dried to 12% to 17% moisture) in a bucket of water.
- **Nuts are mature if 94% of them sink**

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Cate

- ***M. tetraphylla.*** Originated on the property of William R. Cate, Malibu, Calif.
- **Nuts medium to large.** Shell average thickness. **Kernels 40% of nut**, cream colored, crisp in texture, flavor good to very good
- **Ripens in late October and November continuing over a period of 6 to 8 weeks.**
- Tree precocious, moderately hardy, shows no alternate bearing tendencies. **The most widely adapted cultivar for commercial use in California.**

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Vista

- **Hybrid.** Originated in Rancho Santa Fe, Calif. by Cliff Tanner.
- Small to medium-sized nut, 3/4 to 7/8 inch in diameter.
- Kernel averages 46% of weight of nut, flavor excellent, oil content 75%.
- Shell very thin, can be cracked in an ordinary hand cracker.
- Tree medium-sized, pyramidal, begins to bear after 3 years. Self-harvesting. Flowers pink.
- Recommended for both home garden and commercial plantings.

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So where are we with cultivars in California?

- **"California growers have strong and divergent opinions regarding the desirability of different cultivars."**
- We need to have a program for evaluating new cultivars.
- The University of California should be doing this, but they said the industry needs to be supporting variety trials financially

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Macadamia Cultivation

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We don't know very much about Macadamia water requirements

- These evergreen trees are grown in areas where rainfall quantity and distribution is often inadequate to sustain optimum yields. As a result, irrigation is often required to meet demands and achieve maximum profits
- However, there is little detail on the minimum volume of water required during different growth stages to obtain optimal yield
- The irrigation trials have been too short (they need to go at least five years). And yields vary naturally from year to year giving mixed results.
- From Scientia Horticulturae January 2022

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Water use in Australia and South Africa

- Macadamia trees have been found to use an average 75 L $tree^{-1}$ day^{-1} in Australia, while values range between 4 and 71 L $tree^{-1}$ day^{-1} for trees grown in South Africa.
- **This equals 20 gallons per tree per day in Australia and 18.8 gallons per tree per day in South Africa**
- **But in California Jim Russell said they need as much water as avocado. But then he said he waters 5 hrs per week. If he had 20 gal/hr sprinklers then he was applying 140 gal per tree per week, or 20 gal per tree per day**

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Macadamia is considered to be a drought tolerant species

- Macadamia has tight stomatal control.
- During drought stress stomates shut down

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The history of how we have decided <u>when</u> to irrigate

<u>Frequency</u>

We decide by soil moisture monitoring

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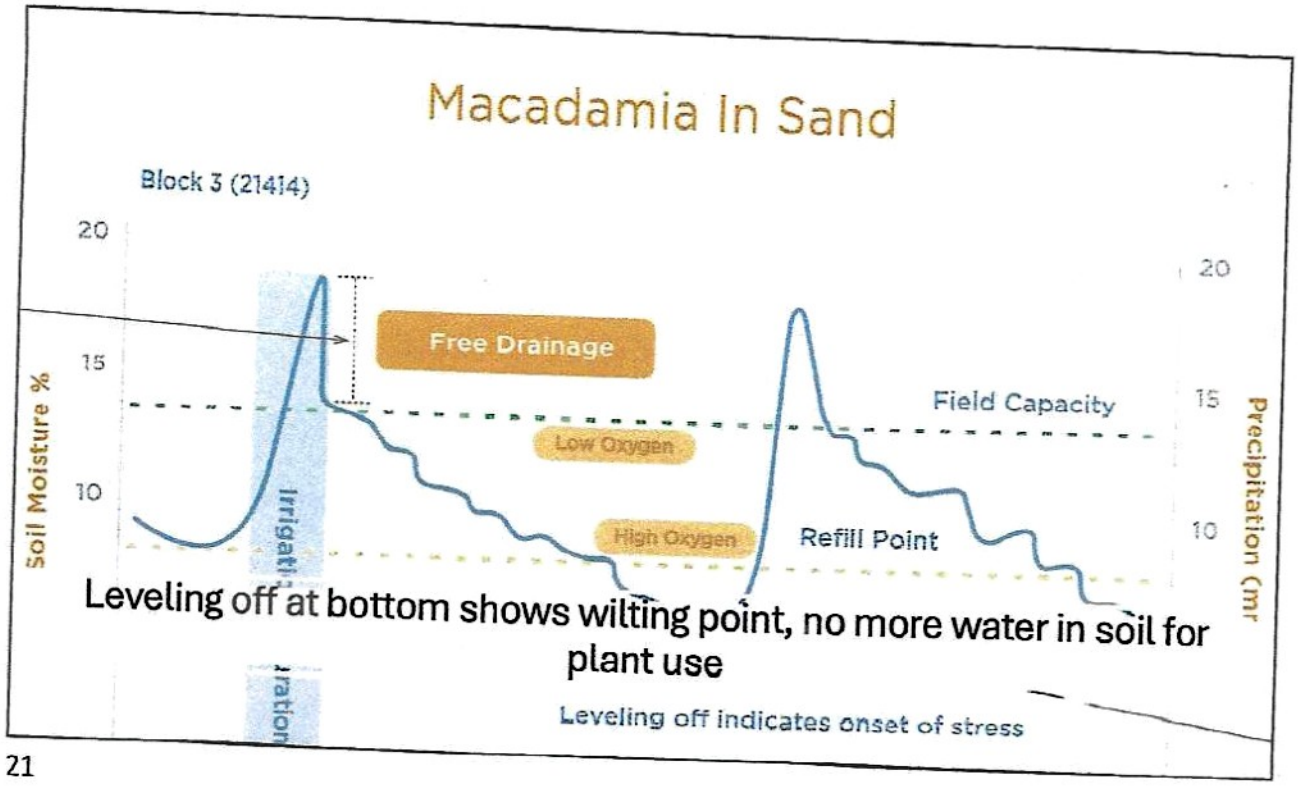

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Shovel and Make a Ball of Soil

Somewhere in the middle is just about right

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Total Guess

- Hmmm, It's Friday.... Must be time to irrigate!

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The "Guessing" Method of Irrigation Scheduling

- It can work if you are a darn good guesser!

- But most of us aren't (see next two slides)

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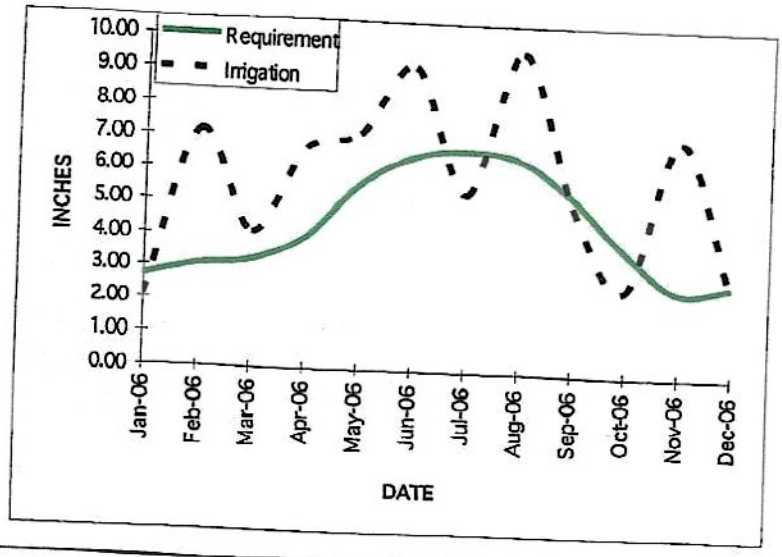
Year Totals	6725	46.2	52.4	68.6	131
Acre Feet =	15.4	Irrigated acreage does not include outbuildings, roads, or landscaping			
Gallons =	5030300			Irrigated Acres =	2.7



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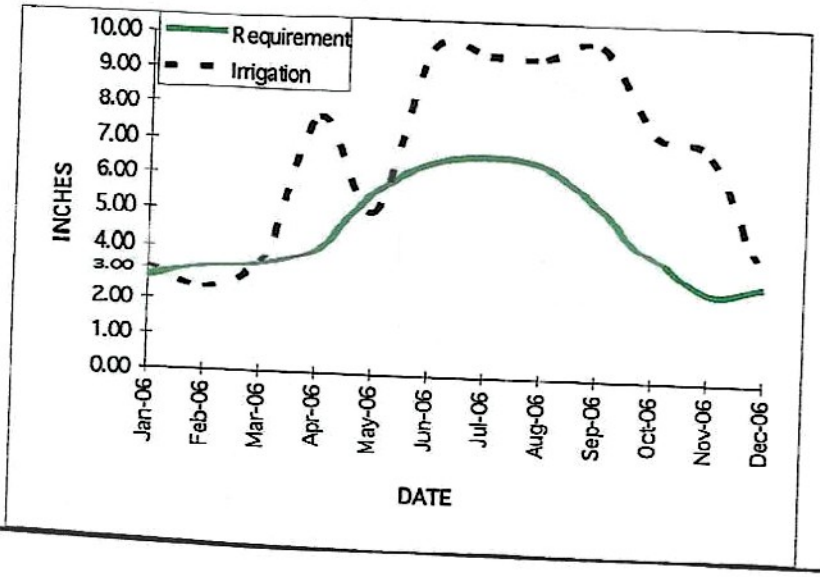
Year Totals	7602	46.2	52.4	77.6	148
Acre Feet =	17.5	Irrigated acreage does not include outbuildings, roads, or landscaping			
Gallons =	5686296			Irrigated Acres =	2.7



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Wishful Thinking: Cloud Goes Overhead

Turn off the water!!

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What is the Neighbor Doing?

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What's in the Checkbook?

- Not a good way to meet the needs of the crop!

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Measuring Soil Moisture – Simple and Cheap Methods

- Tensiometers
  - **Labor intensive to collect data**
  - **Requires regular maintenance**
  - Can be inaccurate in extremely wet or dry soils
  - Not accurate in very sandy soils
  - Indicates when to apply, not how much to apply

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Simple

(and relatively cheap devices)

- **Gyspsum blocks (Water Marks®)**
  - Labor intensive to collect data
  - Needs a digital meter
  - Can be inaccurate in extremely wet or dry soils
  - Indicates when to irrigate, not how much
  - Will last up to six years in the soil

Watermark Soil Moisture Sensor (Item #400)

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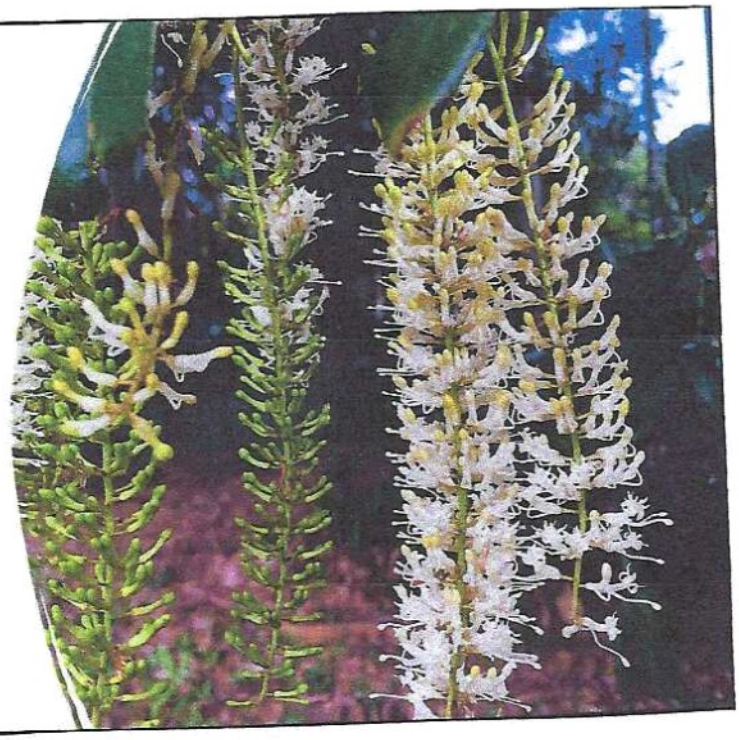
Critical Period for Irrigation

- Flowering
- Time of nut set
- During nut filling
- Vegetative growth period in mid-summer



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Fertilization

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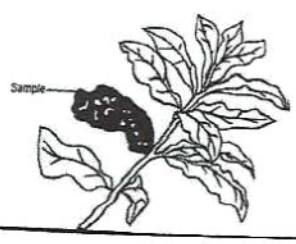
Leaf Analysis

- In Australia they sample the leaves from September to November
- This would be **March to May** in California
- In Hawaii they sample before the major flush, usually in March
- Sample mature leaves from the second whorl of non-flushing terminals



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Leaf Collection

- Pick one healthy leaf from the second node below the bud, 15 leaves from 4-5 trees are needed for each sample.
- Sample each variety separately
- Sample healthy trees only
- Sample leaves on the outside of the canopy exposed to the sun
- Do not sample the outside rows or the trees at the end of the rows

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Leaf Nutrient Levels

Nutrient	Def.	Low	Recommended
N (%)	1.2		1.4 - 1.5
P (%)	0.05	0.05-0.08	0.08 - 0.10
K (%)	0.40		0.4 – 0.7
S (%)	0.16		0.16 – 0.25
Ca (%)	0.4	0.4-0.5	0.5 – 0.9
Mg (%)	0.06	0.06-0.07	0.07-0.10
Chloride (%)			<0.05
Copper (mg/kg)	<3	3.0-4.5	4.5 - 10
Zinc (mg/kg)	<5		6-15 (30 in Hawaii)
Mn (mg/kg)	<20	20-100	100-1000

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Nitrogen

- Nitrogen should be applied in small amounts regularly, avoid applying it all at once in the summer
  - Too much N applied during vegetative growth can result in reduced nut yield and quality.
  - How Much?
  - In Hawaii they recommend 8:10:5 formula, at rate of .45 kg (**0.4 lb actual N)** per tree per year of age, a maximum of 4.5 kg (4 lb actual N).
  - We don't need much P and K. For N just use 1 lb urea/tree split in several applications per year

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Organic Fertilizers – Food Safety

- **Do not apply raw animal manures within four months of the start of nut drop and until after the completion of harvest**
- **This is important!**

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Soil Rototilling – Don't Do It!

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Proteoid Roots help absorb P and Iron, useful in poor soils

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Mulching

- Mulch after harvest with small chunk mulch.
- You don't want large chunk wood chips interfering with harvesting nuts
- Cools the soil
- Reduces water use
- Adds nutrients

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Canopy Management

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Notice the clean orchard floor

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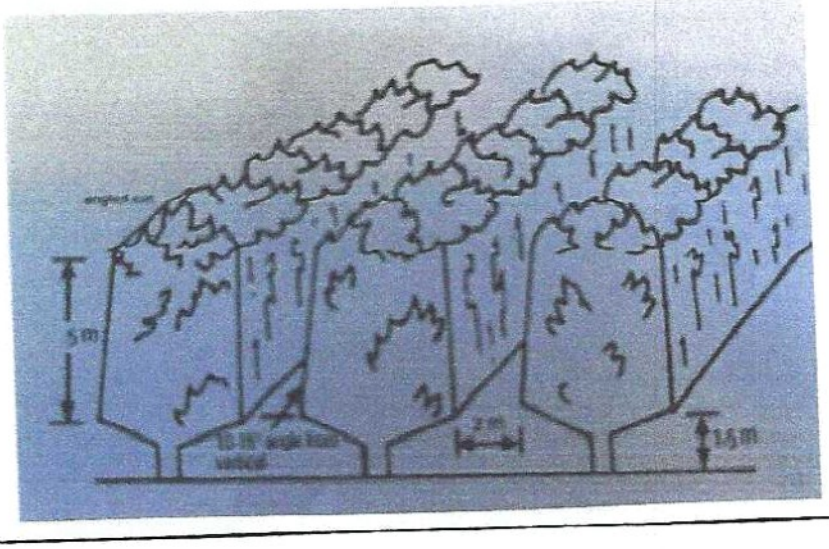
In Australia, Light pruning between trees after harvesting. But do we need to prune?



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Cross Pollination

- "Cross pollination between varieties is believed to increase the number of nuts, the % of first grade kernel, kernel recovery and nut size."
- Plant at least two varieties in separate rows so that they can be harvested separately if the processor requires that.

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Pest Control

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Pests and Diseases

- **In Australia there are a host of pests and diseases that afflict macadamias, but in the U.S. there are few problems in home gardens.**
- Occasionally, thrips, mites and scale may be troublesome, and anthracnose can infect leaves and nuts in humid climates.
- **Navel orange worm, Carob moth and Indian meal moth are problems. They lay eggs in the husk, the worm hatches and chews into the shell to eat the kernel**
- Canker can also result from wounds to the tree. **Macadamias are fairly resistant to *Phytophthora cinnamoni*, and are sometimes used to replant avocado orchards infected with the fungus.** The roots of the macadamia do not appear to be very attractive to gophers, but deer will browse on the new foliage.

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Southern Green Stinkbug, keep compost piles far away from the orchard

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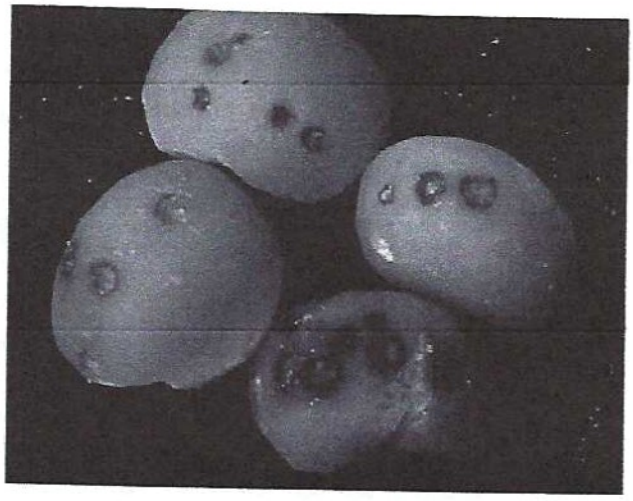
Stinkbug damage on macadamia kernels



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Harvest

- Mature macadamia nuts will fall to the ground from late fall to spring. It is best to harvest fallen nuts at least once a week. Shaking the trees to dislodge the nuts may also bring down immature nuts.
- A long pole can be used to carefully knock down mature nuts that are out of reach. A reasonably good tree will produce 30-50 pounds of nuts at 10 years age and gradually increase for many years.

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Harvester in Austrailia

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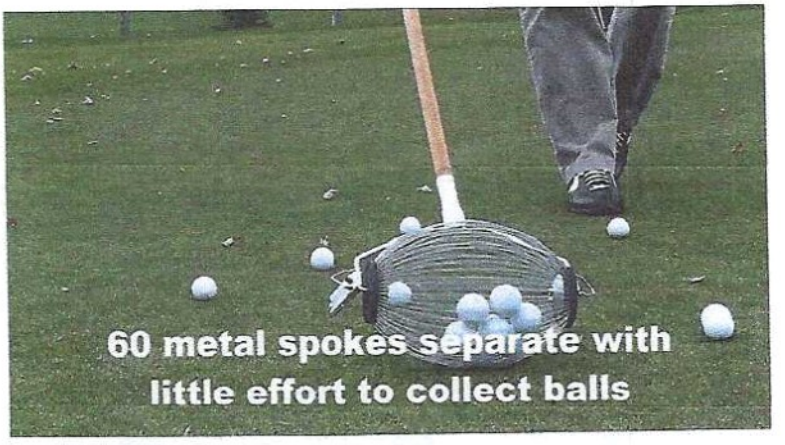
Macadamia harvesting in California



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Harvest

- **Harvested nuts should be dehusked and spread in a dry place protected from the sun and allowed to air dry for 2 or 3 weeks.**
- To finish drying put the nuts in a shallow pan and place in the oven at the lowest temperature setting (95° to 110° F) for about 2-5 days . Stir occasionally and watch that the nuts do not cook. Excessive heating will damage nut quality.
- Store the nuts in a cool, dry area. A heavy plastic bag will prevent nuts from reabsorbing moisture. When the nuts are dry, the shells can be removed with a nutcracker. A cottage industry of sorts has developed around designing nutcrackers that can best cope with the hard shells.

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Roasting and uses

- To home-roast macadamia nuts, place shelled nuts (whole kernels or halves only) in a shallow pan no more than two deep. Roast 40 to 50 minutes, stirring occasionally. Watch carefully and remove from the oven as soon as they start to turn tan. After roasting, the nuts store nicely, salted or unsalted, in airtight jars at 40° to 65° F. They can also be frozen. Macadamia nuts are excellent raw or roasted. In addition to being a quality snack, they can be used in almost any recipe that calls for nuts, including stuffings, fruit salads, cakes, etc.

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Literature cited

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