DESIGN OF EFFICIENT PISTACHIO ORCHARDS

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Some Pre-planting Issues to Investigate
(Some of these topics will be discussed in more detail in other presentations – also see www.coststudies.ucdavis.edu)

Does the farm have suitable soils?

Is suitable and sufficient water available and type of irrigation system?

Does the farm have a suitable climate (enough heat units, low summer and fall rainfall, sufficient chilling, no late spring frosts) ?

How long will it take to receive trees from the nursery? Which rootstock and scion cultivar will you select and why?

Does the farm have power for irrigation pumps? How soon can you get it?

Where is the money for the farm and, at least, 5 or 6 years of a negative balance sheet coming from?

Who will farm them?

Who will buy the nuts? Where is the processor?

Major Orchard Design Considerations Discussed in this presentation:

Tree Density,
Tree Design,
Pollinizer Placement
And an Orchard Floor Management System.

The Well Designed Orchard Should Create a Farm That Ensures:

- **earliest economic return per acre**
- **maximum production per acre at tree maturity**
- **Least management cost**

Sometimes these goals may be mutually exclusive.

The leaf canopy is what catches the energy from the sun to produce nuts. The more energy caught – the more nuts to harvest.

The questions are:

- **How long will it take an orchard to achieve full leaf canopy and still leave room for machinery access to shake and catch the nuts.**
- **How many tree trunks do you need to hold the orchard leaf canopy up at maturity?**

If trees are too close,

- Trees eventually crowd together shading the lower tree canopy (nuts borne higher in tree and air flow restricted which may mean more fungal problems).
- Pruning costs increase to maintain equipment access to the orchard and tree isolation for shaking.
- You paid for too many rootstocks, budded/trained too many trees and now have to prune too many trees.
- Trees should be at least 12 ft. apart so that the mechanical shaker frame (typically 22 ft. long) will be able to access the tree trunk.

If trees are too far apart,

- Potential per acre yield may be permanently reduced or delayed for many years.
- If trees are too far apart and grow too large, nuts will fall outside of the catching frame at harvest.
- How big a trunk circumference can we shake efficiently? All else being equal, closely spaced trees will grow slower, due to inter-tree competition for light and nutrients.

ORCHARD TREE DESIGN

Decision! Upon which option will I base initial tree density?

High Density Orchard

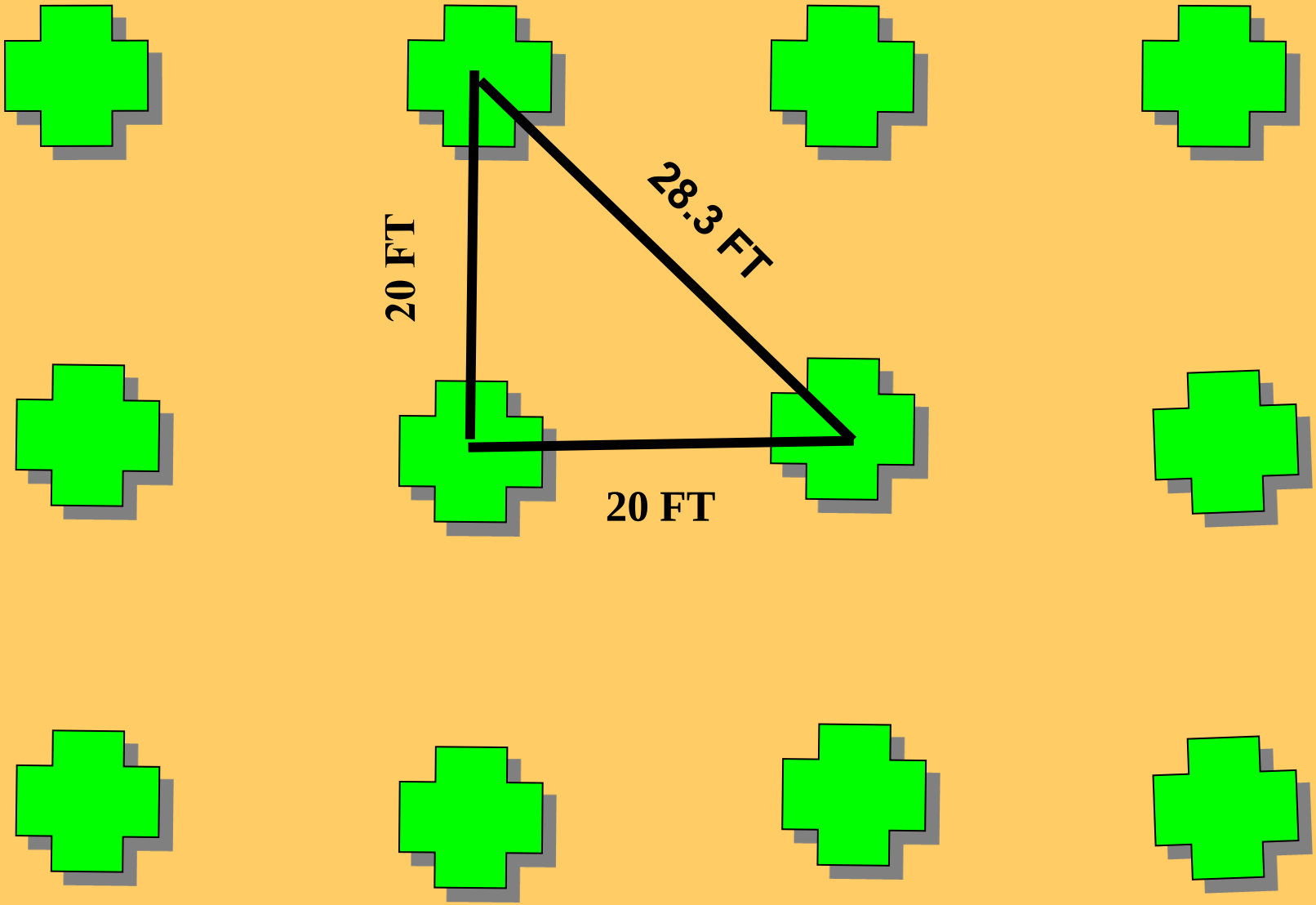
Earlier economic returns. Trees may end up too close for easy canopy management and be too far apart to thin.

LOW DENSITY Orchard –

Longer wait for economic returns. Better air-flow through the orchard. Fewer trees to buy, train, prune and shake.

Pistachio harvesting equipment is large. Space rows of trees 20 ft. or so apart.

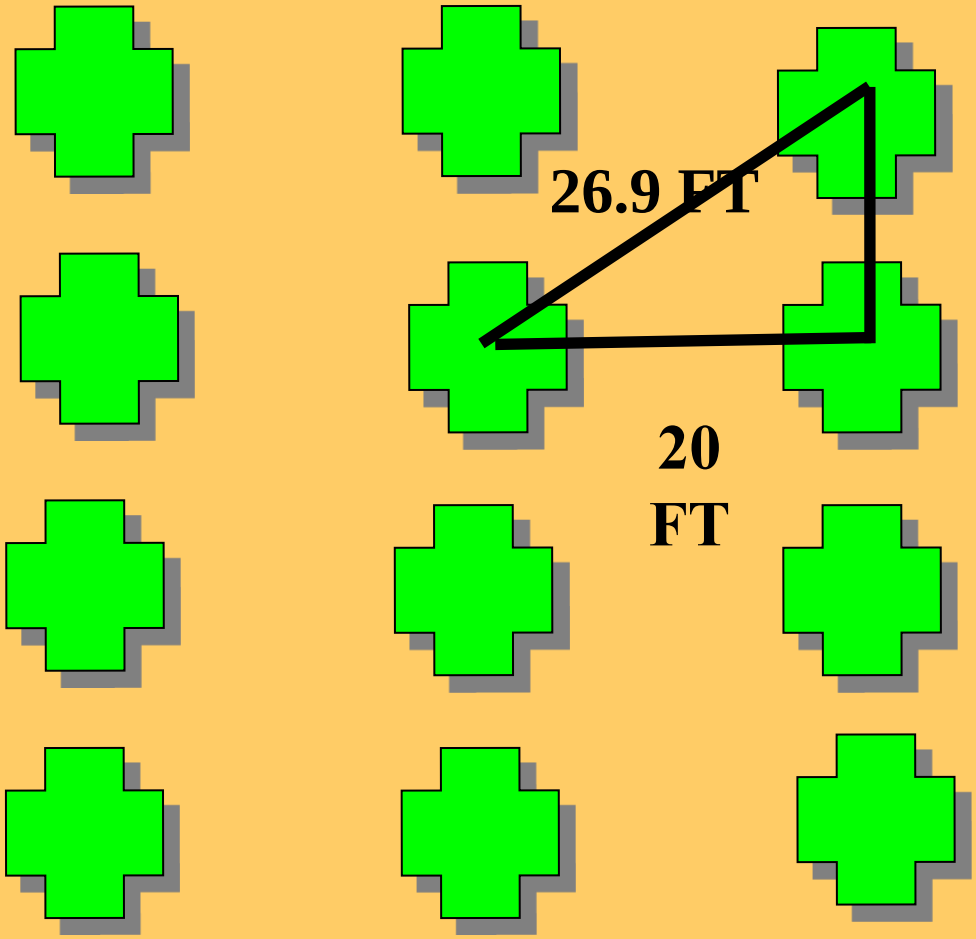
Square design (109 trees/acre at this spacing)



Spacing the trees closer together in the row may be pay off where trees grow slower due to hardpans, high salt, excessively high boron, or for other reasons,

Trees in poor growing environments will take longer to provide full canopy leaf cover, so yield will benefit by higher tree numbers for a longer period of time after planting.

The variety ‘Golden Hills’ appears to be a smaller tree and can be spaced closer together down the tree row, than for example ‘Kerman’.



Rectangular planting - Most common design in California but spacing varies.

(121 trees/acre at this spacing)

Mechanical cross-hedging still possible with trees 18 ft. apart.

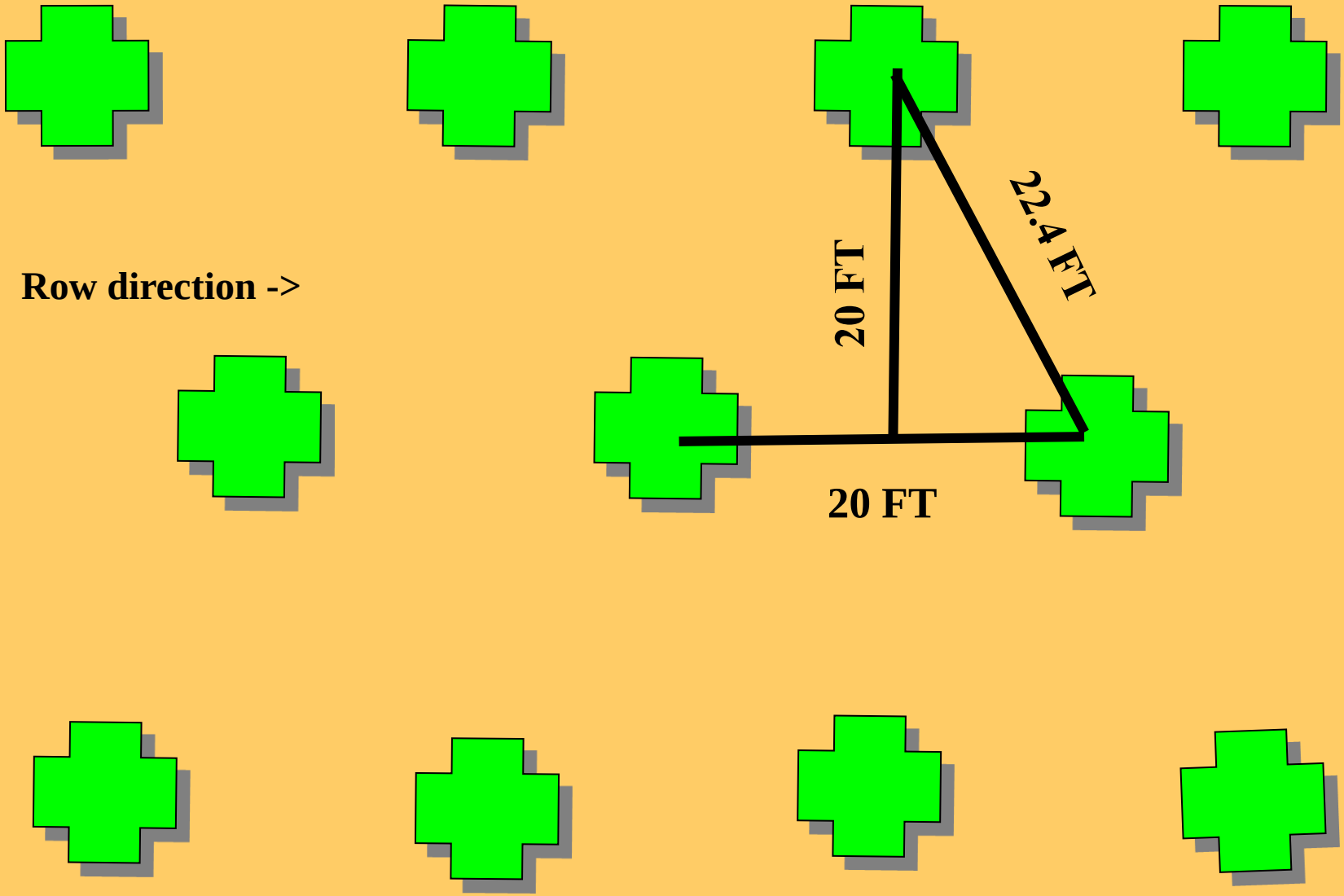
For organic and conventional growers with rectangular or square plantings,

Leave enough room between rows to cross-cultivate for weed control in orchards. This is particularly important for organic growers

This will allow sufficient space for cross-hedging to control the canopy if desired (labor costs continue to rise).

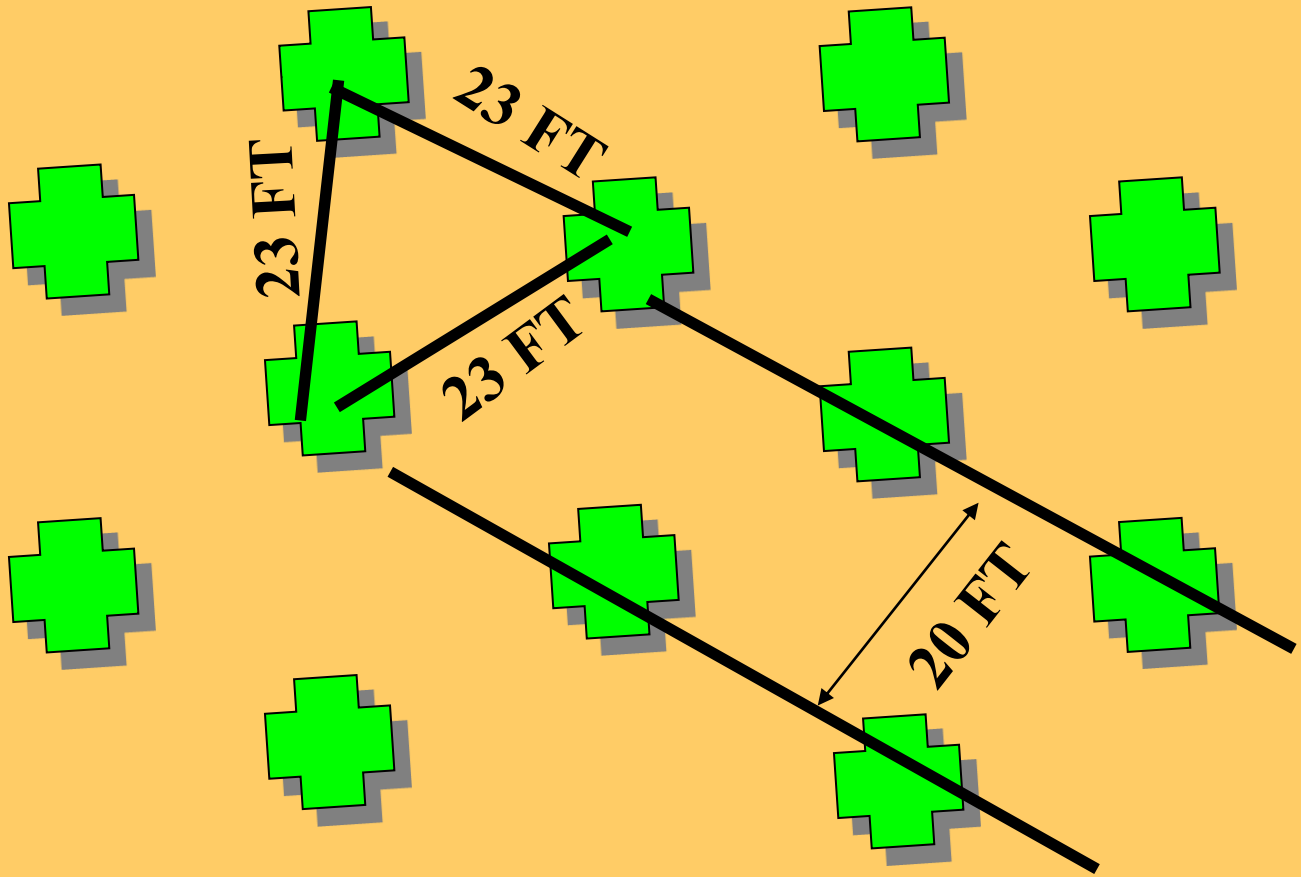
Obviously, if you plan to cross-cultivate or eventually cross-hedge the orchard, trees should *not* be planted on a berm.

Offset square design (109 trees/acre at this spacing)



Cross hedging not possible with this design

Hexagonal planting (97 trees/acre at this spacing)



Theoretically, with trees spaced equidistant from each other, mutual shading should be minimized.

Number of Trees Per Acre at Different Rectangular Plantings

Row x Tree Spacing	Trees/acre
20 x 17	128
20 x 18	121
20 x 19	115
20 x 20	109

$$\text{Trees per acre} = \frac{43560}{\text{Row spacing (ft) x tree spacing (ft)}}$$

In pistachio, male and female flowers are borne on different cultivars.

There are male trees and female trees. Male trees do not bear nuts.

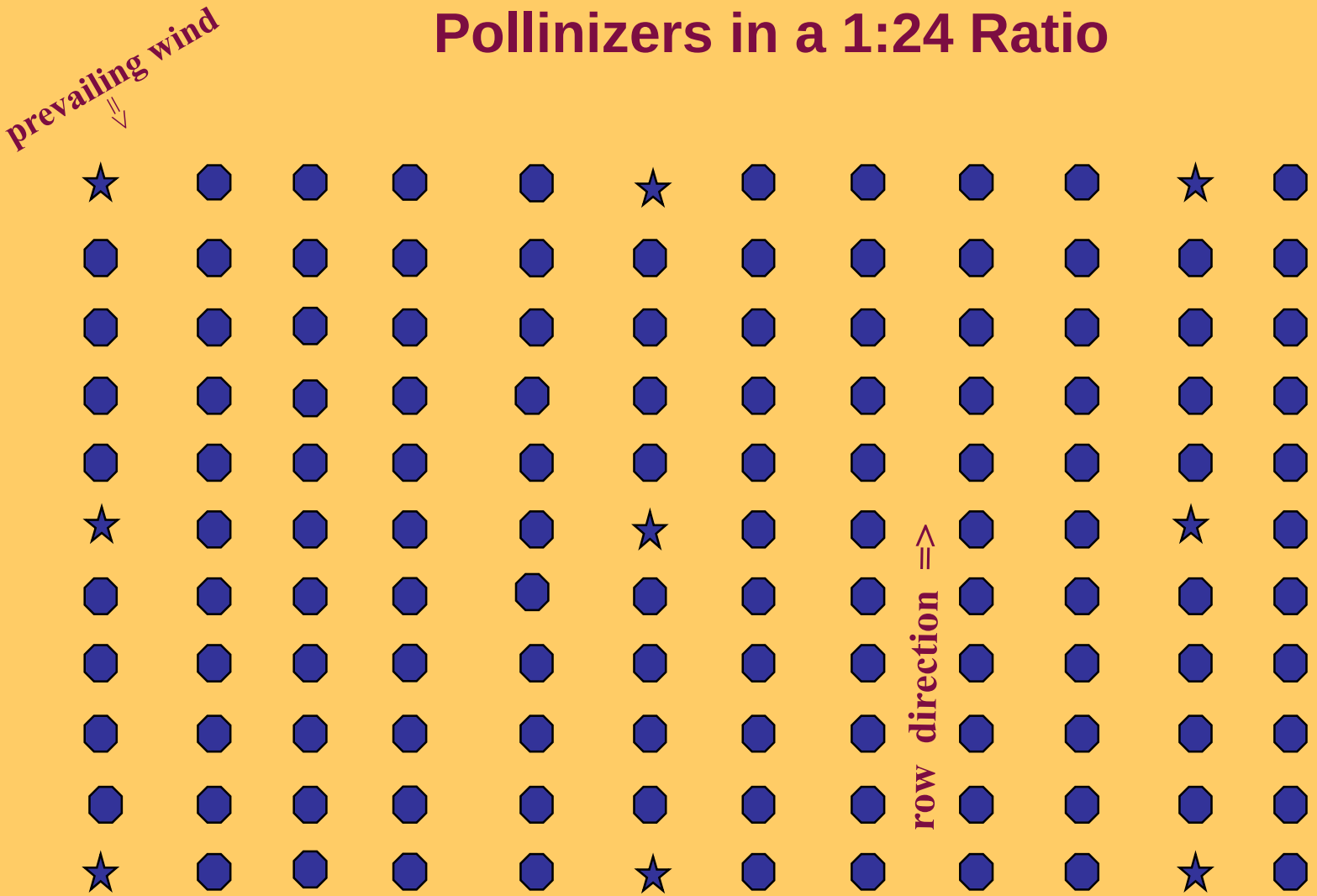
Male trees have to be dispersed through the orchard so that female trees are pollinated.

Pollen is blown to female trees. Bees are not involved in pollination, although they do gather pollen from the flowers on male trees.

In the San Joaquin Valley of California, with the advent of more “low chill – warm winter” years, the trend is to plant more than one male variety. In “low chill – warm winter” years, male – female bloom synchrony may be lost as male trees tend to bloom later than the female.

For example, in ‘Kerman’ orchards, in addition to the ‘Peters’ male, the earlier-blooming male variety ‘Randy’ may be planted as it will have better synchrony with Kerman in ‘low-chill/warm winter’ scenarios.

An Orchard Design with Male Pollinizers in a 1:24 Ratio



Currently (2015) in the SJV, males (★) are frequently interplanted with females ( ) every 5th tree in every 5th row

Row Length?

Rows longer than 1/4 mile should have a break (access road) to allow equipment to turn around if necessary.

Reason - A bank-out wagon on an “on” year cannot carry all the production from a row over a quarter mile in a length.

Have a harvest loading site -

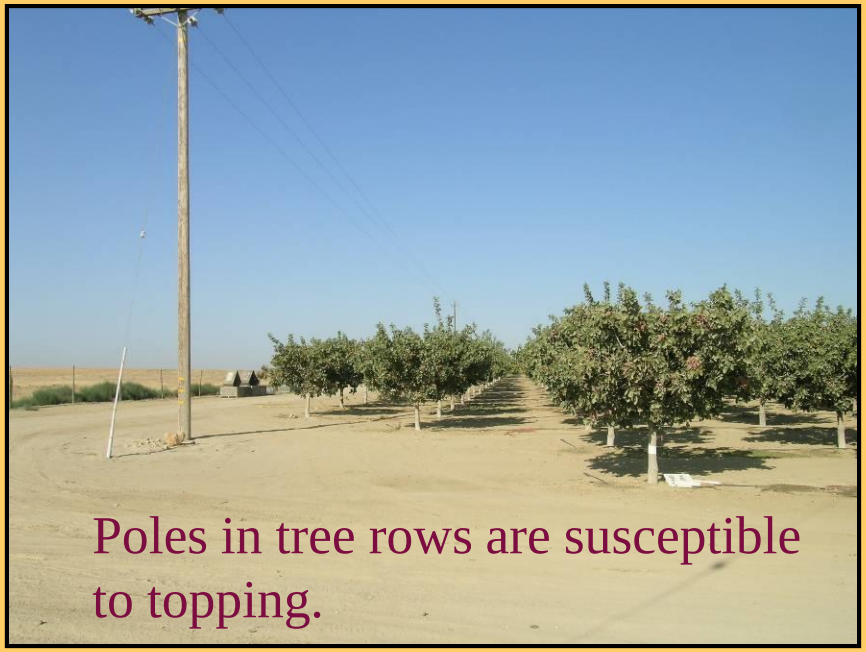
A loading site should be contiguous to every 40 acre block. A single loading site can service 160 acres. A loading site is typically 50 ft x 500 ft.

Loading site in action

A safe harvest loading site takes space

Try to avoid a loading site like this.

Somebody snuck in another row of citrus trees



Poles in tree rows are susceptible to topping.

Leave plenty of room around county roads, poles, reservoirs, filters, and pumps so that harvesting and other equipment can turn or pass easily.

Leave room to turn equipment in and out of tree rows.

Potential liability from pesticide drift should be considered. Is a tree-free buffer needed between the orchard and neighboring schools, houses, county or state roads?

Design to minimize existing obstructions.

This pole interferes with harvesting equipment, grading, irrigation, weed control, etc.

This air-release valve is still too tall in the tree row.

Buried vaults in the tree row protect valves, air release valves, etc. from shaker and mechanical cross-hedging

Various road-surfacing materials are available that can be used both to reduce dust and/or improve wet-weather access to the orchard.

The suitability of a material for a given road application varies with the following:

- **the native soil of the road,**
- **the current condition of the road,**
- **seasonal rainfall patterns, amounts and drainage,**
- **frequency that the road is traveled,**
- **material cost,**
- **and ability to grade, blade, replace or repair.**

This is an example of the native soil used as a road surfacing material.

Access road to pistachio orchard in Kern County – this fellow is stuck and the silt is 2 feet deep in places on the road. Is it time to review what considerations affect choice of road materials?

Some fixes aren't simple.

Some of the materials used to control dust on farm service roads are as follows:

- **Water**
- **Lignosulfate dust binders**
- **New or recycled asphalt**
- **Heavy road oil**
- **Washed gravel**
- **Crushed rock or decomposed granite**
- **Vinyl/acrylic emulsion/polymers**
- **Organic materials**

Reservoir Considerations

- Will a reservoir be needed and how big?
  - How does the irrigation district deliver water? Is the delivery interval so long that you will have to store large volumes of water for considerable periods of time?
  - Does the district provide pressurized water on demand?
  - Are you using a well? Will you need a reservoir for pressure control or for storing water pumped at off-peak electrical rates?
  - Will you need a settling pond for silt or sand or other debris – or capacity for backflushing of filters or capturing/recovering drainage from field.
  - Engineering of the reservoir – problems include building in steep topography, surface and deep drainage out of the reservoir, environmental considerations. Depending upon future environmental regulations, and your water quality or runoff - your reservoir could one day be labeled by a governmental agency as a wildlife refuge or toxic waste dump.

OPTIONS FOR ORCHARD FLOOR MANAGMENT

- Complete cultivation (irrigation hose concerns?)
- Complete vegetation cover (disease concerns?)
- Complete herbicide control (erosion concerns?)
- Strip herbicide control down tree row with cultivation of middles
- Strip herbicide control down tree row with cover crops in middles
- Intercropping

Strip herbicide control with cultivation

Terracing complicates harvest and cross-hedging.

So can high and wide berms

STRIP HERBICIDE CONTROL WITH COVER CROPS

Cover crops do not necessarily use a lot of water.

If you want a cover crop all year in the southern SJV you will have to irrigate the middles.

Cover crops may have multiple effects:

- **insect/mite control (+/-)**
- **water relations (+/-)**
- **disease (+/-)**
- **nutrition (+/-)**
- **erosion control (+)**
- **vertebrate pests (gophers, mice, voles) (-)**

We've got a lot to learn about cover crops.

Interplanting in young pistachios

Because pistachio take more years to come into production than other perennial crops, some growers are interplanting cotton, melons or other crops between rows of young pistachio trees.

Blake Sanden, UCCE Farm Advisor in Kern County, has explored the economics of this.

There can be financial advantages to interplanting when the pistachios are young, but make sure that you know how to grow the interplanted crop before attempting this at home. Potential problems:

- weed control (herbicides), phytotoxicity, registration
- fertilizers, irrigation, discing roots, harvest timing, etc.
- shading
- pests – meadow mice (voles), insects and mites

PLAN WELL AND GOOD LUCK!