Citrus Site Selection, Preparation and Establishment

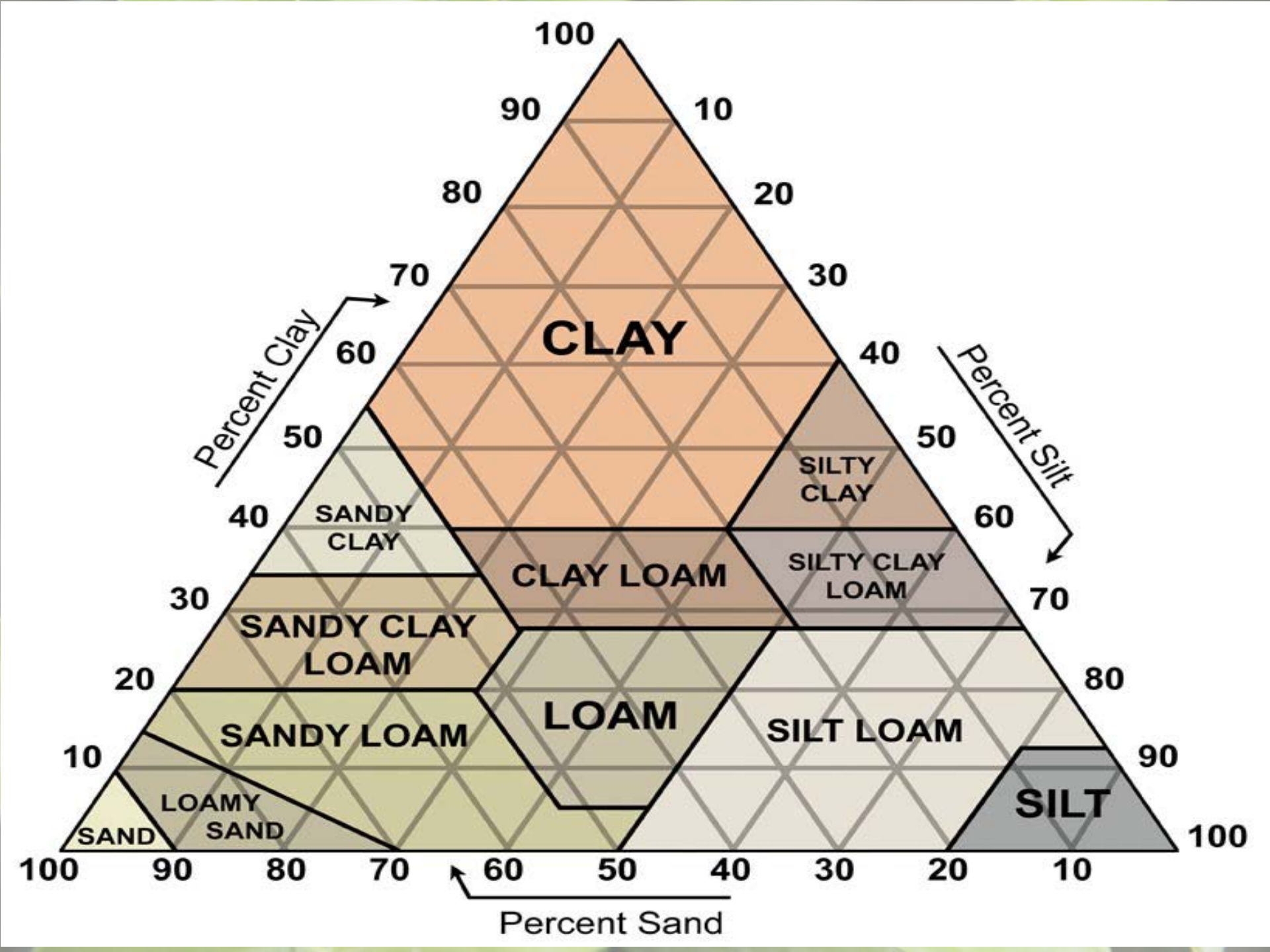
Louise Ferguson PhD
University of California Davis
LFerguson@UCDavis.edu

Site Selection

- Low temperature is the most critical factor affecting the extent of citrus growing worldwide.
- Long-term localized temperature data should be collected in addition to long-term region temperature information.
- Microclimates should also be taken into consideration. These include:
  - presence of bodies of water.
  - slopes, and depressions.

Soil Texture

- Soil type is important. The best are deep sandy to sandy loam soils.
- Soils with over 50% clay may have drainage problems.


100
90
10
80
20
70
30
60
40
50
50
40
60
30
70
20
80
10
90
100
Percent Clay
Percent Silt
Percent Sand
CLAY
SILTY CLAY
SANDY CLAY
CLAY LOAM
SILTY CLAY LOAM
SANDY CLAY LOAM
LOAM
SILT LOAM
SANDY LOAM
SILT
LOAMY SAND
SAND
100
90
80
70
60
50
40
30
20
10

Salt tolerance of fruit Crops.

	Relative yield decrease -- %			
	0	10	25	50
	mmhos/Cm			
Date palm	4.0	6.8	10.9	17.9
Fig, Olive	2.7	3.8	5.5	8.4
Grape	1.5	2.5	4.1	6.7
Grapefruit	1.8	2.4	3.4	4.9
Orange	1.7	2.3	3.2	4.8
Lemon, Apple	1.7	2.3	3.3	4.8

Table 8. Irrigation water salinity tolerances for different crops. (Adapted from Ayers and Westcot, 1976)

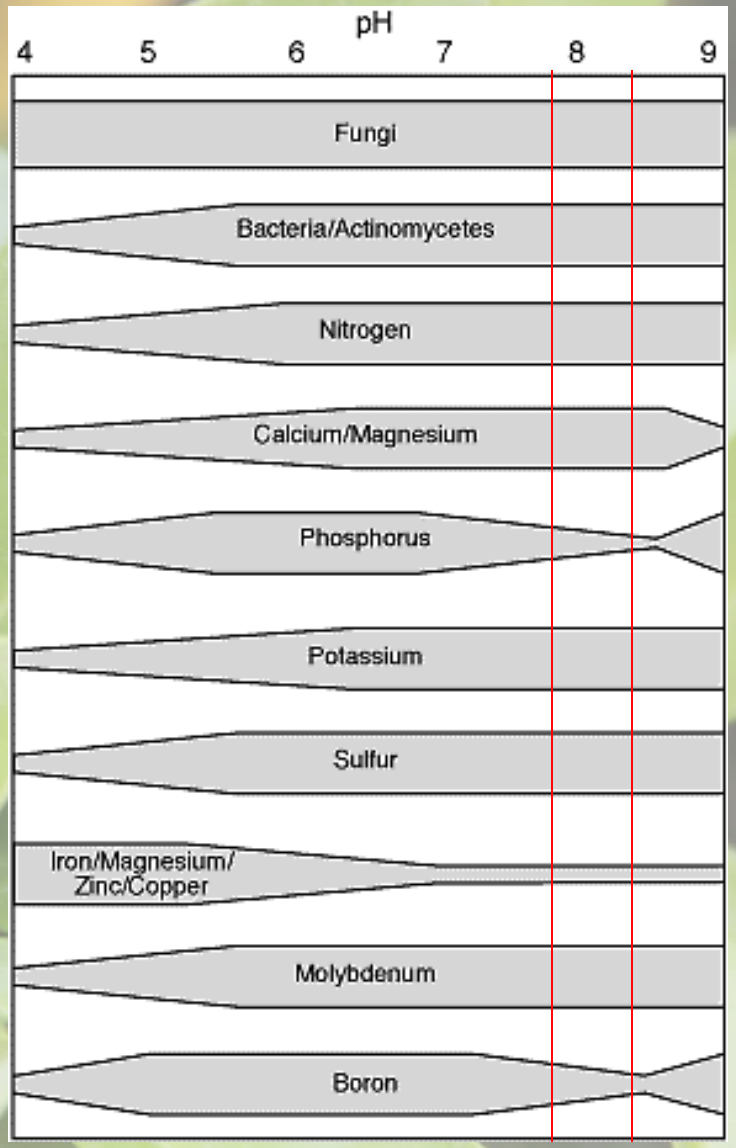
Crop	Yield potential, ECiw			
Fruit crops	100%	90%	75%	50%
Almond	1.0	1.4	1.9	2.7
Apple, pear	1.0	1.6	2.2	3.2
Apricot	1.1	1.3	1.8	2.5
Avocado	0.9	1.2	1.7	2.4
Date Palm	2.7	4.5	7.3	12.0
Fig, olive, pomegranate	1.8	2.6	3.7	5.6
Grape	1.0	1.7	2.7	4.5
Grapefruit	1.2	1.6	2.2	3.3
Lemon	1.1	1.6	2.2	3.2
Orange	1.1	1.6	2.2	3.2

Soil and Water Salinity Testing

- Surface water test kits range from $150 to $300 for water chemistry only, microorganism test kits will cost more.
- Various laboratories will test as well. Cost ranges from $5 to $25 per sample depending on what you want.

Site Selection

- Soil pH is also a factor. Optimum pH is 5.0 to 7.0.
- Above 7.0, there may be micronutrient deficiencies, and proper rootstock selection may be required.
- Sometimes high pH soil may be amended with sulfur to lower the pH, but with highly calcareous soils, this is difficult.
- Low pH soils may cause aluminum toxicity, but may be amended with limestone.



Site Selection

- Irrigation water is a factor. There must be an adequate supply, it must be of good quality,
- Water must be accessible.
- There must be an affordable delivery system,
- There should not be too much competition with urban users.

Site Selection

- Long-term economic prospects should be considered.
- Investors must consider:
  - the cost of the land,
  - irrigation systems,
  - planting costs,
  - interest rates,
  - potential demand for citrus (long range planting and consumption trends).
  - marketing ability.

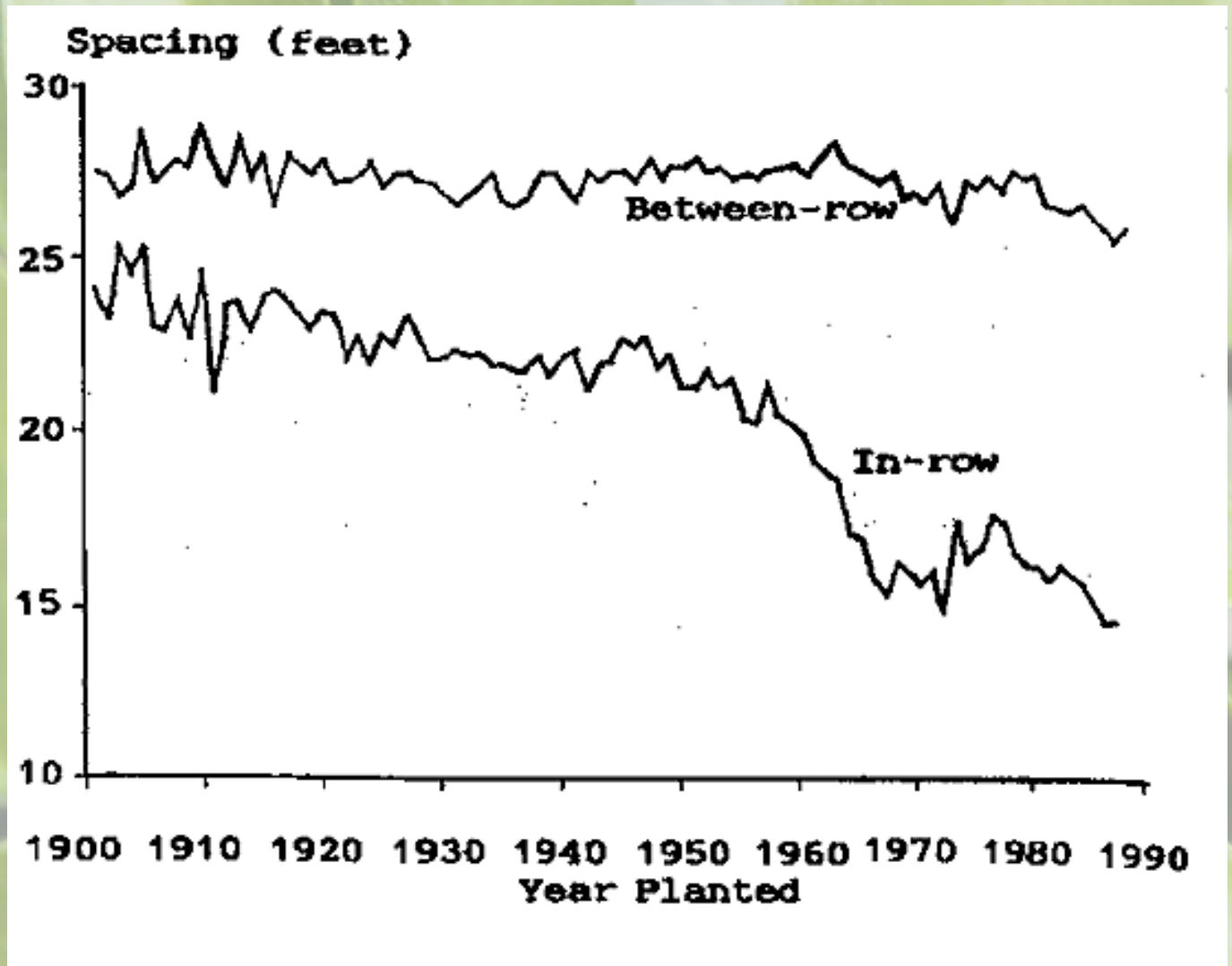
Orchard Design

- The objective of planting density is to maximize the "capture" of sunlight while still allowing for equipment movement throughout the orchard.
- There is no consensus as to the proper tree spacing, either in Arizona or across the world. Spacing ranges from:
  - 10 x 10 m (23 trees per jerib)
  - 1.5 x 3 m (450) trees per jerib)

	Between Row Spacing							
Within Row Spacing		30	28	26	25	24	23	22	20
	30	48	52	56	58	61	63	66	73
	28	52	56	60	62	65	68	71	78
	26	56	60	64	67	70	73	76	84
	25	58	62	67	70	73	76	79	87
	24	61	65	70	73	76	79	83	91
	23	63	68	73	76	79	82	86	95
	22	66	71	76	79	83	86	90	99
	20	73	78	84	87	91	95	99	109
	18	81	86	93	97	101	105	110	121
	16	91	97	105	109	113	118	124	136
	14	104	111	120	124	130	135	141	156
	12	121	130	140	145	151	158	165	182
	10	145	156	168	174	182	189	198	218

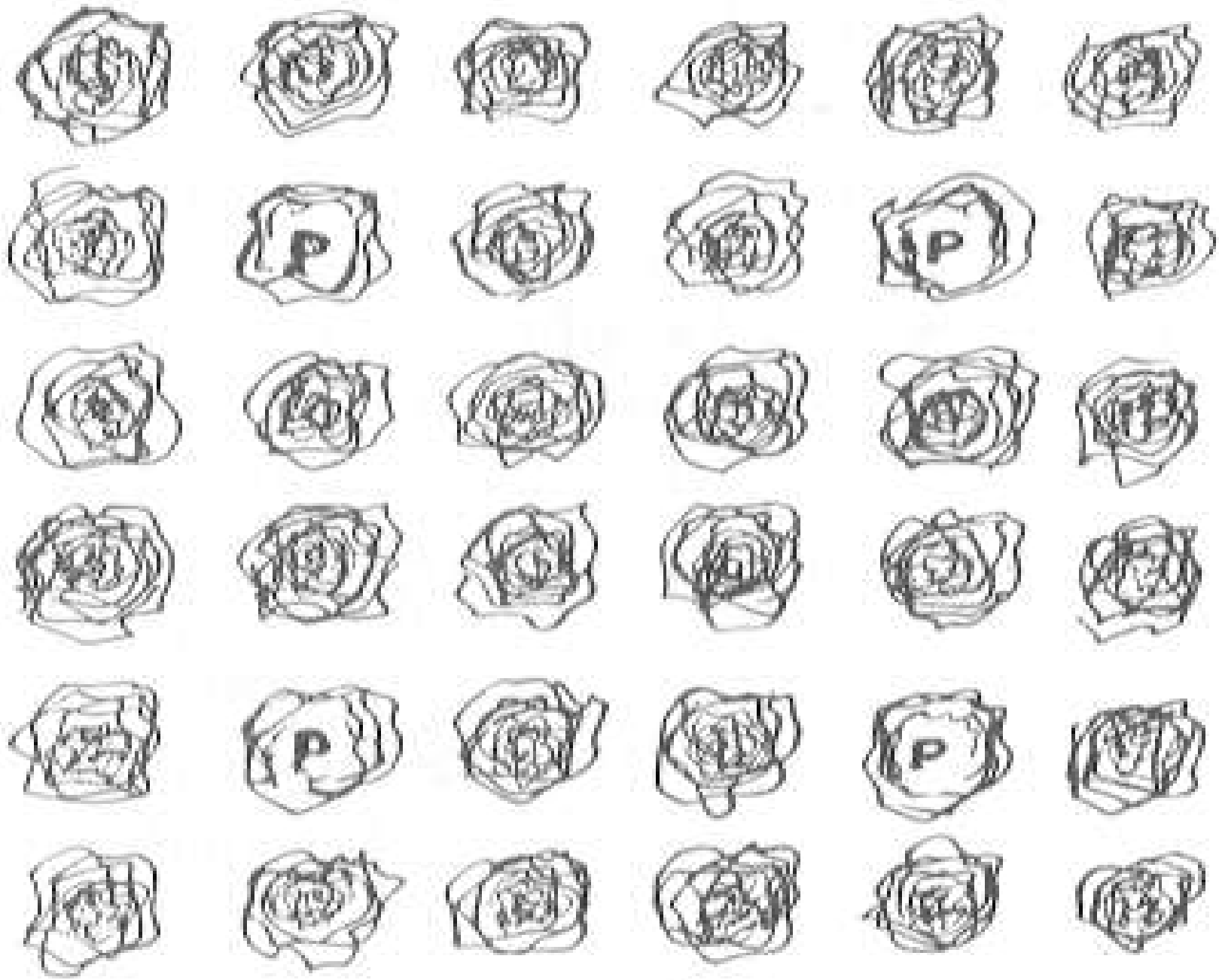
Orchard Design

Tree spacings have decreased in past several decades.



Orchard Design

- Orchards are usually planted in square, rectangular or quincuncial configurations.
- Square configurations are usually wide spacing, because this type allows for ease of spraying and harvesting operations.

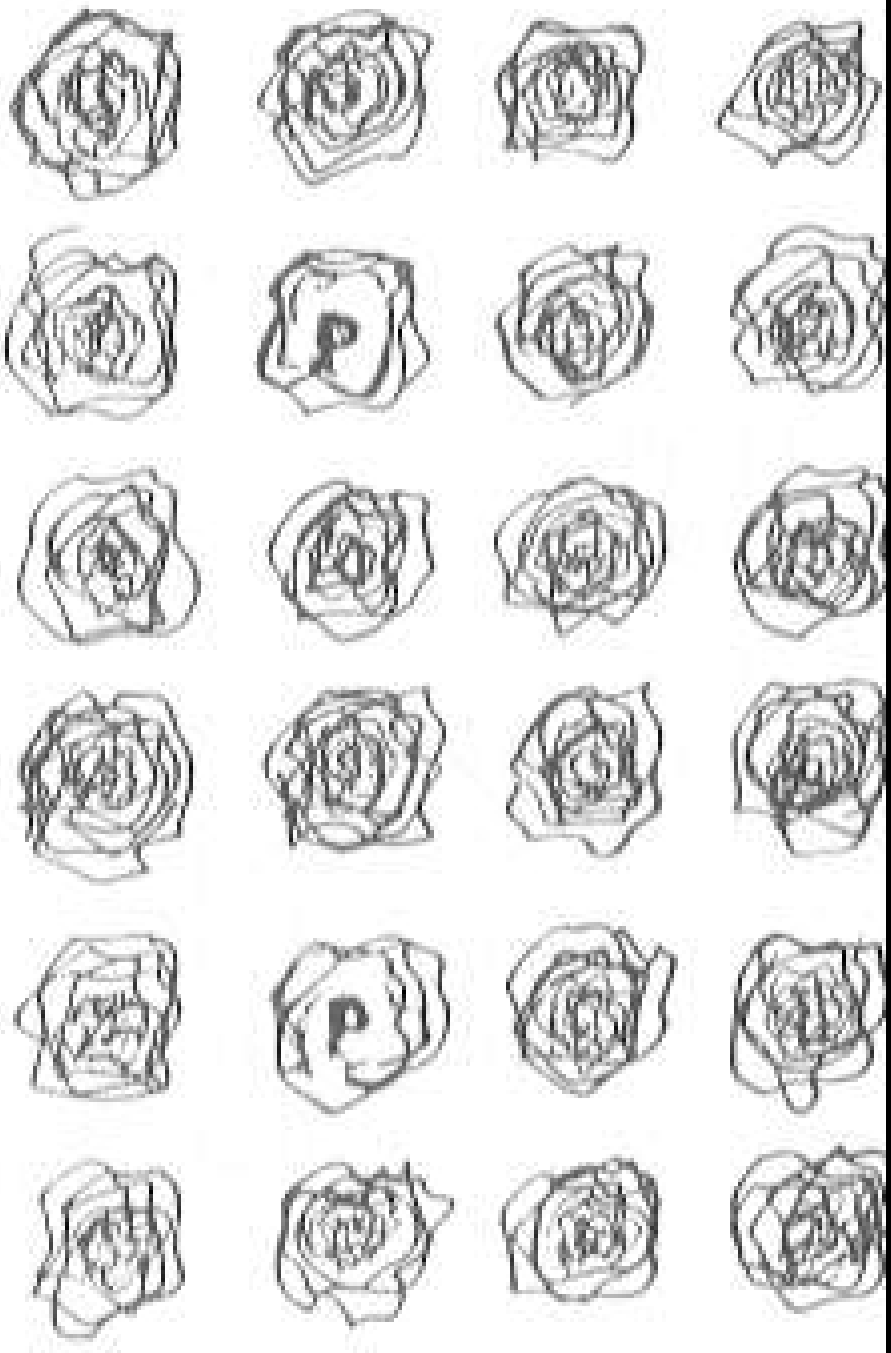

P
P
P
P
P

Orchard Design

- Square configuration is also used in areas where tree growth is vigorous, or where pruning and hedging equipment is not available.
- Consideration should be given to tree - growth and equipment width, because row middles that are too small will require frequent hedging or will lead to broken scaffold limbs.

Orchard Design

- Rectangular configurations are used when the trees will be allowed to grow into a hedgerow. This allows for more trees per acre and higher yields.
- Spraying and harvesting may be more difficult when an orchard is rectangular, and shading may be a problem if a regular hedging and topping program is not followed.

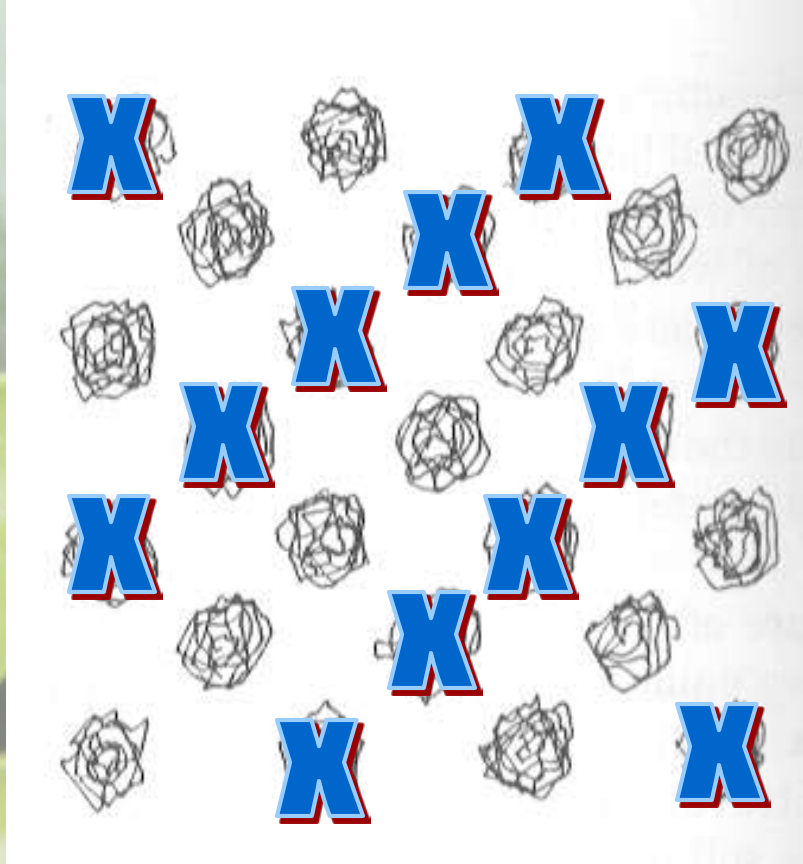


Orchard Design

- Rectangular plantings should be oriented north to south to maximize sunlight interception.
- A general rule of thumb is that trees should be no taller than twice the distance between canopy widths. For example, if there is a 3.7m drive middle, then the trees should be no taller than 7.4m high.

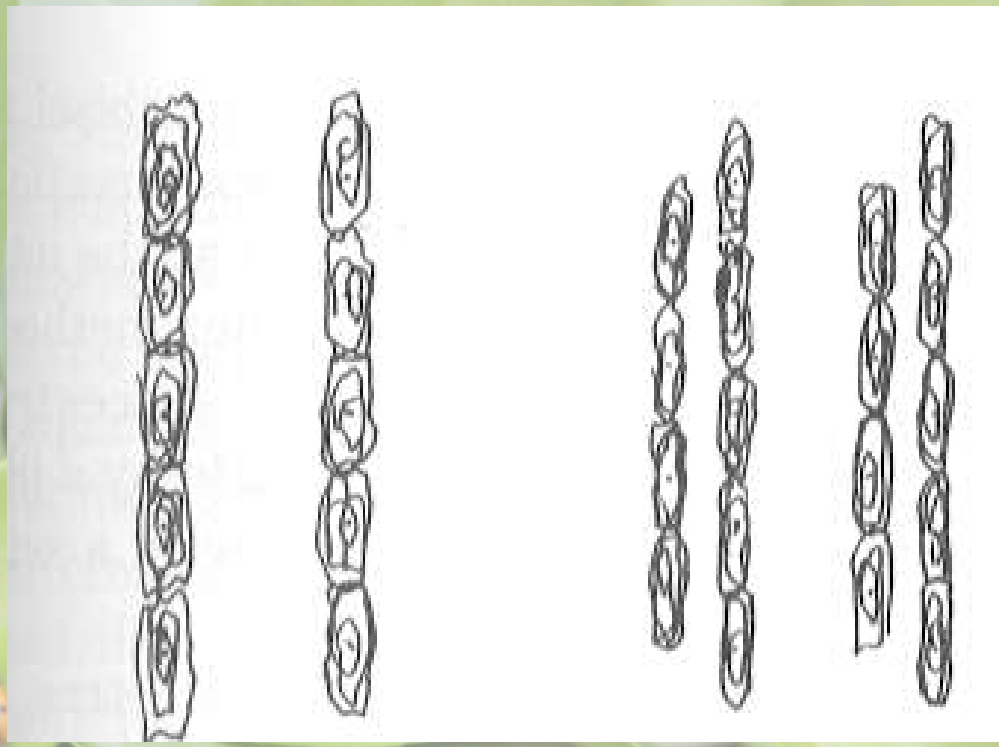
Orchard Design

- Quincuncial plantings are those where some trees are designated to be removed after trees are too dense.
- Typically, every other tree is removed, resulting in a square pattern.



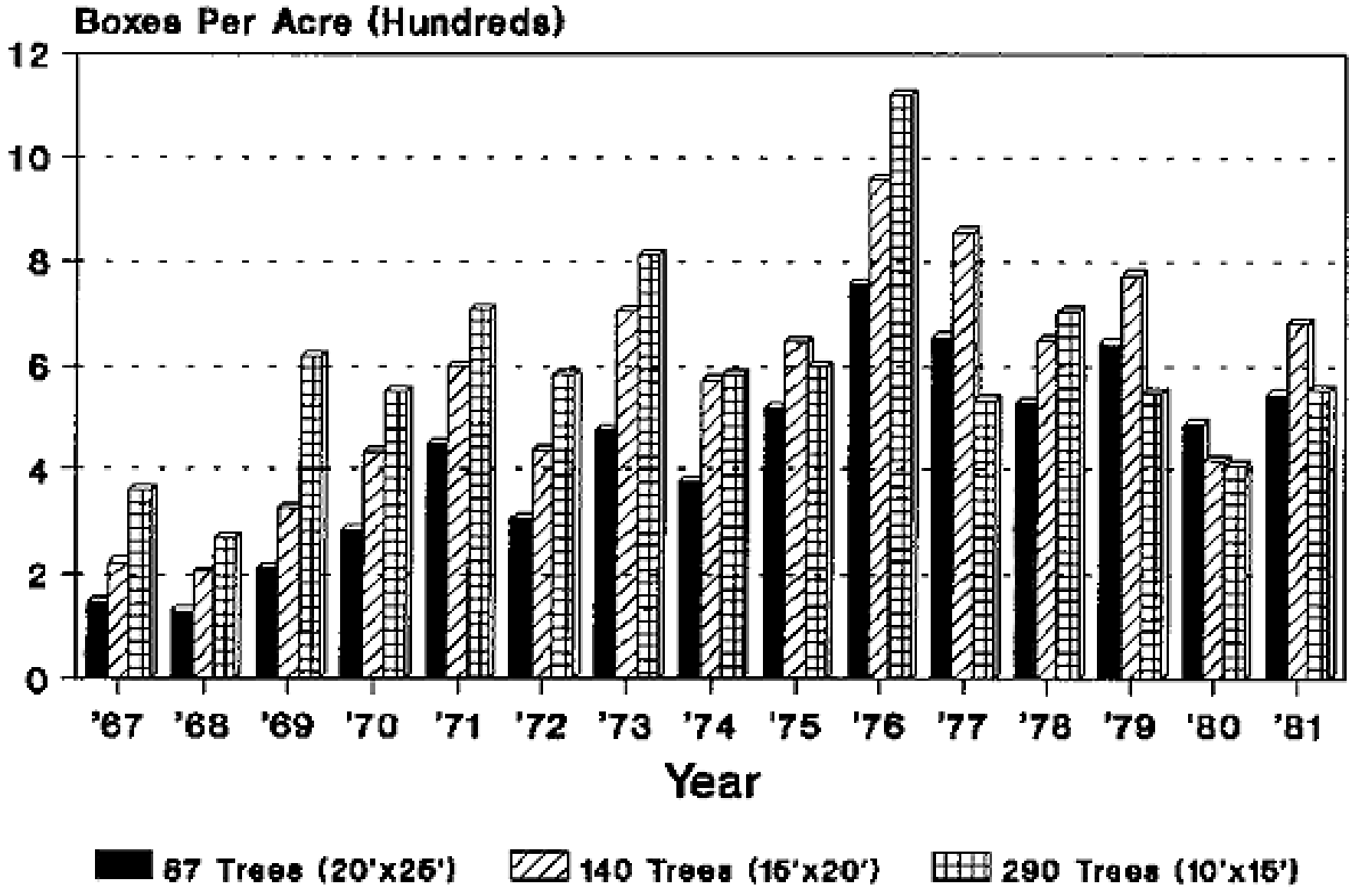
Orchard Design

- High-density plantings usually consist of more than 100 trees per jerib.
- In areas where less vigorous growth is common, higher densities can be planted.
- The reason for planting in a high-density scheme has been to optimize land use and increase early returns on an investment by increasing early yield.



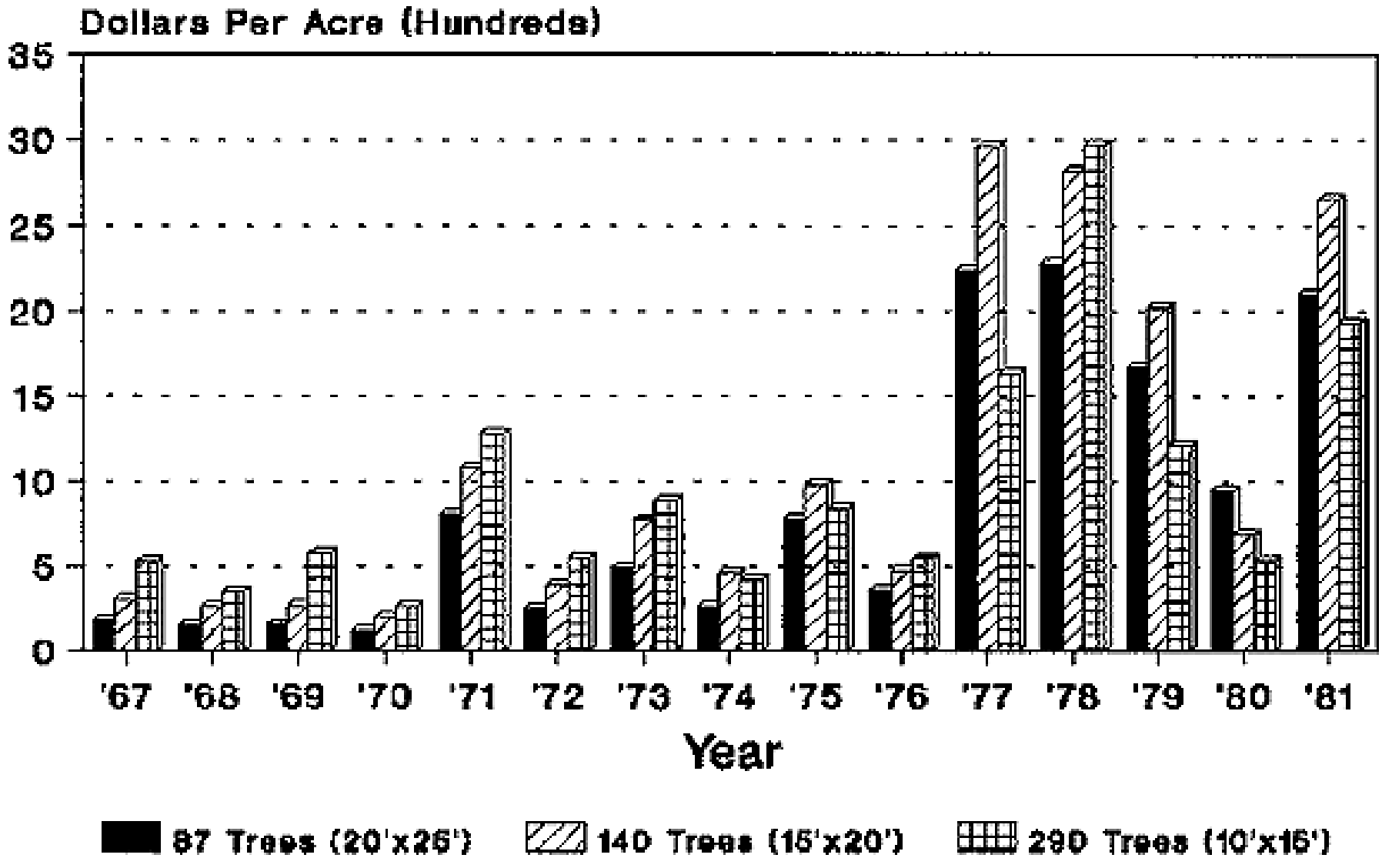
Orchard Design

- After 5-8 years, this advantage disappears, because a normal density planting will develop into a hedgerow as well.
- Some studies suggest that profitability of high-density plantings continues until the orchard is 15 to 20 years old.
- A regular hedging and topping program and a tree removal plan is then necessary.


Boxes Per Acre (Hundreds)
12
10
8
6
4
2
0
'67
'68
'69
'70
'71
'72
'73
'74
'75
'76
'77
'78
'79
'80
'81
Year
87 Trees (20'x26')
140 Trees (15'x20')
290 Trees (10'x15')

Orchard Design

- When dwarfing rootstocks become available, high-density plantings will be more economical because the cost of hedging and topping will be reduced.
- Where there is flood irrigation and where nutrients are broadcast, water and nutrient uptake efficiency is increased with a high density planting. Also, heat loss during a freeze would be less. Spraying and harvesting would be more difficult


Dollars Per Acre (Hundreds)
35
30
25
20
15
10
5
0
'67
'68
'69
'70
'71
'72
'73
'74
'75
'76
'77
'78
'79
'80
'81
Year
87 Trees (20'x25')
140 Trees (15'x20')
290 Trees (10'x15')

Preplant Preparation

- Remove the old grove
  - Use bulldozer to pile up, then burn.
  - Bulldoze out, then chip if burn permits cannot be acquired.
- Timing:
  - Summer or early fall when the tree can be dried out easily following cessation of irrigation.

Citrus tree Chipper

Preplant Preparation

- Fallow?
  - Can reduce Phytophthora in soil by subjecting it to a dry fallow period.
    - Soil temperatures from 35 to 37C
    - No irrigation
  - Establishment of alfalfa does not reduce Phytophthora

Preplant Preparation

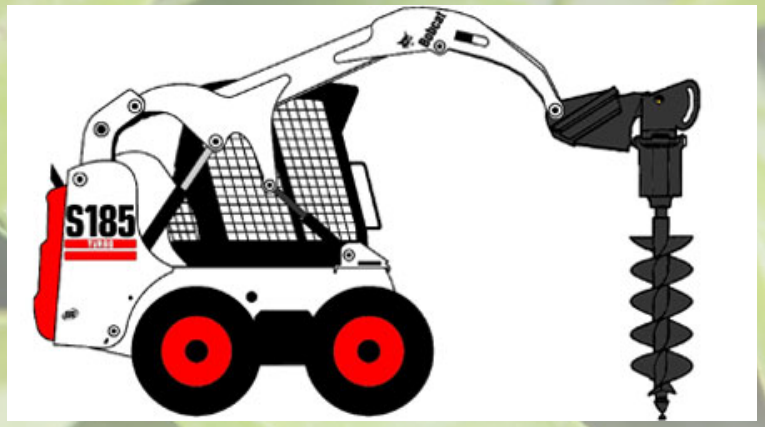
- Deep Tillage (Ripping) as deep as possible
  - Minimum 3 feet
  - Or, as deep as possible to break up hard pan or caliche and/or improve drainage
- Laser Field
- Apply pre-emergent herbicides

Citrus Tree Planting

- Trees are typically planted in the spring or fall, but they may be planted in the summer if enough irrigation water is provided.
- Trees from Arizona and California desert nurseries are typically provided as ball and burlap.

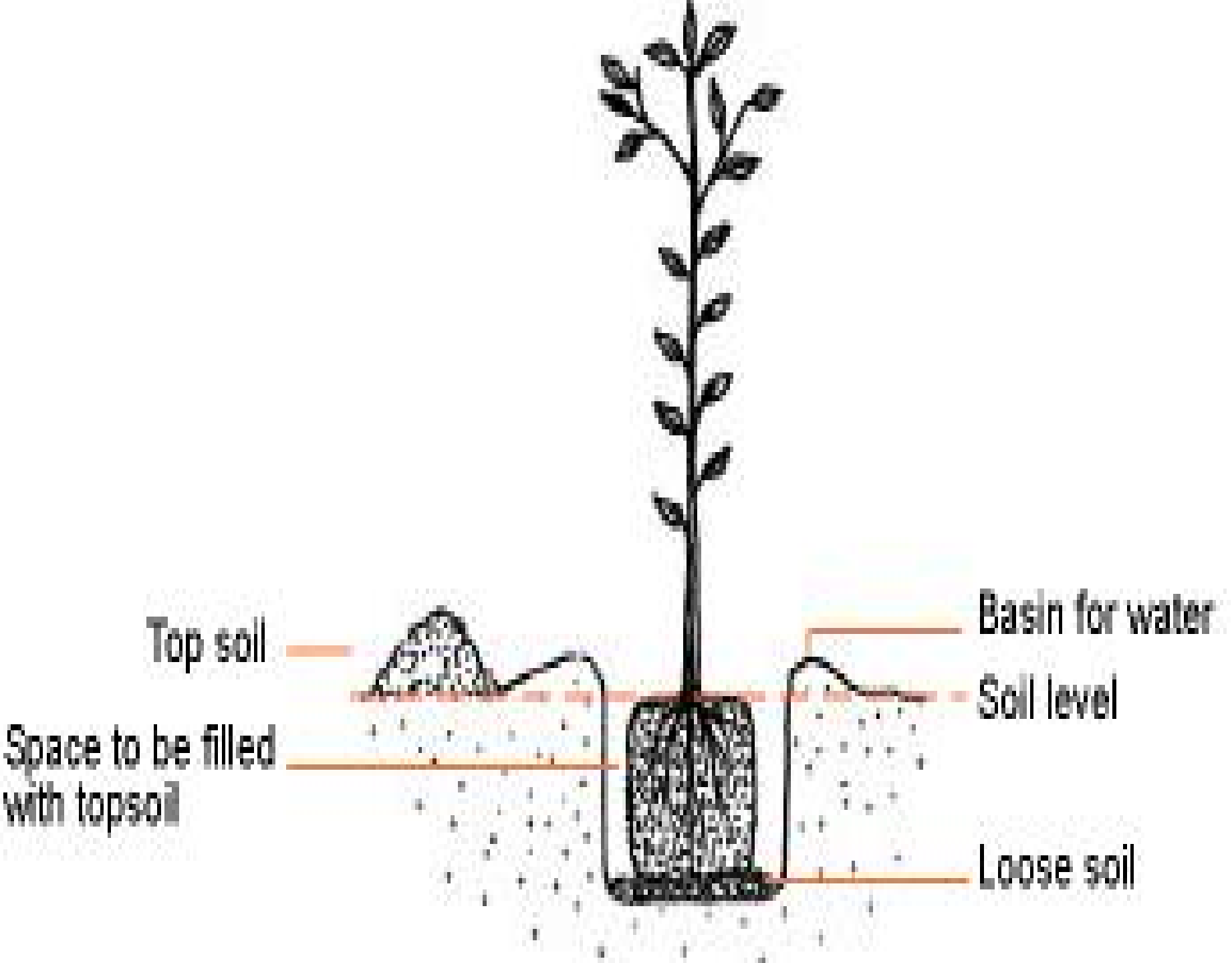
Orchard planting

- Fields are marked out with stakes, straws or gypsum prior to planting.
- Tree holes are dug by hand or with augur.
- Hand crews cost ½ as much as an auger, and can plant a tree every 30 to 40 seconds.



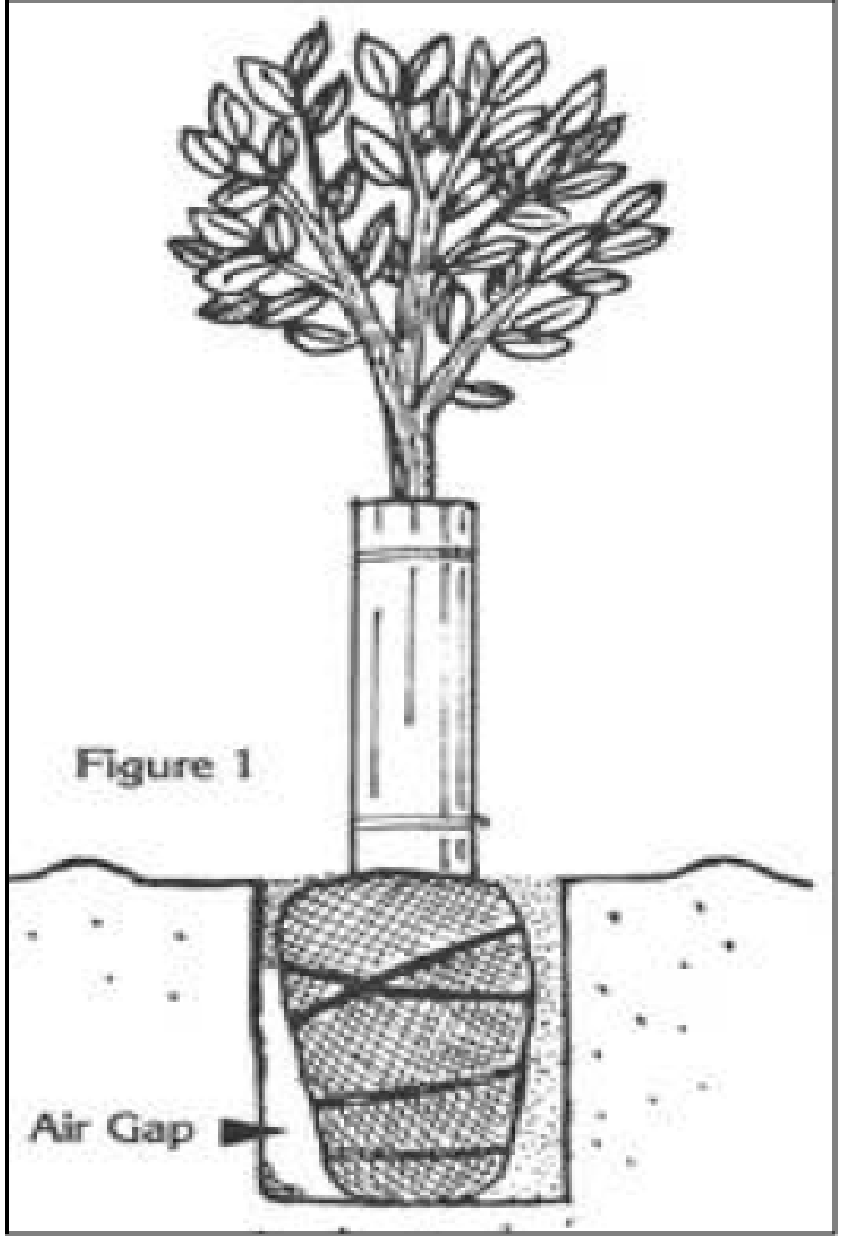
Orchard planting

- String around the trunk is cut, and burlap is pulled down over the shoulder of the root ball.
- Tree is placed in the hole at the same level as it existed in the nursery so as to avoid soil diseases and water loss from the root ball.
- Hole is refilled with soil.
- Tree is tamped down to eliminate air pockets.
- Field is irrigated.


Top soil
Space to be filled with topsoil
Basin for water
Soil level
Loose soil

Air Pockets and Wraps

- Check trees to see if they have air pockets
  - Probe soil around tree with a soil probe
  - If gaps exist, collapse the gap with a 4-foot long ¾ inch rod.
  - Irrigate again.
- Wrap tree trunk wrap
  - White, corrugated cardboard



Air gaps often occur when a tree is shovel planted due to the taper of the root ball.