Planting & Growing Info
Super-High-Density Evaluation

Super-High-Density Varietals & Orchards

Overview - This is adaped from a 2008 presentation by Dr. Joan Tous and is presented in tabular form for the convenience of the reader.

I. Overview

1. Traditional: 100 trees/ha
2. Intensive: 200-400 trees/ha (tall Vase); 500-700 trees/ha (central leader)
3. Super-High-Density: greater than 1.500 trees/ha

II. Details on Intensive & Super-High-Density

1. Intensive - Tree Shaker
   a. 200-400 trees/ha (tall free vase)
   b. Efficiency of tree shaker
      ii. training system
      iv. fruit removal force
      vi. harvest period
      viii. tree age
2. Intensive Integral - Collossus: 400-500 trees/ha (free vase or central leader)
3. Intensive - Lateral Hedge Harvesters: 600-800 trees/ha (central leader)
4. Intensive Orchards - Advantages
   a. Good Orographic & Edapho-climate Conditions
   b. Mechanization
   c. Medium-Low Crop Costs
   d. High Yields (Argequina, Picual, Leccino & others): 5,000 to 7,000 Kg/ha dry; 20,000 to 13,000 Kg/ha with irregation
   e. Good Economic Returns
   f. Medium to Long Economic Life

III. Hedgerow (Super-High-Density) Orchards

1. Greater than 1,500 trees/ha; Usual Layout: 4 Meters x 1.5 meters
2. Main Advantages of Hedgerow System
   a. Early Bearing
   b. High Yields in the First Years After Planting
   c. Integral Harvest Mechanization
   d. Fruit Harvesting Very Fast
   e. Good Oil Quality
3. Issues & Opportunities
   a. 40,000 ha Worldwide (65% in Spain)
   b. Irrigation Needs > 2,000 M^3/ha
   c. Plantation in Flat & Medium-Large Groves (> 15 ha)
   d. High Planting Costs & Higher Impact of Drought & Frost
   e. Mechanization of Orchards (Continuous Harvesters)
   f. Crop Management Problems (Pruning, Light Distribution & Diseases)
   g. Yields and Profits are Currently Being Studied
   h. Short Term Investment (~ 15 Years depending on Latitude)
   i. Issue of Replanting *versus* Rejuvination Pruning
4. Plant Material
   a. Few Cultivars with Compact & Medium-Low Vigor: Arbequina; Arbosana & Koroneiki
   b. Limited Published Results from Cultivar Trials: Godini et al. ('06); Leon et al. ('06); Tous et al. ('03 & '06)
   c. R & D In Progress to Reduce Olive Vigor
      i. Breeding Programs (IRTA, Univ. of Cordoba & others)
      ii. Dwarf Rootstock Selections (IRTA, CIFA Cordoba)
      iii. In Coming Years: First Clones of Empeltre Cultivar (Oil & Table Olives); Dwarf Rootstocks
5. Cultivar Trial: Tarragone (Catalonia)

Cultivar	Precosity (3rd yr) Kg/ ha	Ave Yield (3rd-6th yr) Kg/ha
Arbequina	6,800	8,600
Arbosana	5,400	7,200
Joanenca	2,900	6,300
FS-17	2,000	3,800

6. Central Leader Training Capability

a. Arbequina: Semierect Habitat, 3 M high by 1 M wide; row spacing 4 M (North-South)

b. Arbosana: Open Habitat; BRUCE I NEED HELP HERE

7. Rootstocks - Present Situation: Arbequina Vigor Can be Reduced by Using Rootstocks (Not Commerically Available)

8. Crop Management Problems

a. Very High Densities = Lower Light & Ventilation Levels Inside Canopy

b. < 10-20% Full Sunlight Distribution In the Canopy (July-October)

i. Decreased Flower Bud Initiation

ii. Decreased Fruit Set

iii. Decreased Fruit Size and Oil Content

c. Oil Quality: Changes Related to growing Area & Latitude

d. Fruit Changes Due to Plant Density (shading effects)

Height	Humidity	Oil db	Oil wb	Production
~ 3M	56.0	44.3	19.5	50%
~ 2M	57.6	39.2	16.6	48%
~.5 M	59.2	36.0	14.7	2%

9. Pests & Diseases

a. Verticillium

b. Gliphodes

c. Antracnosis (Colletotrichum spp)

d. Cercosporiosis (Pseudocercospora cladosporioides)

e. Olive Leaf Spot

10. Continuous Harvester Efficiency

a. Removed Fruit = 90% on Average Without Significant Differences Between Cultivars

b. Remaining Fruit on the Tree by Cultivar:Arbequina (~1%);FS-17 (~4%);Arbosana (~5%);Koroneiki (~7%)

c. Broken Branches (4th-5th yrs) per 100 trees by Cyltivar: Arbequina (10); Arbosana (17); FS-17 (30); Koroneiki (40)

d. Arbequina Potential yield (Kg/ha)

Orchard Year	Min Obs (Kg/ ha)	Mean Obs (Kg/ ha)	Max Obs (Kg/ ha)
3	5,000	9,000	17,000
4	5,000	10,000	17,500
5	7,000	13,500	22,000
6	6,500	7,900	12,000
7	5,000	9,500	13,800
8	9,000	9,700	10,000
9	8,000	9,000	10,000

11. Topping: First Cut After 5-6 Years, Then Again at 10 Years

12. Pruning Strategies in Mature Trees

a. Hand Pruning (Pneumatic Scissors)

b Topping and Hedge Mechanical Pruning

c. Mixed Hand (sides 6 feet high) and Mechanical (above 6 feet) Pruning

13 Fate of Orchard After 15 Years?

a. End of Investment?

b. Replanting. Soil Diseases?

c. Rejuvenation Pruning (Viability of Different Options Under Study)

- One Possibility is Full Row Removal at 10 Years: Go From 3 x 1.5 M to 6 x 1.5 M

IV. Economic Evaluation: Intensive vs Hedgerow (Super-High-Density)

1. Investment Costs: Intensive (300 trees/ha) = $4,500/ha; Hedgerow (2000 trees/ha) = $12,000 to $13,500/ha
2. Pruning Costs: Intensive (300 trees/ha) = 20-25 hrs/ha; Hedgerow (2000 trees/ha) = 40-50 hrs/ha (Pneumatic Scissors)
3. Harvest Costs

Type & Density (trees/ha)	Harvest Method	Cost ($/ Kg)	Harvest Rate
Intensive 300	Shaker + Umbrella	0.20 - 0.23	1 - 2 (ha/ day)
Intensive 600	Colosus	0.10 - 0.15	2 - 3 (ha/ day)
Hedgerow (Super High Density) 2000	Straddle Harvester	0.06 - 0.10	3 - 4 (ha/ day)

4. Economic Profitability
   a. Few Economic Studies Comparing Both Densities
   b. Initial Results
      i. Both Systems are Profitable - intensive has better financial indices
      ii. Hedgerow: Financial not Agronomic Criteria (greater interest in a fast & easy harvests vs. overall cost reduction)
      iii. Other Factors: Investment type; Orchard Size; Labor facilities

V. Summary: Intensive Orchards

1. All Cultivars
2. Medium-Long Economic Life (30 years)
3. Many Orchard Sizes
4. Easy Crop Management
5. Good Profitability
6. Use of New Lateral Hedge or Integral Harvesters
7. More Intensive Layoughts (400-600 trees/ha)
8. Mechanical Pruning
9. Integrated Pest & Disease Management

V. Summary: Hedgerow (Super High Density) Orchards

1. Compact, low to medium vigor, early bearing Cultivars (Arbequina, Arbosana and Koroneiki)
2. Soil Quality (Fair)
3. Short Term Investment (15 Years)
4. Replanting or Rejuvenation Pruning After ~ 15 years
5. Very High Planting Costs
6. Medium to Large Orchard Size with Irrigation
7. Straddle Harvester Availability
8. Oil Mill's Size related to Harvest Dimension
9. Crop Mangt & Global Returns Still Under Study (cultivars, densities, pruning, new harvesters, rootstoecks, etc.)
10. Investments Usually Not Related to the Agronomic Sector