



High Density Planting in Apple

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High Density planting in apple

High density planting (HDP) means to increase the plant population per unit area for increasing the production of fruit crops.

- To overcome low productivity and
- Long gestation period for early returns.



Types of High Density planting

- **Semi-intensive:** 500-1,000 trees/ha,
- **Intensive system:** 1,000 to 10,000 trees/ha
- **Super-intensive system:** 10,000 to 1,00,000 per ha.





Components of HDP

- Use of dwarf scion varieties;
- Adopting dwarfing rootstocks and inter-stocks;
- Efficient training and pruning,
- Use of plant growth regulating chemicals; and
- Suitable crop management practices.





Advantages of HDP

- **Best Utilization of land and resources;**
- **Quality production of fruit crops;**
- **Increase in yield per unit area,**
- **Easy for inter-cultural, plant protection and harvesting**
- **Obtain export quality of the harvest.**





HDP in Apple

There are 4 categories of HDP in apple

- **Low (less than 250 plants/ha),**
- **Moderate (250 to 500 plants/ha),**
- **High (500 to 1,250 plants/ha) and**
- **Ultra-high (more than 1,250 plants/ha) density.**

**Super high-density plantings or meadow orcharding
(20,000 to 70,000 plants/ha)**





Commonly used Rootstocks for HDP

Dwarfing/semi-dwarfing : M9, M26, M4, M7 and MM106

Meadow orchards: M27

Spur types: MM106 and MM109 for and M7 and

Non-spur types: MM111

For J&K: MM106





Promising spur varieties

- ❖ Starkrimson
- ❖ Red Spur
- ❖ Gold Spur
- ❖ Well Spur
- ❖ Oregon Spur
- ❖ Silver Spur
- ❖ Red Chief
- ❖ Bright 'N' Early
- ❖ Royal Gala
- ❖ Red Fuji



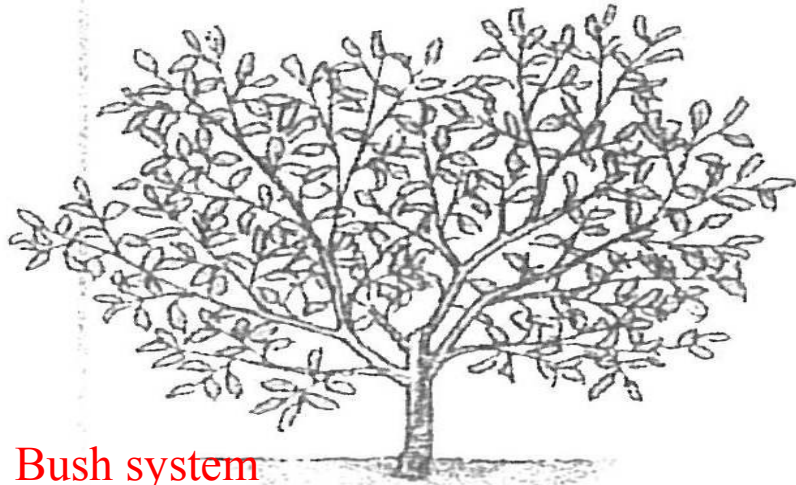


Training systems



- **Spindle bush**
- **Dwarf pyramid**
- **Espalier**
- **Cordon**
- **Palmette and**
- **Noored Holland Spindle bush**

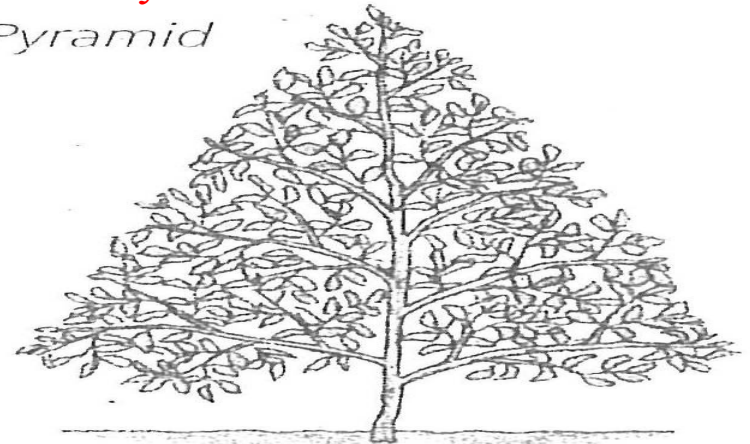
Training System for Canopy Management in HDP



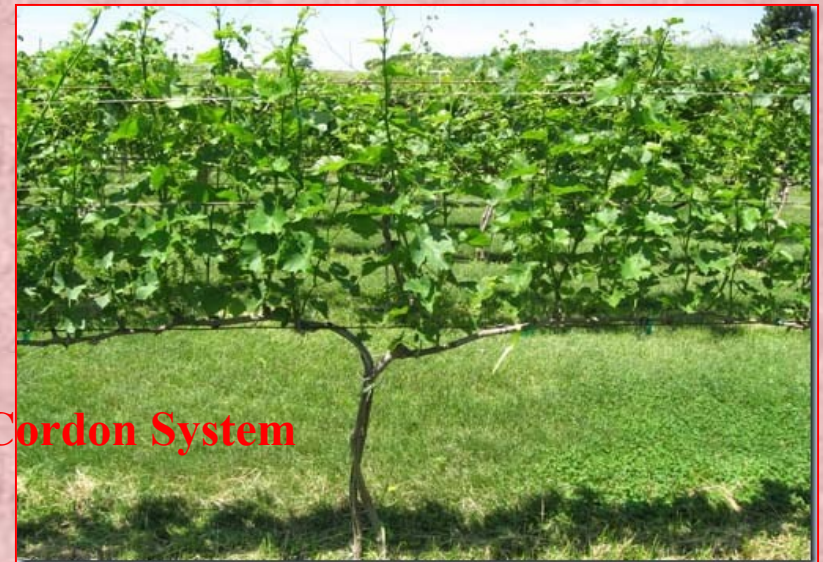
Bush system

Pyramid System

Pyramid

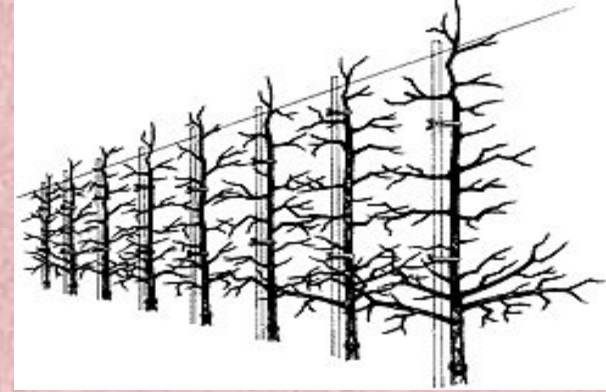


Espalier System



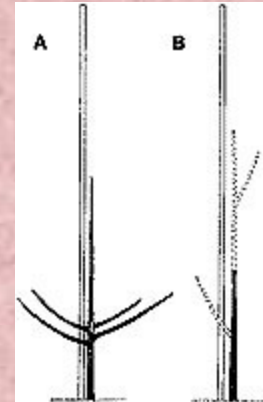
Cordon System

Vertical Axis in Apple



- 500-1000 trees/acre
- Dwarfing rootstocks
- Narrow pyramid shape with dominant central leader
- Max height of about 10'
- Few cuts made during the first few years 45

Vertical Axis: Planting Year

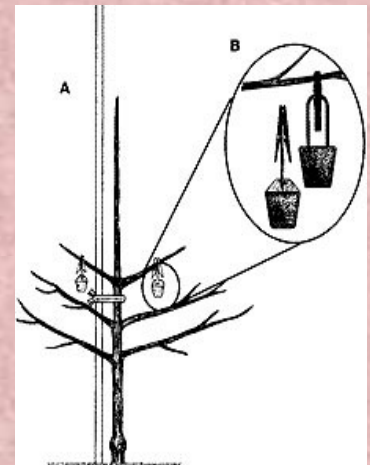


Ideal tree has 4 branches evenly spaced and central leader

- Remove any branches within 18" of soil surface
- Remove branches that are at a narrow angle or unevenly spaced around the leader
- Poorly branched tree (B) head leader and remove branches

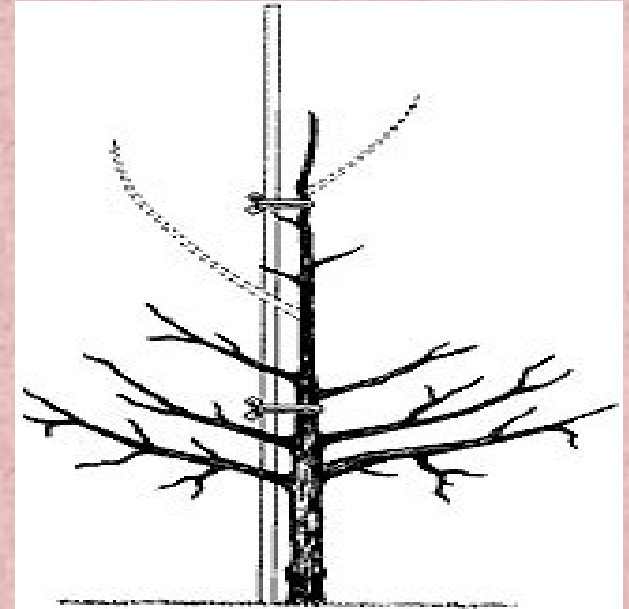
Vertical Axis

- ✓ In early July, any branches that are at less than a 60-degree angle from the central leader should be spread or tied down to this angle. Wire or plastic tree spreaders and other products are available commercially.
- ✓ When using cement weights, the branch initially should be weighted at slightly less than a 60-degree angle, since the branch angle will increase with time.
- ✓ Upright sprouts that were not spread during July should be removed later in the growing season or during dormancy. Tree weights can be removed from limbs any time after late August.



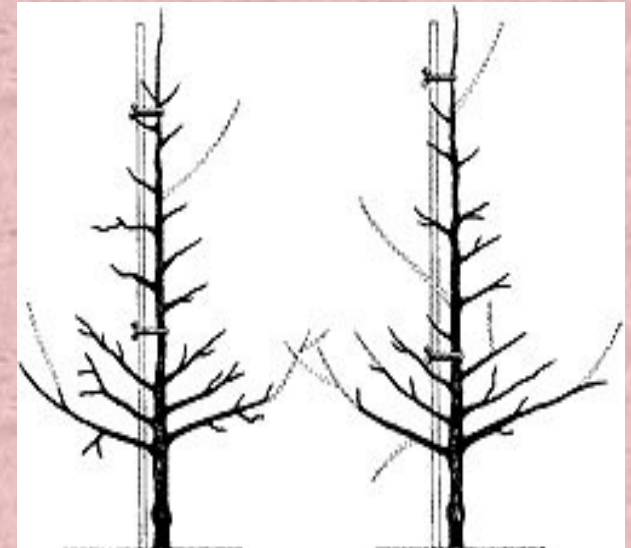
Vertical Axis: 2nd Year

- In early spring of the second growing season, remove vigorous shoots that compete with the central leader.



Vertical Axis: 3rd Year

- In the dormant season after the third year, prune the lower branches of adjacent trees that have grown together.



Tall Spindle in Apple

- 1000-1500 trees/acre
- Dwarfing root stock
- Early fruiting- 2nd and 3rd leaf
- No permanent wood! All scaffolds are renewed by complete removal when they become too big
- Upper branches bent below horizontal to devigorate 54

Tall Spindle: First Summer

- Pinch side shoots in upper $\frac{1}{4}$ of leader when shoots are 4-5" long
 - Re-pinch when regrowth is 4-5" long
- Tie leader to support system
- Train lower branches to below horizontal
 - Encourage flower production

Tall Spindle: 2nd Year

- ✓ Remove:
 - Branches competing with leader
 - Narrow angled branches
 - Large scaffolds(2/3 dia. of leader)
- ✓ Large branches=large trees
- Side branches longer than 2”

Tall Spindle: Year 3-5

- ✓ Bend top
- ✓ Limit height by cutting back to weak fruitful side branch
- ✓ Remove:
 - Branches larger than $\frac{3}{4}$ ” diameter
- ✓ Shorten older, pendant branches to a weak side branch or spur

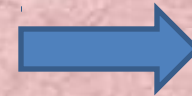
Choice and Utilization of Training Systems for HDP

- ❑ First of all satisfy the fundamental requirement of rational utilization of light. This condition is indispensable to achieve and maintain a balanced relation between the various parts of the canopy and to optimise tree productivity as well as fruit quality.
- ❑ The fundamental aim of any orchard system should be that of optimising photosynthetic efficiency and shifting assimilate partitioning to the growing fruits, as a function of the growth and production characteristics of the species or cultivar utilized.
- ❑ The theoretical concepts concerning light interception and distribution in canopies of different sizes have been widely applied in management of HDP in apple with a density of 3000-3500 or more trees/ha.

- **To meet the challenge of high productivity, optimization of growth parameters and minimization of the unproductive components of trees without sacrificing the overall health of the tree and quality of the product are required.**
- **The control of excessive vegetative growth in the tree for increased productivity is the major principle of high density orcharding.**
- **Therefore, controlling tree size by dwarfing rootstocks in high density orchards is one of the methods of increasing production.**

- **The training begins when the tree is first planted and continues throughout its productive life.**
- **Proper tree forms, branch angle and limb spacing in themselves aid in growth control.**
- **Once the tree is mature, excessive growth can be regularly removed by pruning to provide a short term or immediate benefit.**
- **Using growth regulators to reduce vegetative growth.**
 - **Gibberellins inhibitor reduce branch elongation in olive.**
 - **Growth inhibition may be followed by increased fruit-set.**

Tatura trellis, V planting system and Vertical Axe, are commonly used in super intensive peach planting systems. The high density of trees per hectare, canopy opening allow easy maintenance works.



Tatura trellis

V- PLANTING SYSTEM





Vertical Axe

Selecting Rootstocks for High Density Systems

Must be dwarfing rootstocks

❖ With vigorous scion cultivars

- **Dwarfing clone of M.9 or B.9 rootstock and/or greater planting distances.**
- **B.9 is a highly productive dwarfing stock that is similar in size to weak clones of M.9. (20-30% the size of seedling)**

❖ With weak scion cultivars

- **vigorous clone of M.9 rootstock should be used and/or closer planting distances.**
- **M.26 a highly productive dwarfing stock that produces a tree about 40% the size of seedling. M.26 remains very popular since it does well at intermediate densities.**

Use of Bioregulators in HDP

- ❑ Reduction of vegetative shoot growth in orchard trees has been obtained with different compounds such as chlormequat chloride, paclobutrazol, uniconazol etc.
- ❑ The general target for growth retardant compounds in many fruit trees species is to alter assimilate partitioning in favour of reproductive parts (flowers and fruits) at the expense of vegetative shoot growth by acting on endogenous gibberellin biosynthesis.
- ❑ Such compounds make it possible to reduce vegetative growth while at the same time also improving tree productivity and fruit quality.

❑ Interesting results have been obtained in peach with paclobutrazol: this compound not only allows significant reduction of shoot growth but also has positive influence over some qualitative characteristics of the fruit, such as greater size, better colour and soluble solids content.

❑ The retardants (Alar 2000 ppm, Ethrel 1000 ppm and a mixture of Alar 1000 ppm with Ethrel 500 ppm) greatly reduced the vegetative growth of Golden Delicious, Starkspur Golden Delicious and James Grieve.

❑ Diaminozide (Alar) and paclobutrazol (Cultar) were applied at different timings and concentrations. Instead of de-heading the trees every two years, as in the original meadow orchard system, shoot growth and cropping were controlled by growth retardants and light winter pruning.

THANK

YOU