

HIGH DENSITY PLANTING

- Pioneered for temperate fruits in Europe.
- First planted in Europe at the end of 1960.
- HDP is defined as planting at a density in excess of that which gives maximum crop yield at maturity if the individual tree grows to its full natural size.
- In other words, it is the planting of more number of plants than optimum through manipulation of tree size.

- HDP is one of the improved production technologies to achieve the objective of
 - enhanced productivity of fruit crops.
- Yield and quality of the produce - two essential components of the productivity.

- HDP aims to achieve the twin requisites of productivity by
 - maintaining a balance between vegetative and reproductive load without impairing the plant health.
- In India, HDP has been proved useful in many fruit crops e.g. Pineapple, banana, mango, apple and citrus.

Principle of HDP

- To make the best use of vertical and horizontal space per unit time and
- To harness maximum possible returns per unit of inputs and resources.

Advantages of HDP

- Induces precocity, increases yield and improves fruit quality.
- Reduces labour cost resulting in low cost of production.
- Enables the mechanization of fruit crop production.
- Facilitates more efficient use of fertilizers, water, solar radiation, fungicides, weedicides and pesticides.

Plant Architecture in HDP

- Fruiting branches-more and structural branches-minimum
- Arrangement – minimum shade on other branches.
- Plant architecture is influenced by
 - the method of propagation,
 - rootstock and
 - spacing.

Desirable Architecture of Temperate Fruit Plants

- Prevent upright growth and develop horizontal laterals.
- Space small laterals along the central leader.
- Develop and maintain fruiting spurs along entire branch as it develops.
- Develop rigid, strong, self supporting laterals.
- Maintain fruiting branches in one position.
- Develop fruiting spurs along the sides rather than top or bottom of lateral branches.

Factors Affecting HDP

- Cultivar
- System of Planting
- Planting material
- Nutrition and moisture
- Economics of production

Methods of HDP

- Control of tree size
- Planting systems

Tree Size Control

- Use of genetically dwarf scion cultivars
- Use of dwarfing rootstocks and interstock
- Training and Pruning
- Use of growth retardants
- Induction of viral infection
- Use of incompatible rootstock

Use of genetically dwarf scion cultivars

Crop	Genetically dwarf cultivars	Desirable features
Mango	Amarpalli	Precocious & tend to bear regularly
Papaya	Pusa Nanha	Dwarf & tend to bear at lower height
Banana	Dwarf Cavendish (AAA)	High yielding with dwarf stature
Apple	Spur varieties like Red Chief, Oregon Spur	Bear on short stem, spurs; grow to 60-70% of standard cultivars in vigour and bear more spurs and yield more
Cherry	Compact Lambert, Meteor and North Star	High yielding, self fruitful Dwarf
Peach	Redheaven	Dwarfing & high yielding
Sapota	PKM1 PKM3	Columnar tree shape Dwarf tree stature

Use of Dwarfing Rootstock

Crop	Dwarfing Rootstock
Apple	M9, M26, M27, Bud.9, P22 & Ottawa3
Pear	Quince C
Peach	Siberian C, St Julien X, Prunus besseyi and Rubira
Plum	Pixy
Cherry	Colt and Charger
Ber	<i>Zizyphus rotundifolia</i>
Citrus	Citrangquat, Feronia and <i>Severinia buxifolia</i>
Guava	<i>Psidium friedrichsthalianum</i> , <i>P. pumilum</i>

- Standard plantation on standard apple rootstocks (MM106) at 5x5 m accommodate 400 plants/ha,
- Non spur type cultivar on dwarf rootstock M9 spaced at 2 x 2 contain 2500 plants /ha.
- Spur apple cultivar on standard rootstock MM111 at 4 x 4 m and semi dwarf MM106 and M7 at 3x3m accommodate 1111 plants/ha.

Training and Pruning

- **Pruning -dwarfing effect on the tree.**
- **Slow growing trees respond more favourably to pruning and training and can be maintained at a given size and shape without sacrificing yield.**
- **Removal of apical portion - compact and bushy tree**
- **Mango, guava, litchi and most of the other fruit crops in India are evergreen and are seldom pruned.**

- **Pruning -to regulate crop in guava, ber and fig, and rejuvenation of old orchards in mango.**
- **Tree size control through pruning - limited to grape, apple and some other temperate fruits.**
- **Spindle bush raised on M9, M7 and M4 rootstocks -promising training system for HDP.**

Use of Growth Retardant

- **Commercially adopted are CCC, Ancymidal, Paclobutrazol , B-9 (Phosphon D) and chloramquat.**
- **Paclobutrazol - gained commercial application in crop regulation in mango**

Induction of Viral Infection

- Not adopted commercially,
 - tree size can be reduced by inducing viral infection
e.g. Citrus, apple .
- In apple, virus free rootstock series East Malling Long Ashton (EMLA) are vigorous than their infected counterparts.

Use of Incompatible Rootstocks

- Use of graft incompatible scion and stock also induces dwarfness.
 - not commercially exploited for this end.
- In ber, cultivars on *Zizyphus rotundifolia*, *Z. nummularia* induces dwarfness due to graft incompatibility

Planting Systems

- Aimed to achieve high assimilated production for its conversion into economic yield.
- Various planting systems adopted in fruit crops
 - square, triangular, quincunx, rectangular, hexagonal, hedgerow (single & double), paired planting and cluster planting.
- Square and triangular systems are followed
 - for HDP in mango, Kinnow, banana, papaya and
- Hedge row system in apple and pineapple in India.

Impact of HDP

- **In mango,**
 - **Amrapali at 2.5x 2.5m in triangular system accommodation of 1600 and**
 - **Dashehari at 3.0 X 2.5 m in square system -1333 plants per hectare,**
- **Increase in yield per hectare was 2.5 times in Amrapali than that of the low density orchards of vigorous cultivar.**
- **In Dashehari mango, the average yield in high density is reportedly 9.6 tonnes compared to 0.2 tonnes in low density planting.**
- **This yield can further be improved in alternate bearing cultivars like Dashehari , Chausa and Bombay Green through the application of growth retardant like Paclobutrazol.**

- In Citrus, Kinnow on Troyer Citrange and Karna khatta rootstocks could be planted at 1.8 x1.8.m and 3x3 m to accommodate 3000 and 1088 plants per hectare, respectively.
- In pineapple, population density of 63758 per hectare coupled with improved package of agrotechniques result in increase in yield from 15-20 to 70-80 tonnes/ha.

Constraints of HDP

- **Lack of standardization of production technology and extension of technical- know how to the farmers.**
- **High initial establishment cost.**
- **Lack of promising dwarfing rootstock in mango, guava, sapota, peach, sweet cherry etc.**
- **In apple, commercial utilisation of dwarf rootstocks for tree size control in HDP is restricted due to their poor anchorage, occurrence of sloppy, shallow and rainfed lands and low fertility.**
- **High incidence of some diseases in HDP e.g. Sigatoka leaf spot & finger tip in banana.**



High Density Apple Plantation

High density planting in Mango



A close-up photograph of two ripe, red apples hanging from a tree branch. The apples are the central focus, with a vibrant red color and a slight yellow-green tint at the bottom. The background is a soft-focus view of green leaves and branches, suggesting an orchard setting. The word "thanks" is written across the middle of the image in a stylized, black, serif font with a slight 3D effect and a drop shadow.

thanks