
A High Density and Ultra High Density Planting of Fruit Crops: A Novel Concept for Increasing Productivity

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Introduction

High Density and Ultra High Density planting is one of the novel concepts for increasing fruit productivity without affecting the quality of fruits. 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 method of planting of more plants than optimum through manipulation of tree size. India is the largest producer of fruits. India ranks second in fruits production in the world after China. The average productivity and per capita production of fruit crops is very low in India other than the developed countries. The main reasons behind low productivity are old and senile orchards, wider spacing, low yielding varieties, poor orchard management and inadequate technological up-gradation and adoption by the Subedi *et.al.*(2020). High density planting gives earlier production and return per unit area, shortens juvenility, eco-friendly, provides efficient land use and better use of resources like light, water and fertilizers, efficient pesticides application, besides, in this system the harvesting becomes easy (Peter *et.al.*(1975). High yield of fruit trees can be achieved by adopting improved cultivar, good rootstock, quality planting materials and better cultivation practices, the important factors for maximum fruit production may depend on the number of trees per unit area. Hence using of HDP and UHDP is the best option to increase

productivity and quality without affecting the plant and soil fertility (Robinson, 2007). HDP is one of the efficient production technologies to achieve the objective of enhanced productivity of fruit crops. Yield and quality of the produce are 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.

Principle of high density planting

- To make the best use of vertical and horizontal space per unit time.
- To harness maximum possible returns per unit of inputs and resources.
- Increased capture sunlight per unit area.
- Land use efficiency

Advantages of high density planting

- Best utilization of land and resources.
- Higher yield per unit area with quality fruits.
- Facilitate better utilization of solar radiation and increase the photosynthetic efficiency of the plant.
- Early economic returns.
- Induces precocity, increases yield and improves fruit quality.
- Reduces labour cost resulting in low cost of production.

Disadvantages of high density planting

- High initial establishment cost compare

to conventional system.

- Economic life span of the orchard becomes lower.
- Chance of reduction in fruit size and weight.
- Intercultural operation becomes difficult.
- Maintenance of plant architecture becomes a tedious job.
- Overcrowded growth of canopy results in build-up of high humidity, reduced cross ventilation in the orchard, which are conducive for more incidence of

pests and diseases. e.g., Sigatoka leaf spot & fingertip in banana causes hindering effect in HDP.

Approaches for establishing high density orchards

- HDP can be achieved with the suitable use of following components:
 - a. Dwarf scion varieties
 - b. Dwarfing rootstocks and inter-stocks
 - c. Training and pruning
 - d. Use of growth regulators
 - e. Suitable crop management practices

Traditional planting system Vs. HDP

| Sr. No. | Attributes | Traditional System | HDP/Meadow System |
|---------|--------------------|---|---|
| 1 | Tree numbers | Few large tree / ha | Many small tree / ha |
| 2 | Bearing | Start after two year | Start from 1st year |
| 3 | Production | Less | High |
| 4 | Labour requirement | More labour | Less labour |
| 5 | Management | Due to large tree size, difficult to manage | Due to small size of tree, easy to manage |
| 6 | Quality | Poor quality due to large canopy so less sunlight penetration | Good quality and colour development due to small canopy so more sunlight is penetrate and minimum insect damage |
| 7 | Production Cost | High | Low |
| 8 | Intercropping | Possible in early years when canopy is not dense | Not possible due to less spacing |

Use of Genetically Dwarf Scion Cultivars

| Sr. No. | Genetically dwarf cultivar | Desirable Features |
|---------|---|--|
| Mango | Amrapalli | Precocious and regular bearing cultivar |
| Papaya | Pusa Nanha | Dwarf cultivar |
| Sapota | PKM 1 and PKM 3 | Dwarf columnar tree shape |
| Apple | Spur variety like Red Chief and Orange spur | Bear on short stem, spur; bear more spurs and yield high |
| Cherry | Compact and Lambert | High yielding, Self fruitful and Dwarf |
| Peach | Red Heaven | Dwarfing and high yielding |

Source: (Singh, 2018)

Use of Dwarfing Rootstock

| Crop | Dwarfing rootstock |
|--------|--|
| Apple | M9, M26, M27 (Ultra dwarf) |
| Ber | <i>Zizyphus rotundifolia</i> |
| Citrus | Trifoliolate orange, Sour orange, Citranges |
| Guava | <i>Psidium friedrichsthalianum</i> , <i>P. pumilum</i> , Aneuploid - 82 |
| Mango | Vellaikolumban for Alphonso, Olour for Himsagar and Langra |
| Cherry | Colt, Charger |
| Peach | Siberian C, St Julien X |
| Pear | Quince C |
| Plum | Pixy |

Source: (Goswami, Jai & Singh, 2014; Singh, 2018)

Use of growth regulators

- Use of Bio-regulators can prolong dormancy, reduce vegetative growth, delay flowering, reduce fruit drop etc.
- Commercially adopted Growth retardants are CCC, Ancymidal, Paclobutrazol, B-9 (Phosphon D) and Chloramquat. Paclobutrazol have gained commercial application in crop regulation in mango.
- Tree size can be reduced by inducing viral infection e.g. Citrus, apple, but not adopted commercially. In apple, virus free rootstock series East Mailing Long Ashton (EMLA) are vigorous than their infected counterparts.

Plant Architecture in HDP

- Plants for high density should have more number of Fruiting branches and minimum number of structural branches.
- These branches should be so Arranged and sized that each branch cast minimum

shade on other branches.

- Plant architecture is influenced by the method of propagation, rootstock and spacing.

Methods of HDP

- High density can be achieved by close planting which in turn is made possible through Control of tree size or planting in a system which accommodates more number of plants.
- Manipulation of tree vigour is an important prerequisite for success of high density planting in any fruit crop.
- High density of fruit orchards is generally achieved by controlling the size of tree or through improved planting system.

Impact of HDP

- In India the concept of High density orcharding in Mango took practical shape after the development of the dwarf and regular mango hybrid Amrapali at IARI, New Delhi and dehorning technique developed at the GBPAUT, Pantnagar.
- In mango, Amrapali at 2.5 X 2.5 m in triangular system accommodation of 1600 plants 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.

Spacing at different planting system of fruit crops

| Sr. No. | Crops | Traditional Spacing (m) | HDP Spacing (m) |
|---------|--------|-------------------------|-----------------------|
| 1 | Mango | 7.5 × 7.5 - 12.5 x 12.5 | 3.0 x 2.5 – 5.0 x 5.0 |
| 2 | Banana | 2 × 2 – 2 × 3 | 1.5 × 1.5 – 1.8 × 1.8 |
| 3 | Papaya | 2 × 2 – 3 × 3 | 1.8 × 1.8 |
| 4 | Sapota | 10 × 10 | 5 × 5 |
| 5 | Guava | 6 × 6 – 8 × 8 | 3 × 3 – 3 × 1.5 |
| 6 | Aonla | 10 × 10 | 5 × 5 |
| 7 | Citrus | 6 × 6 – 8 × 8 | 3 – 6 × 3 – 4.5 |
| 8 | Apple | 10 × 10 | 3 × 0.75 |

Source: (Singh, 2018)

Conclusion

Though HDP and UHDP have various advantages in much crop production but commercial adoption at farmer's orchard is still lacking. HDP and UHDP give maximum production per unit of area due to maximum number of tree. Hence, it is essential to maintain HDP and UHDP orchard by using various techniques like pruning of trees to develop proper plant architecture and annual canopy management for proper light interception. Use modern training system especially in temperate fruit crops for maintains shape and size of canopy for quality fruit production.

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