

High Density Planting System in Fruit Crops

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SUMMARY

High density planting is defined as accommodation of the maximum possible number of plants per unit area to get the maximum possible profit per unit of the tree volume without impairing the soil fertility status. It gives high yields in the early periods of the orchard along with ease in its management. It concept increasing productivity without affecting quality of fruits. Under HDP has been found most suitable technique for some tropical and subtropical fruits accommodating more number of plants per unit area viz., Dashehari mango (1333 plants/ha), guava (5000 plants/ha), papaya (6400 plants/ha), etc.

INTRODUCTION

India is the second largest producer of fruits in the world. The average productivity of fruits in India is low as compared to many developed countries. The main reasons for low productivity are old and senile orchards, poor orchard management, low yielding varieties, wider spacing and inadequate technological up-gradation and adoption by the growers. Land availability for agriculture is reducing due to urban development and the demand for fruits is increasing. It is necessary to achieve higher productivity of fruit crops from limited space. The tall trees require heavy machinery and equipment for spraying of pesticides. For efficient use of horizontal and vertical space, HDP technologies have been developed in mango, citrus, papaya and guava. Planting of fruit trees rather at a closer spacing than the recommended one using certain special techniques with the sole objective of obtaining maximum productivity per unit area without sacrificing quality is often referred as 'High density planting' or HDP. In this system, four planting densities are recognized for apples viz., low HDP (< 250 trees/ha), moderate HDP (250-500 tree/ha), high HDP (500 to 1250 trees/ha) and ultra-high HDP (>1250 trees/ha). This technique was first established in apple in Europe during sixties and now majority of the apple orchards in Europe, America, Australia and New Zealand are grown under this system. Recently, super high density planting system has been also established in apple orchards with a plant population of 20,000 trees per ha (Usha *et al.*, 2015). In HDP, trees should have maximum number of fruiting branches, structural branches and generally trained with a central leader surrounded by nearly horizontal fruiting branches. The success of this technology in most of the fruit crops is dependent on the use of methods to control shoot growth and maximize light interception as the trees begin to bear fruit (Menzel and Lagadec, 2014).

Principle of HDP

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

Status of High Density Planting in Fruit Crops

In mango, Amrapali at 2.5 x 2.5 m in triangular system accommodation of 1600 plants and Dashehari mango at 2.5 m x 3 m (1,333 plants per ha) was raised under HDP with pruning and dehorning after the harvesting followed by paclobutrazol application and yield was secured every year. In Citrus, Kinnow on Troyer Citrange and Karna khatta rootstocks could be planted at 1.8 x 1.8.m and 3 x 3 m to accommodate 3000 and 1088 plants per ha, respectively. In pineapple, population density of 63, 758 per ha coupled with improved package of agro techniques result in increase in yield from 15-20 to 70-80 t /ha. Pusa Nanha papaya may be planted at a distance of 1.25 x 1.25 m (6,400 plants per ha). Similar observations have been made by various workers in citrus, litchi, banana and pineapple (Mishra and Goswami, 2016). In an experiment in guava was standardized at CISH,

Lucknow. The ultra high density orchard system of guava accommodates 5000 plants per ha with spacing of 2.0 x 1.0 m and managed with regular topping and hedging during initial stages which helped in controlling tree size and getting higher yield (Singh, *et al.*, 2007). In India, high density plantings have successfully been demonstrated in guava (Lal *et al.*, 2007), litchi (Mishra *et al.*, 2014), mango and papaya (Ram, 1996).

Components of HDP

HDP can be achieved with the suitable use of following components:

- Dwarf scion varieties
- Dwarf rootstocks and inter-stocks
- Training and pruning
- Use of growth regulators
- Suitable crop management practices

Use of Genetically Dwarf Scion Varieties

The use of dwarf scion varieties is easier to establish high density orchards if the trees are naturally small. It offers great scope for close plantings, which have the potential for higher yields and returns than traditional plantings.

Table:1 Dwarf Scion Varieties

Crop	Dwarf Cultivar	Desirable Characters
Banana	Dwarf Cavendish	Dwarf stature with high yield
Guava	Pant Prabhat	Less spreading and high yielder
Litchi	Calcuttia, China	Upright tree growth habit
Mango	Amrapali, Arunika	Precocious and regular bearer
Papaya	Pusa Dwarf, Pusa Nanha	Bears at lower height
Peach	Red heaven	Dwarfing & high yielding
Sapota	PKM-1, PKM-3	Dwarf stature

Use of Dwarfing Root Stocks

Root stocks are known to have a profound effect on the tree vigour, precocity, quality of fruits, productivity and longevity of varieties grafted on them. Dwarfing can be due to the rootstock or the scion, or both. Attempts have made to standardize dwarfing rootstocks especially in the fruit crops like ber, citrus and grape.

Table:2 Dwarfing Rootstock

Crop	Dwarfing Rootstock	Crop	Dwarfing Rootstock
Mango	Vellaikolumban (Alphanso), Olour (Himsagar and Langra)	Pear	Quince C
Gauva	Pusa srijan, <i>Psidium friedrichsthalianum</i> , Aneuploid-82	Ber	<i>Zizyphus rotundifolia</i> , <i>Z. nummularia</i>
Citrus	Trifoliolate orange, Sour orange, Flying Dragon	Plum	Pixy
Apple	M4, M7, M9, M26, MM106, M27 (Ultra-dwarfing)		

Training and Pruning

Training and Pruning are effective tools in HDP by virtue of their impact on shape and size control of the tree. Overcrowding poses a serious problem for orchard access and for adequate light interception needed for optimum photosynthesis, flowering and fruit set and quality. Attempts have been made by various workers on the use of pruning for canopy management in high density orchards (Sharma and Singh, 2006; Nath *et al.*, 2007). The training begins when the tree is first planted and continues throughout its productive life. Proper tree forms, branch angle and limb spacing in it aids in growth control. Pruning is applied to regulate crop in guava, ber and fig, and rejuvenation of old orchards in mango. Tree size control through pruning is limited to grape, apple and some other temperate fruits.

Use of Growth Regulators

Use of growth regulators to prolong dormancy, reduce vegetative growth, delay flowering and reduce fruit drop etc. Plant growth regulators such as Paclobutrazol, Alar, Uniconazole, prohexadione-calcium have been used to restrict vegetative growth. Paclobutrazol have gained commercial application in crop regulation in mango. September to November treatment was highly effective in increasing flowering and fruiting besides reducing vegetative growth (30-35%).

Adoption of Suitable Crop Management Practices

In HDP adoption of suitable crop management practices such as mulching, fertigation, organic farming, Integrated Nutrient Management (INM) and Integrated Pest Management (IPM) are important for care and maintenance of plants.

Advantages of HDP

- It induces the precocity
- Low cost per unit production
- Enhanced fruit yield and quality
- Enables mechanization in fruit crops
- Early economic returns
- Efficient use of applied and natural resources

Disadvantages of HDP

- Effective canopy management appears to be the largest barrier to success of high-density orchards.
- In long run, it results in heavy competition for space, nutrients and water.
- Overcrowded growth of canopy results in buildup of high humidity, reduced cross ventilation in the orchard, which are conducive for more incidence of pests and diseases.
- Chances of reduction in fruit size and weight.

CONCLUSION

HDP gives higher yield as well as returns/unit area due to increasing the no. of trees/unit area. It is possible by regular pruning and use of bioregulators for develop proper plant architecture and annual canopy management. Besides, providing optimum irrigation through drip to replenish moisture loss through evapotranspiration and proper fertigation practices to provide balanced vegetative growth and fruiting, are highly essential so as to get higher yield. If these practices are followed, the management of pests and diseases would be very effective.

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