

## High Density Planting in Fruit Crops

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### Introduction

HDP is one of the important methods to achieve high productivity per unit area both in short duration and perennial horticultural crops. High Density Planting (HDP) is a very intensive form of fruit production which has high relevance to the food and nutritional security of our ever-increasing population (Anon. 2010). 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. 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). 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). Plant density needs to be designed to intercept and distribute the solar radiations effectively keeping in view the climatic conditions, cultivar, planting system and management practices. It aims to achieve the objective of enhanced productivity in both qualitative and quantitative aspects.

### 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.

### High Density planting in fruit crops

High density planting technique is a modern method of fruit cultivation involving of fruit trees densely, allowing small or dwarf tree with modified canopy for better light interception and distribution and ease of mechanized field operation. HDP gives higher yield as well as return/ unit area. It is possible by regular pruning and use of bio regulators for maintaining the size and shape of the tree. It is well known that the diversity in soil and climate conditions in India permits growing of a large variety of Tropical, Subtropical and Temperate fruits in different regions, due to which India is regard as a horticultural paradise. In recent years, the concept of fruit production is undergoing a change where emphasis is being given to higher production per unit area. High density planting system is the fastest way of reducing the gestation period and increasing the productivity of the orchards. The choice of the system of planting in the orchard depends on topography, crop variety, plant density, production technology to be followed.

#### Spacing at different planting systems in fruit crops:

Sr. no.	Crop	Normal spacing (cm)	HDP spacing (cm)
1.	Mango	7.5×7.5 - 12.5×12.5	3×2.5 - 5×5
2.	Banana	2×2 - 2×3	1.5×1.5 - 1.8×1.8
3.	Citrus	6×6 - 8×8	3 - 6×3 - 4.5
4.	Papaya	2×2 - 3×3	1.8×1.8
5.	Guava	6×6 - 8×8	3×3 - 3×1.5
6.	Sapota	10×10	5×5
7.	Aonla	10×10	5×5
8.	Apple	10×10	3×0.75

#### 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

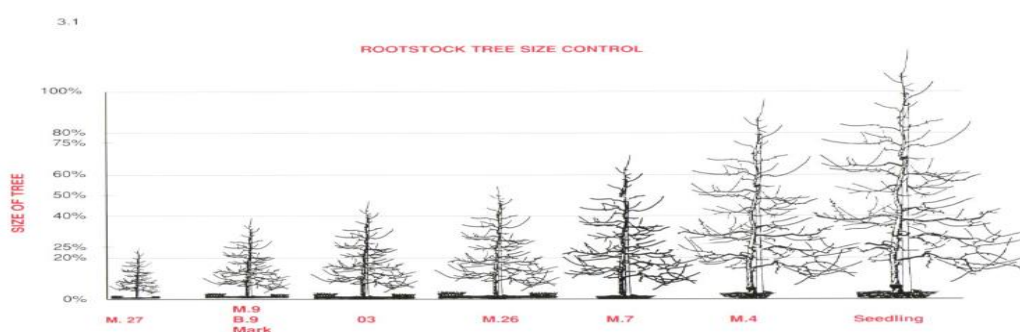
#### Use of Dwarf scion varieties

Crop	Dwarf cultivar	Desirable characters
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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
Sapota	PKM-1, PKM-3	Dwarf stature
Apple	Red spur, Star Crimson Spur, Gold Spur, Well Spur, Oregon Spur, Silver Spur, Red Chief, Hardi Spur	Bear on short stems, grow to 60-70 % the standard cultivar in vigour and bears more spurs and yield more
Peach	Red heaven, Candor	Dwarfing and high yielding
Cherry	Compact lambert Meteor and North star	Hihg yielding, self-fruitful Dwarf

#### Adopting dwarfing rootstocks and inter-stocks

Crop	Dwarfing rootstocks
Ber	<i>Zizyphus rotundifolia</i> , <i>Z. Nummularia</i>
Citrus	Troyer citrange, Flying Dragon ( <i>Poncirus stri foliata</i> ), Karna Khatta
Guava	<i>Psidium friedrchsthalianum</i> , <i>P.chinensis</i> , Pusa Srijan
Mango	Vellai kullamban
Apple	M9, M26, M27, Bud. 9, Bud. 146
Plum	Pixy
Pear	EM Quince A& C
Peach	Siberian C, St Julien X, P. Besseyi and Rubria
Cherry	Colt, Charger and Rubria
Sweet cherry	Mahaleb, Colt, CAB 6-P, CAB -11E, F 12/1, GM-61/1, G-258, F-283, MM 1/5413, GM-9, GM-61
Almond	Hansen-2168, GM-677, GF-556, Istara
Apricot	Citation, Istara, Torinel, Myrobalan

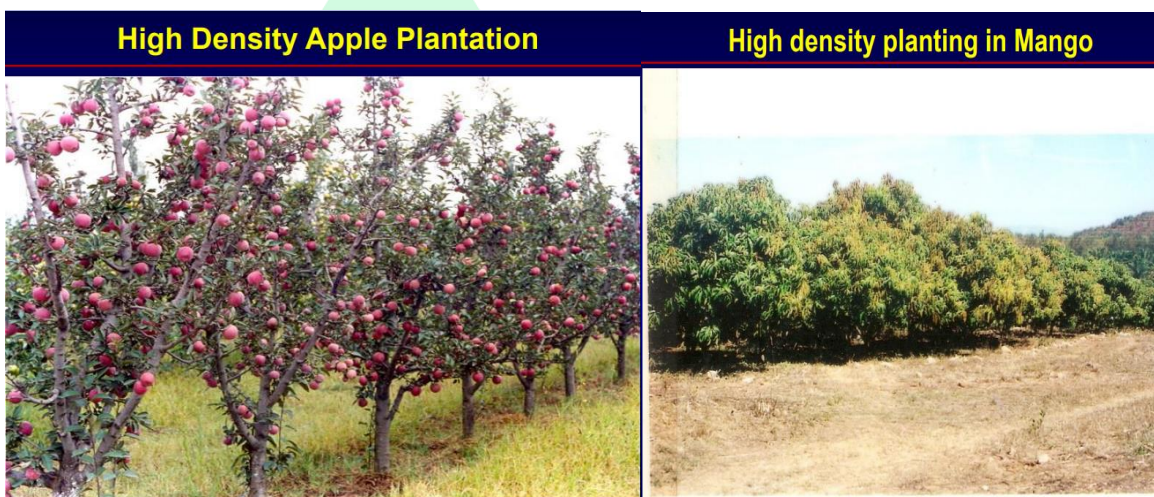
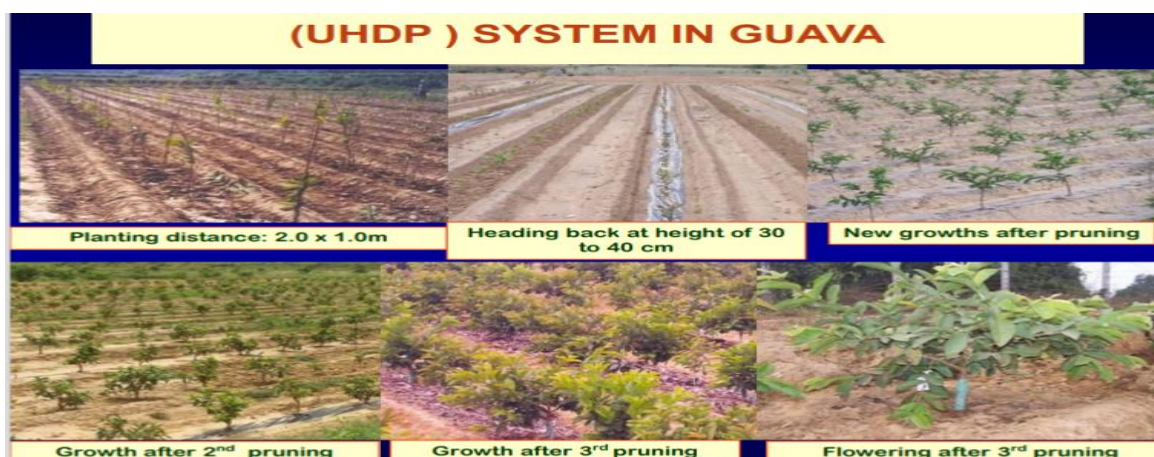


### Training and Pruning system:

Crops	Training Systems
Apple	Espalier, Cordon, Spindle bush, Oblique palmette, Trellis, Vertical axis, Slender spindle
Pear	Lincoln canopy, Free standing tree, Pyramid, Spindle bush, Palmette, Tatura trellis
Peach	Tatura trellis, Central leader, Open centre, Modified leader, Pillar, Belgium Fence, Hedgerow and Meadow
Plum	Hedge row, Central leader, Open central, Tatura Trellis, Lincoln canopy, Vase palmette.
Cherries	Central leader, Free spindle, Tatura trellis
Apricot	Free spindle, Bent canopy, Vase palmette, Kecheмент hedge and wedger hedge.

### Use of plant growth regulators

The lack of appropriate rootstocks for growth control in some fruit crops such as cherry, plum and peach makes chemical growth regulation an attractive possibility in modern orchard systems. Growth regulators such as daminozideethephon, chlormequat and paclobutrazol have been used to reduce shoot growth by 1/3 to 1/2 (Steffinset *al.*, 1983; Miller, 1988). This was followed by increased flowering in the subsequent year and may be useful in encouraging earlier commercial fruits production in strongly vegetative, sparingly fruitful young trees (Volz and Knight, 1986; Miller, 1988). Paclobutrazol helps in reducing juvenile phase, checks vegetative growth and induces FBD and spur development.



### Estimated cost and return from traditional and high density planting in mango

Particular	Traditional system traditional varieties	High density planting
Spacing (m x m)	10 x 10	2.5 x 2.5
No. of plants/ha	100	1,600
Cost of establishing orchard (Rs.)	35,000	75,000
Annual maintenance cost (Rs.)	25,000	40,000
Age of stable yield (year)	8 to 10	7 to 8
Production (kg/ha)	6,000 to 8,000	16,000 to 19,000
Sale of produce (whole sale) @ Rs. 9.0 per kg	54,000 to 72,000	1,44,000 to 1,71,000
Net return (Rs.)	29,000 to 47,000	1,00,000 to 1,30,000

**Estimated cost and return from traditional and high density planting in Papaya**

	<b>Traditional system traditional varieties</b>	<b>High density planting</b>
Spacing (m x m)	2.4 x 2.4	1.25 x 1.25
No. of plants/ha	1,736	6,400
Cost of establishing orchard (Rs.)	40,000	75,000
Annual maintenance cost (Rs.)	25,000	50,000
Age of stable yield (year)	2	2
Production (kg/ha)	45,000 to 50,000	80,000 to 90,000
Sale of produce (whole sale) @ Rs. 9.0 per kg	2,25,000 to 2,50,000	4,00,000 to 4,50,000
Net return (Rs.)	1,60,000 to 1,85,000	2,75,000 to 3,25,000

**Estimated cost and return from traditional and high density planting in Guava**

<b>Particular</b>	<b>Traditional system</b>	<b>High density</b>
Rootstock	Allahabad Safeda	PusaSrijan
Spacing (m x m)	6 m x 6 m	3 m x 3 m
No. of plants/ha	278	1,111
Cost of establishing orchard (Rs.)	35,000	50,000
Annual maintenance cost (Rs.)	20,000	40,000
Age of stable yield (year)	5	4
Production (kg/ha)	8,000 to 12,000	16,000 to 18,000
Sale of produce (whole sale) @ Rs. 9.0 per kg	64,000 to 96,000	128,000 to 1,44,000
Net return (Rs.)	56,000 to 84,000	1,12,000 to 1,26,000

**Conclusion**

HDP and meadow orcharding gives higher yield as well as returns per unit area due to increasing the number of tree/unit area. Generally, for successful high density plantings, the package of different components viz., cultivars, rootstock, canopy management, floor management, irrigation and nutrition management, orchard planning and layout are to be

adopted as per the available natural resources, agro-climatic and soil conditions and judicious use of inputs. It is possible by regular pruning and use of bio regulators for maintaining the size and shape of the tree. Mango planted at spacing of 5m x5m (Kesar and Alphonso) and 3m x 1m (Keit) gives higher yield under high density and meadow, respectively. Guava planted at spacing 2.5m x2.5m and 3m x6m under HDP and 2m x 1m under meadow gives higher production as well as more income in Allahabad Safeda and L-49. Citrus gives higher production when planted at 6m x 3m spacing under HDP. For HDP in banana is planted at 1.0m x 1.2m spacing gives better yield in cv.Rajapuri. So, the HDP is present need as per increasing population and decreasing agricultural area.

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