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High Density and Meadow Orchard Planting System in Fruit Crops

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SUMMARY

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 evapo-transpiration 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.

INTRODUCTION

High density planting technique is a modern method of fruit cultivation involving the planting of fruit trees densely, allowing small or dwarf trees with modified canopy for better light interception and distribution and ease of mechanized field operation. HDP gives higher yield as well as returns/unit area due to increasing the no. of the trees/ unit area. It is possible by regular pruning and use of bio regulators to maintain 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.

Principle of HDP

- To make the best use of vertical and horizontal space per unit time.
- Increased capture of 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.

Spacing at different planting systems 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).

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.	Apple	10×10	3×0.75
3.	Aonla	10×10	5×5
4.	Guava	6×6 - 8×8	3×3 - 3×1.5
5.	Sapota	10×10	5×5
6.	Banana	2×2 - 2×3	1.5×1.5 - 1.8×1.8
7.	Citrus	6×6 - 8×8	3 - 6×3 - 4.5
8.	Papaya	2×2 - 3×3	1.8×1.8

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
- Suitable crop management practices
- Use of bio-regulators
- Planting density
- Planting geometry
- Mechanization

Use of genetically dwarf scion cultivars

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
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:

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.

Crop	Dwarfing rootstocks
Ber	*Zizyphus rotundifolia*
Citrus	Troyer citrange, Flying Dragon (*Poncirustri foliata*), Karna Khatta
Cashew Nut	Anacardium pumilum
Guava	*Psidium friedrchsthalianum*, *P.chinensis*, Pusa Srijan
Mango	Olour,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, G
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, Kechement hedge and wedger hedge.

Suitable crop management practices

In high density planting 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.

Use of bio-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%).

- Prolonging dormancy
- Reducing vegetative growth
- Flowering
- Reducing fruit drop

Planting density

Even though a small canopy with a high number of well illuminated leaves are efficient in photosynthesis, but it is very poor in light interception, which leads to low potential yield per hectare. Light interception could be improved by increasing tree density. An optimum tree density is the level of density, which is required to facilitate optimum light distribution and interception leading to high photosynthesis. As a result, yield per hectare is maximized. An optimum light interception is a factor of plant form, planting density, tree arrangement and leaf response to light for photosynthesis. Optimum light interception can be defined as a level of light intercepted by an orchard system above or below which, the economic yield will be reduced.

Planting geometry

Planting system is a combination of tree arrangement and plant form. Tree arrangement in HDP system must have sufficient alleyways for movement of farm machinery. The way trees are arranged also determines the light distribution pattern and light interception level. Single hedge row and double hedge row system and square b system having enough alley space is being practiced in developed countries for HDP.

Mechanization

Another component in high density fruit planting is the system automation, which contributes to high production. One of the important farm operations that can be automated is irrigation and fertigation vis-à-vis indiscriminate mechanical. In fact, irrigation and fertigation have been identified as one of the key factors for the success of high density orchards. The plant should not be kept under stress after pruning therefore, assured irrigation coupled with fertigation is
essential after pruning and during fruit development in high density orchards.

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.

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