CHAPTER
12

ORCHARD REJUVENATION AND HIGH DENSITY PLANTING

OBJECTIVES

After reading this chapter, students will be able to:

- Understand the necessity for rejuvenation of orchards
- Know the technology of rejuvenation of orchards
- Understand the importance of high density planting and its advantages
- Tell the basic approached adopted for high density planting in different fruit crops

INTRODUCTION

While going on a long drive through a village, you & might have seen acreage and acreage of fruit plantation. Some of them must be in good conditions while others might be declining. Some must be very old while other may be in initial years of bearing. Similarly, some plantations must be little dense (closely planted) while others may be at normal planting distance. You might have observed that most of fruit plant orchards start declining after bearing certain fruitful life. Such old orchards bear low yield of poor quality. However, such orchards can be made fruitful by rejuvenating them scientifically. Similarly, due to non-availability of good land for fruit cultivation, trend has shifted to grow fruit in high density planting system. For this system, several techniques are used. In this chapter, you will come to know about the importance of rejuvenation in fruits, methods of rejuvenation, concept of high density in fruits and different approaches used for high density planting in India and abroad.

Rejuvenation of old orchards

Points to remember

- Most of fruit orchards in India are very old, and declining and produce low yield of poor quality. Such orchards can be made productive by 'rejuvenation'.
- Rejuvenation technology involves heading back of branches of declining tree and grafting or budding of selected branches with a desirable variety.

Despite the country being the second largest producer of fruits in world, the per capita consumption of fruits is one of the lowest in the world. The existing orchards are not able to meet the present requirements of the country. In fruit crops, the majority of the older plantations are of seedling origin embodying non-descript material and poor genetic potentiality, which become senile. In several areas, plantations of varieties having good genetic potentiality have either gone unproductive or showing marked decline in productivity. This is the outcome of over-crowded and intermingling of large branches and meager foliage, allowing poor light availability to growing shoots within the canopy. This renders them uneconomical. Such exhausted fruit trees can be rejuvenated by heading back of old declining mango orchards branches in winter for the production of new shoots, which can bear good crops in the years to come. The term 'rejuvenation' means renewal or making new or young again. As applied to the orchard tree, it would mean restoring the productive capacity of the fruit trees.

There are two approaches to rejuvenate an old orchard:

Canopy management: It is applicable in plantation of commercial varieties, where the canopy has become over crowded resulting in reduction in yield.

Top working: It is followed in older plantations of seedling origin, which have become senile. It is achieved

by top working by grafting (budding) with scion of superior varieties to upgrade seedling plantation with superior commercial varieties.

Old declining mango orchard

Heading back of branches

Technology for rejuvenating senile orchards

In several old fruit orchasds, there is a tendency of over lapping of canopy between 10 and 12 years of age depending on the nature of variety unless the canopy is maintained by trimming overlapping branches that lead to decline in yield in later years. Such plantation can be rejuvenated through canopy redevelopment. The redevelopment of canopy is necessary in older plantations, when the canopies are overcrowded, resulting in reduction in yield. This is possible by hedging of branches followed by shoot management to modify the tree structure and maintain canopy size.

Emergence of new growth in beheaded branches

The rejuvenation technology involves heading back (topping) of branches during December-January at a height of 2.5 to 3.0 m from the ground level in crops like mango and *aonla*. Before rejuvenation pruning, branches are marked with white chalk by making a ring around the branches. The cut portion of the branches is then pasted with copper oxychloride to avoid infection of fungal pathogens. Immediately after heading back, the pruned wood needs to be removed from the orchard so as to prevent the damage by trunk borers.

Manipulation of vegetative growth

The new shoots arise from pruned branches after heading back. Of which, 4 to 6 shoots are retained at proper spacing and allowed to grow towards periphery of trees. Successive removal of unwanted shoots, considering the vigour and growing direction is important.

During May-June, selected shoots are subjected to further pruning to about 50 per cent of their total length for emergence of multiple shoots below the pruning points. This is mainly done to modify the tree structure and maintain canopy size. Fruiting starts on third year after rejuvenation. Yield levels during initial year are slightly low, while the yield from third year onward has been found to be better than the unpruned trees.

Rejuvenation by top working

Top working can be easily adopted in old trees to improve the productivity of the old and senile plantations of seedling progeny with superior commercial cultivars. Top working involves two steps (i) beheading of the tree to be top worked, and (ii) budding with a elite material on the new flushes emerging out on the stumps of the beheaded tree. The plants are headed back in December-January to the extent of 2.5 to 3.0 m above the ground level. Four- to-six shoots from the outer directions on main limbs are allowed to develop.

During June-July, scion of desired variety is grafted/ budded on these shoots. After bud sprouting, the top

portion of the shoot is removed. Numerous side shoots, which emerge on the pruned branches after the budding operation should be removed regularly as and when they emerge, so as to encourage the growth of desired scion variety. The pruned trees must be irrigated at an interval of 15-20 days starting from March till the onset of monsoon. Adequate care should be taken to manage the insect-pest problems as these plants are prone to insect and sometimes to wind damage. Trees develop healthy and productive canopy after two years and bearing starts. Additional income from pruned wood and intercropping with short duration vegetables and ornamental crops are the other advantages of rejuvenated orchard.

High density planting system

High density planting (HDP) can be defined as accommodation of the maximum possible number of the plants per unit area to get the maximum possible profit per unit of tree volume without impairing the soil fertility status. 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. 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). Recently, super high density planting system has been also established in apple orchards with a plant population of 20,000 trees per ha. In some orchards, still closer, planting of apple trees is followed (say 70,000 trees/ha), which is often referred as 'meadow orchards'.

Points to remember

- Accommodation of the maximum possible number of the plants per unit area to get the maximum possible profit per unit of tree volume without impairing the soil fertility status is called HDP.
- This technique was first established in apple in Europe during sixties and now majority of the apple orchards in Europeare are under HDP.
- In India, HDP has been standardized in mango, banana, pineapple, papaya and apple, but it is followed commercially in banana and pineapple.

Advantages of HDP

- Early cropping and higher yields for a long time.
- Best utilization of interspaces.
- Best utilization of natural resources (sun light).
- Better water and fertilization use efficiency.
- Reduced labour costs.
- Reduction in disorders like sun scald.
- Improved fruit quality.
- Adoption of mechanization is possible.
- Easy management due to smaller tree size.

Characteristics of trees for HDP

a. The trees of HDP should have maximum number of fruiting branches and minimum number of structural branches.

b. The trees are generally trained with a central leader surrounded by nearly horizontal fruiting branches.

c. These branches should be so arranged and pruned that each branch casts a minimum amount of shade on other branches.

d. The height should be one and half its diameter at the base. A key to successful HDP depends upon the control of tree size.

Approaches for high density planting

Use of dwarf cultivars/ spur type scions: Genetically dwarf varieties suitable for HDP are available in many fruit crops like Pusa Nanha & Pusa Dwarf in papaya, Amrapali in mango, Van & Stella in cherry, Dwarf Cavendish & Dwarf Naine in banana etc. In temperate fruit crops like apple, the cultivars are classified into a spur type or non-spur type. The spur types which have restricted annual growth are suitable for HDP.

Use of size controlling rootstocks: In apple, dwarfing rootstocks such as M_{27} and intermediate stocks like MM 106, MM 109, and MM 111 are used to control the size of the plant. In citrus, Flying Dragon is used commercially as a dwarfing rootstock. In pears, Quince A, Adam and Quince-C are commonly used as dwarfing root stocks. Similarly, in mango cv. Anupam has been recommended for its use as dwarfing interstock.

Training and pruning: Proper tree forms, branch angle and limb spacing among themselves aid in growth control of any plant. Once the tree is mature, excessive growth can be regularly removed by pruning to provide a short term or immediate benefit. This is achieved by heading back and thinning out. Heading back involves the removal of terminal apex and a portion of dominant shoots, while thinning involves removal of complete shoots or limb at the point of origin. Even a dwarf tree under after few years of commercial production show decline due to overcrowding and intermingling of canopies. Therefore, pruning has been recommended after twelfth year of planting in mango cv. Amrapali. Similarly, mango cv. Dashehari when accommodated under HDP system are severely pruned (dehorned) to 50% of their branches in 11th year and another 25% in the 12th year. Likewise, under Indian conditions, apple trees trained under spindle bush, dwarf pyramid, cordon systems are found to contain the growth of the trees appreciably for HDP systems.

Mechanical device and use of chemicals: Growth regulators such as paclobutrazol, daminozide, ethephon and chlormaquat are extensively used to reduce shoot growth. This results in increased flowering in the subsequent years and may be useful in encouraging earlier commercial fruit production in strongly vegetative fruitful young trees. Besides chemical manipulation, mechanical devices employing the use of spreaders and tying down the branches to make them grow from near horizontal to an angle of 45° from the main stem are also some of the standard practices to control tree size.

A view of HDP in pineapple

Planting system for high density planting

The success of HDP depends upon the appropriate choice of planting system. Generally, rectangular planting with single, double and three row plantings are followed. In single row planting, the distance within the row is close, whereas the distance between the row is wide (4x2m). In double row planting, a wider spacing is given after every two rows (4+2x2m) whereas in three row planting, a wider spacing is given after every three rows (4+2x2x2m). In meadow orchard system, a bed of 10 to 15 rows is closely planted (nay 30x45cm) and separated by alleys of 2.5m width between beds. This system is also called bed system.

High density orchard of Amrapali mango

HDP by hedgerow system in guava

Examples of successful HDP in fruit crops

There are quite a good number of success stories of HDP in fruit crops under Indian conditions as given in talbe below.

Performance of fruit crops under high density planting

S. No.	Crop	Variety	Density (Plants/ha)	Spacing (m)	Yield (t/ha)
1.	Banana	Basarai	4,444	1.5x1.5	78.0
2.	Papaya	Pusa Nanha	6,400	1.25x1.25	103.6
3.	Pineapple	Kew	63,758	0.22x0.6x0.75	118.8
4.	Guava	Lalit	5,000	1x2	55
5.	Mango	Amrapali	1,600	2.5x2.5	22
6.	Kinnow	Kinnow on Troyer citrange	2,990	1.83x1.83	Higher and precocious fruiting
7.	Litchi	Shahi	3,333	2.0x1.5	5.82

ACTIVITIES/EXERCISES

- Go to some old or declining fruit orchard. Ask gardener to demonstrate different steps involved in its rejuvenation.
- Go to some ICAR institute or Agricultural University in your area. Visit the fruit orchard. Note down the planting density and the approaches adopted for high density orchard, if they have any.

CHECK YOUR PROGRESS

1) Define rejuvenation. Write different steps involved in rejuvenation of a mango orchard.
2) What is high density planting? Write its advantages over traditional system of planting.
3) Write basic approaches employed for adopting HDP in fruit crops.
4) Write briefly about achievements made in HDP of fruits in India.

FILL IN THE BLANKS

i) Old orchards produce low yields of ……..quality.

ii) …… variety of mango has been recommend for HDP in mango.

iii) ……. variety is most suitable for HDP in papaya.

iv) For reducing growth of plant, …… growth regulator can be used.

v) In citrus, ……is used as the most dwarfing rootstock in the world.

SUGGESTED FURTHER READINGS

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