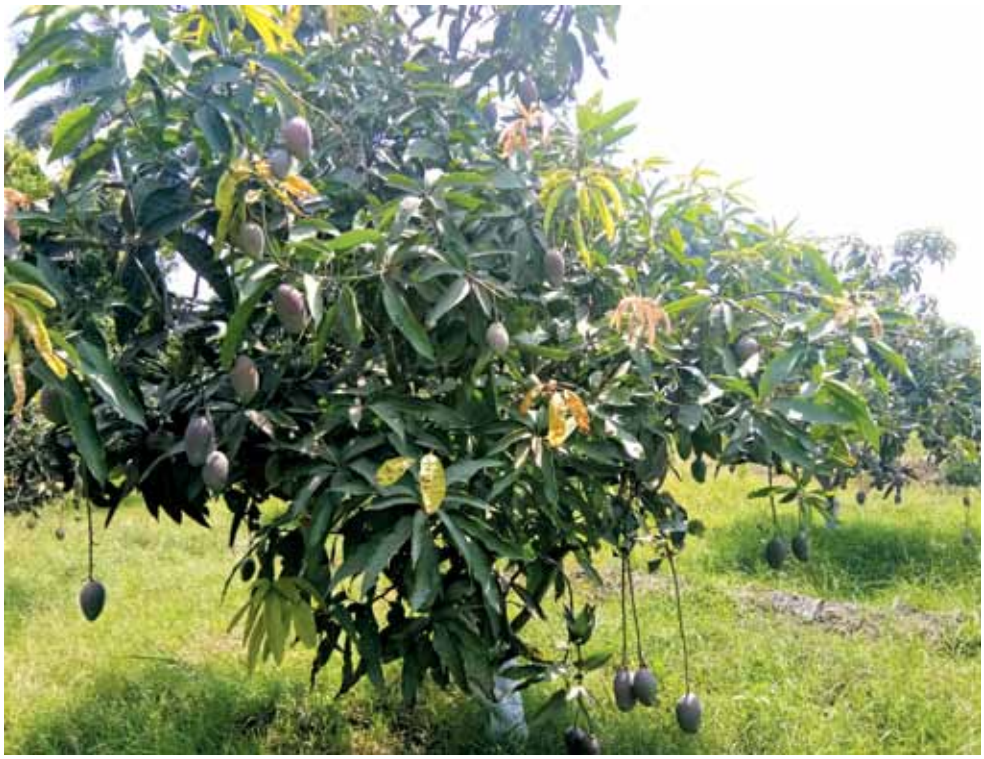
K K Srivastava,
Dinesh Kumar and S Rajan*

Increasing mango productivity through high density planting

Despite being the world leader in mango production, India's productivity is low (9.7 MT/ha) in comparison to Brazil's 12.50 MT/ha. Mango's low output is due to inadequate orchard floor management, sparse planting density, poor canopy control, and lack of training, pruning, nutrient, and water management practices. Furthermore, due to the long gestation period and late orchard income, the present generation is unwilling to adopt mango cultivation. On the other hand, the introduction of dwarf, high and regular yielding cultivars, as well as high density planting strategies, have opened up new commercial options for mango production.

High density planting system

Planting systems with a high density allow for a greater number of plants per unit area. Mango trees are normally planted 10 meters apart, with only 100 plants per hectare. When compared to the HDP system, these plants starts late bearing, while per plant yield is high and total yield per unit area is low. In northern India, UHDP is possible with the 'Amrapali' variety at 2.5×2.5 m spacing (1600 plants per hectare), whereas HDP is planted at 5×5 m spacing (400 plants per hectare). HDP orchards require regular pruning and canopy management strategies to keep the canopy under control. Yield and quality degrade as the plant advances in age due to overshading, crowding, and a decrease in light penetration inside the canopy.



Mango variety Ambika in HDP

Suitable varieties for high density planting

Regular bearing varieties are suitable for high-density orcharding of mango; dwarf varieties that are responsive to pruning are usually preferred.

Amrapali: A hybrid between 'Dashehari' and 'Neelum', suitable for high density planting due to dwarfing nature, fruits mature late (Last week of July to mid August), fruit weight 150-350 g, remain green at ripening stage, good taste and flavour.

Arunika: It is a cross between 'Amrapali' and 'Vanraj', dwarf canopy with medium fruit size, fruit weight 150-300 g/ fruit, coloured and attractive fruits; mature late, suitable for high density planting.

Ambika: It is a cross between 'Amrapali' and 'Janardan Pasand', fruits oblong to oval in shape, light yellow colour with dark red blush, fruits 250-360 g in weight, TSS 21° Brix, regular bearer and late maturing variety, average yield 80 kg/tree at 10 years of age, suitable for high density planting.

Three years old Arunika in blooming

Five years old mango variety Dashehari in flowering

Mallika: A semi-dwarf variety, cross between 'Dashehari' and 'Neelum', suitable for high density plantation. It is prolific bearer, fibreless, orange in colour, flesh firm suitable for slice making also. Fruit mature late in July to first week of August, 350-480 g fruit weight.

Use of paclobutrazol

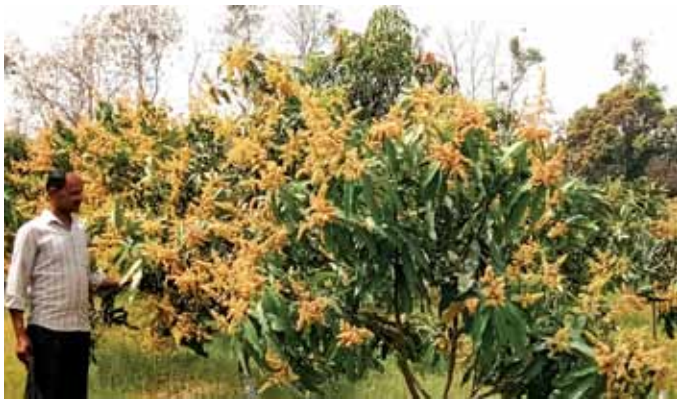
Shoots induced due to pruning after the harvest of the fruits may remain unproductive for a year therefore for flower induction paclobutrazol application is practiced. Paclobutrazol reduces annual flushing and shoots linear growth resulting in a smaller canopy. Flowering and fruit production are greatly helped by the application of 4 g of Paclobutrazol per tree (3.2 ml/m canopy diameter) to the soil. Recommended dose of paclobutrazol is dissolved in 15-20 liter water and applied in manuring ring 1.5-2.0 m away from the trunk where the feeding roots are present. It is applied 90-100 days before flowering in the month of September, followed by light irrigation.

Canopy architecture development

During the first 2-3 years of HDP, training is a crucial instrument for developing tree canopy. This is done in order to establish a strong framework for the future, ensuring that the branches are appropriately spaced and capable of carrying the maximum fruit load. For HDP, grafted saplings are taken after planting; 3-4 scaffold branches (as primary branch) at 45-60 cm height from ground level are allowed spirally at 10-15 cm interval. Cut the apical portion of primary scaffolds to allow secondary shoots to grow on it and then tertiary shoots. The upright growing shoots are required to be removed and the scaffolds be allowed to develop at 45-60 degree angle and after attaining the length of 50-60 cm it must be headed back. These operations lead to complete canopy structure with increased number of short shoots. Increased branching results in more fruiting shoots in young trees and encourages precocity which is pre-requisite for high density planting system. Thus, after 2-3 years, the entire canopy develops. The 'Amrapali' forming an uneven or irregular canopy where as 'Ambika', 'Arunika', and 'Dashehari' forming a compact, semi-spherical canopy.

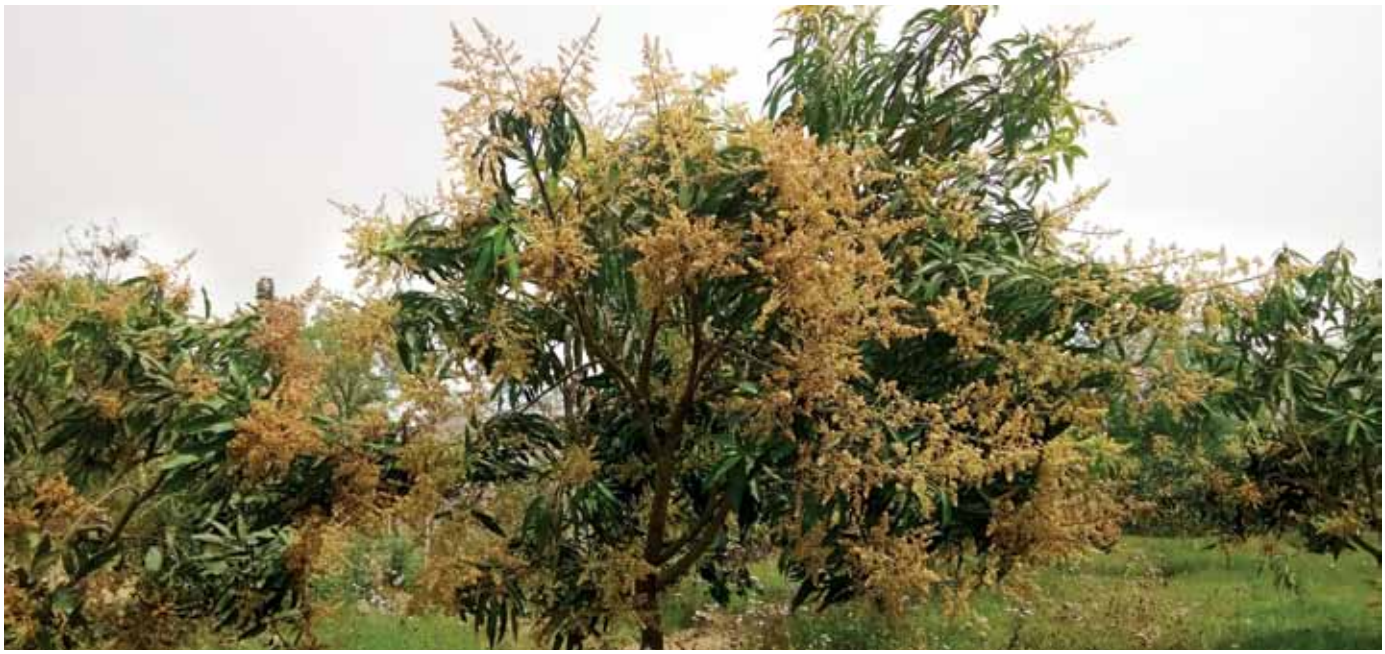
Pruning

The tree under high density attains optimum canopy shape and size within 3-4 years and the canopy expansion is slowed down when bearing starts. Pruning strategies for mango is based on requirements of the tree. Annual pruning in mango is done for flowering management,



Five years old mango variety Amrapali in flowering

Five years old Amrapali laden with fruits



Five years old mango variety Amrapali in flowering

control tree size; reshaping of the trees to smaller and more manageable size. Pinching and tip pruning force the formation of lateral shoots from dormant lateral stem buds. Through frequent pruning of young trees, tip pruning in mango helps to shorten the juvenility and accelerate branching of lateral branches, resulting in a dense spreading canopy that flower 1-2 years earlier than conventional plantations. Pruning is normally done following the fruit harvest, which takes place in July-August.

Nutrient and water management

The success of mango production under high density planting system depends upon proper nutrient and water management. Nutrient applied (three year old plants) at different phenological stages i.e. after harvest (120 g N, 60 g P and 75 g K), pre-flowering (75 g N, 60 g P and 60 g K), flowering to fruit set (60 g N, 30 g P and 75 g K) fruit development (45 g N and 90 g K) in mango. The source of soluble fertilizers such as NPK grade (18:18:18 %), Urea and MOP were applied at phenological stages in mango. The nutrient doses as per the stage can be split into six and applied at weekly intervals. The concentrations of the nutrient solution should be >1-1.5% and injected through ventury. For irrigation, drip irrigation is most effective and efficient technology to supply precise amount of water directly to root zone by saving of water through percolation and seepage losses. The water requirement in mango is determined by using pan evaporation, pan coefficient, crop factor, wetted area, and plant spacing. The water requirement is assessed on daily basis and applied through drip on alternate day. During the rainy season (June to September), rain provides 30-40% of total crop water requirements, whereas from October to May crops require 60-70% irrigation water for better productivity and quality. Drip irrigation is the best method for water management in mango when there is a water shortage.

Mango variety Dashehari in flowering

Yield

The mango under high density planting system starts bearing 2nd year onward; however, good fruiting takes place in 3rd year onwards. In Amrapali, 3.5 to 14.0 kg fruits/tree (5.6 to 22.40 t/ha) were harvested after 3 to 5 years. Dashehari bears good fruits at 5×5 m spacing and 6-7 t/ha fruits in 5th year, while in traditional spacing (10×10 m), 2-3 t/ha yield was recorded. Average fruit weight recorded was about 220-260 g in Amrapali and Dashehari.

Mango orcharding under high density planting is more profitable, although it requires more initial investment, which is offset by early production. Since most of the canopy is close to the main trunk hence, more fruit is produced. Because of the controlled canopy growth, HDP is very easy to care for and upkeep. After 4-6 years, HDP yields are 10-12 times higher than standard spacing.

For further interaction, please write to:
S Rajan (Director), ICAR-Central Institute for Subtropical Horticulture, Rehmankhera, Kakori, Lucknow, Uttar Pradesh 227 101. *Corresponding author e-mail: srajanlko@gmail.com