

CANOPY MANAGEMENT IN MANGO

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CANOPY MANAGEMENT IN MANGO

I. INTRODUCTION

Mango (*Mangifera indica L.*) is one of the oldest and most popular fruits having delightful flavour and taste of the tropical world. India is the leader sharing 65 per cent of the world's mango production. Currently, mango is cultivated in an area of 2.3 million hectares with a total production of 12.75 million tonnes in India. The average productivity of 5.5 metric tonnes per hectare in India is comparatively low against 35-40 metric tonnes per hectare realized in Israel. Moreover, the productivity declined from 8.1 t/ha (1991-92) to 5.5 t/ha (2008-09). Despite India's share of 65 per cent in the world's mango production, its share in world's fresh mango market is just 5.25 per cent in terms of quantity and 3.5 per cent in terms of value, which are very meagre considering the total production. Oflate, all the mango importing countries are considering India as a source of quality mangoes due to its varietal wealth and availability. In this background, it is imperative to improve the productivity and quality of Indian mangoes.

Table.1 Area and production in Indi

Year	Area (in 000'ha)	% share of mango out of total fruit area	Production (in 000't)	% share of mango out of out of total production	Productivity (in India)
1991-92	1077.6	37.5	8715.6	30.4	8.1
2001-02	1575.8	39.3	10020.2	23.3	6.4
2002-03	1623.4	42.9	12733.2	28.2	7.8
2003-04	1906.7	40.8	11490.0	25.2	6.0
2004-05	1970.4	39.7	11829.7	24.0	6.0
2005-06	2080.7	39.1	12663.1	22.9	6.1
2006-07	2154.0	38.8	13734.0	23.1	6.4
2007-08	2201.0	37.6	13997.0	21.3	6.4
2008-09	2309.0	37.8	12750.0	18.6	5.5

In India, among the different state growing mangoes, Uttar Pradesh leads in productivity with 12.8 t/ha followed by Bihar registering 9.2 t/ha and Karnataka with 9.1 t/ha. However, the productivity in Tamilnadu is only 5.5 t/ha which is exactly the national average for the crop.

II. PRODUCTIVITY IN MANGO

1. Reasons for low productivity in mango

There are several reasons that can be attributed for low productivity but among them, the major causes are given below.

I. Predominant existing orchards are of seedling progenies

Even now, in many parts of the country, senile unproductive orchards of seedling origin are being maintained. These orchards with unmanageable canopy neither produce fruits nor the quality. Besides, these orchards are acting as sources of pest and disease.

II. Cultivation of location specific mango varieties

There are more than 1000 mango varieties exist in India. Most of these varieties are happened to either poor yielders or alternate bearers.

III. Long gestation period in mango

New plantations are now established through mango grafts only. In generally mango orchards used to take 4 to 7 years to reach commercial proportion due to several factors including soil, climatic and cultural methods.

IV. Alternate bearing habit of mango

Except few varieties *viz.*, Neelum and Bangalora, most of the choice varieties are either alternate bearers or poor yielders.

V. Dominance of vegetative phase over reproductive phase Evergreen trees bound to grow continuously due to abundant sunlight throughout the year. Dominant vegetative phase can affect the reproductive phase especially under tropical regions, if not regulated properly.

VI. Conventional spacing (wider spacing) followed in many parts of the country

The lands which were not suitable for agricultural crops were used for planting of perennial trees with the view that the natural resources could not support the agricultural crops any more. Hence, the fruit trees were spaced widely resulting into poor land use efficiency and yield.

VII. Pest and disease problems

Several pest and diseases are affecting the mango all through the year. The yield loss due to pest and diseases is accounted to more than 15 to 20 per cent in a normal year and even to the extent of 40 to 60 per cent in severe infection. Pests like stem borer and bark borer are some of them causing severe damage to the tree.

VIII. Physiological disorders associated with mango

Spongy tissue in Alphonso is a typical example for physiological disorder in mango which affects both the domestic and international trading. Similarly, flower malformation, black tip and alternate bearing, are the other disorders associated with mango cultivation.

2. Ways to improve the mango productivity

Considering the aforesaid reasons for low productivity, several technologies have been developed over a period of time to improve the productivity and quality of mangoes. Adoption

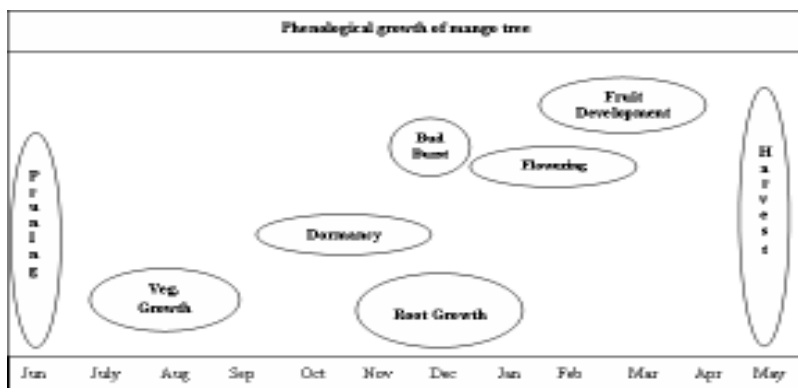
of latest technologies are of paramount importance in achieving higher productivity. The technologies are:

1. Adopting a fitting planting system (High Density or Ultra High Density)
2. Micro irrigation and fertigation system
3. Better canopy management in mango
4. Mechanization in crop cultivation
5. Pre and post harvest handling including bagging of fruits, harvesting with pedicel, desapping, plastic crates etc.,
6. Top working and rejuvenation
7. Use of growth regulators on flower induction and setting

Canopy management practices in mango are elaborated in this manual.

III. PHENOLOGICAL GROWTH OF MANGO TREE

Before adopting any technologies, it is important to understand the phenological growth of the tree so that the cultural operations can be taken up at right time to get right results. Phenological growth of mango trees of South India is depicted in the diagram. It clearly shows the different growth stages so that, canopy management can be taken up at an appropriate time for the desired results.



Mango produces flowers from December onwards under normal circumstances and the flowering can extend up to March. However, the fruit development phase range from January to May depending upon the time of flower formation. Harvest starts from April continue up to June and at times extended up to August. For early varieties, harvest is over by May and the tree is ready for pruning by June. After harvest, mango trees put-forth vegetative growth till September. Fruit bud initiation and differentiation takes place during October-November and then the buds enter into dormancy. Root growth takes place during November to January. Bud burst takes place any time between November and December depending upon the environmental factors like night temperature dry weather before flowering.

IV. CANOPY MANAGEMENT

There are several operations involved in improving the yield and the quality of mango fruits. Among them, canopy management is one of the most important factors to sustain the yield and quality of fruits in mango. In many fruit crops, increase in production with enhanced fruit quality is achieved by managing canopies. Capturing and conversion of sunlight into the fruit biomass (dry matter content) is an important process in fruit production. In general, compact and small trees capture and convert sunlight into fruit production in a better way than the larger ones. The main controlling factors are the extent of incoming radiation and percentage radiation intercepted by tree canopies. It can be enhanced by proper canopy management practices.

For commercial fruit cultivation, the natural form and shape of fruit trees are to be modified through the practice of pruning to achieve the targeted yield by scientific approach. This

is because; it is not always wise to allow a plant to develop naturally, since unwanted portions may develop at the expense of those which are essential. Appropriate pruning practices keep the plant in such shape and condition as to yield fruits of desired quality. Canopy management depends on the nature and growth pattern of plant, number of plants per hectare and pruning techniques.

Principles of Canopy Management in mango

Canopy management is the manipulation of tree canopy to optimize the production of quality fruits. It encompasses both training and pruning which affect the quantity of sunlight intercepted by trees, as tree shape determines the exposure of leaf area to incoming radiation. An ideal training strategy centers around the arrangement of plant parts, especially, to develop a better plant architecture that optimizes the utilization of sunlight and promotes productivity.

Light is critical for growth and development of trees and fruits. The green leaves harvest the sunlight to produce carbohydrates and sugars which are translocated to the sites where they are needed *viz.*, buds, flowers and fruits. Better light penetration into the tree canopy improves tree growth, productivity, yield and fruit quality. The density and orientation of planting also impact the light penetration in an orchard. Generally, in close planting, quicker shading becomes a problem. Initial build up of a strong and balanced framework of the tree is essential for further management. The canopy management should aim for,

1. Maximum utilization of light by regulating the growth
2. Avoidance of built – up microclimate congenial for diseases and pest infestation

3. Convenience in carrying out the cultural practices
4. Maximizing the productivity with quality fruit production
5. Economy in obtaining the required canopy architecture

The canopy management should broadly aim at

1. Formation of strong frame work having branches on all directions with near equidistance between branches.
2. Developing the canopy with centre opened so that it gets better exposure to sun light.
3. Controlling the stature/size of the plant to harness the maximum productivity.

V. CANOPY MANAGEMENT IN YOUNG TREES

The early stages of growth are most important for the initial shaping of the young tree. A well structured tree will be able to carry a heavy crop, facilitate spraying operations and ensure the fruit is exposed to plenty of light leading to a good blush on the fruit at maturity. Training the plant during juvenile phase is important to get a strong frame. To develop a strong trunk, the trees should be allowed to grow over 1 metre height initially. They are then cut back to a height of 0.6 to 0.7 m. The site of first cut is important for the development of a strong frame. Mangoes grow in flushes; each flush is delineated by a concentrated whorl of leaves on the stem. This is referred to as a “ring of buds”, as a bud capable of forming into a branch which is situated at the base of each leaf. If the cut is made above this “ring of buds” the resulting regrowth will be a feather duster effect of seven or more shoots developing. These would need to be thinned out to three or four if a good tree structure is to be attained (Plate.1).

However, cutting above the ring of buds may result in the formation of weak crotches, prone to breaking during storms and heavy bearing. Below the “ring of buds”, the leaves are more spaced out along the trunk. An inch below the ring of buds is the correct point to give a cut (Fig.1 and 2).

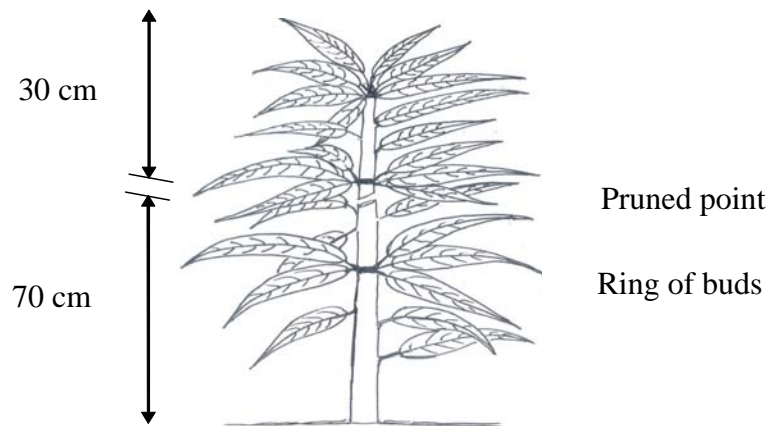


Fig .1. Young seedling of 1 M height with cut given below ring of buds

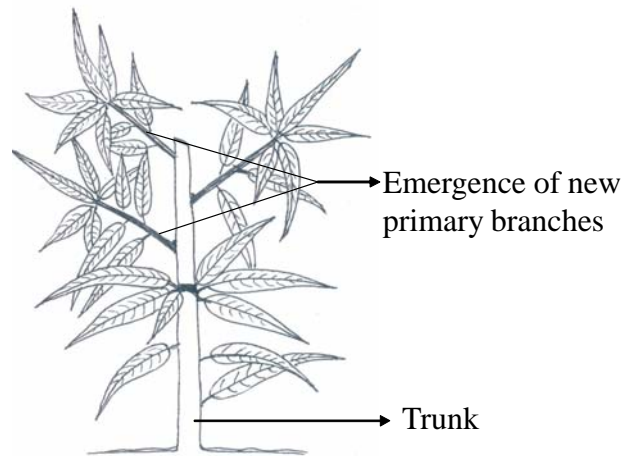


Fig .2. Emergence of new shoots below cut end

It will ensure that the branches are well spaced out resulting in a strong frame for future development. After the initial cut, allow 3 or 4 shoots to grow into branches of over one metre long. These are then cut back to about 60-70 cm length, which will give a good strong branch for supporting the growing tree. After this, the trees should start branching by themselves. Young trees can be pruned at any time of the year. The aim should be to develop a spreading tree rather than a tall tree. Downward and inward growing branches or branches that cross over each other should also be removed.

Stepwise operations

Allow the grafts to grow to a height of one metre from ground (single stem)

Head back the graft at 60-70 cm from the ground during October-November to induce primary branches (make a smooth cut with sharp secateur)

Heading back results in the formation of new primary branches (3-7) during March-April. Prune the excess branches and allow 3 to 4 in all the directions

Prune primary branches at 60-70 cm height to induce new secondary shoots (7-10 month after the first cut preferably during October-November)



Thin the excessive secondary shoots retaining 2-3 shoots per primary branch

Tertiary branches (2 to 3) can be obtained by pruning the secondary branches at 60-70 cm height

VI. CANOPY MANAGEMENT IN BEARING TREES

It may not be necessary to prune trees every year. Mango trees normally respond to pruning by sending out a vegetative flush, usually the heavier the pruning the more vigorous and numerous the flushes. Mango trees are terminal bearers, *i.e.*, they flower from the ends of the branches and will only flower on mature wood, *i.e.*, shoots that are six weeks or older. Hence, pruning affects the flowering and yield. It is therefore most important to ensure that the trees do not have enough vegetative flushes with poor yield. There are two periods when pruning can be taken up.

A. First pruning after harvest

First pruning should be done immediately after harvest and should be completed by the end of June/July. It includes:

i. Skirting. Removal of low hanging branches is known as skirting. It facilitates the operations such as fertilizer application and controlling of weed.

ii. Opening up. Removal of branches inside the tree which cross over or clutter up the centre of the tree restricting the penetration of sprays. One or two uprightly growing branches from center of tree are to be removed to reduce tree height significantly and to increase the availability of light inside the canopy for better photosynthesis. During removal of branches, first cut should be given on the lower side of branch, so that a smooth cut is possible which avoids bark splitting. In bearing mango trees, not more than 25 per cent biomass should be removed at a time; otherwise it results in excessive vegetative growth (Plate.2) with reduced flowering shoots.

iii. Hygiene. It involves the removal of any diseased or dead branches in the tree, which could be a source of infection.

However, it is need based and recommended for those trees found to have yield decline

B. Second pruning – pre flowering

Second pruning may be taken up in the middle of December and, if the timing is right, it is to be followed by a floral flush rather than a vegetative flush. Second pruning should be completed in a short period not exceeding one to two weeks.

- i. Skirting:** Low hanging branches which could cause fruit to drag on the ground are to be removed.
- ii. Opening up:** Twigs and disorderly branches inside the tree are to be removed to have a open canopy. This not only facilitates spray penetration for better insect and disease control but also allows light into the tree, improving fruit colour.
- iii. Tip pruning:** It is a useful practice where the trees have had a vegetative flush just prior to flowering. The young flushes are cut back to mature wood; the resulting flush may result into a floral one. Tip pruning will also reduce tree size (Plate.3).
- iv. Hygiene:** It is essential to reduce the source of flower and fruit infection. Any diseased or dead branches should be removed before flowering.

VII. CANOPY MANAGEMENT THROUGH CHEMICALS IN BEARING TREES

Mango responds well for growth retardant treatments. Among the several chemicals, paclobutrazol has pronounced effect on flowering in mango.

Pruning the flowered/vegetative shoots 10 cm above the node during June-July (immediately after harvest) followed by soil drenching with paclobutrazol 1 gm *a.i* per sq.m during

August -September enhanced flowering, fruit set and quality of fruit in Banganapalli mango under irrigated condition in the regular season (Plate.4).

Similarly, pruning 10 cm of terminal shoots after emergence of new growth (floral or vegetative growth) during December–January followed by application of paclobutrazol at 0.75 gm *a.i.* per tree of 9 year old during March–April resulted in good off-season crop in cv Neelum. Here also, trees subjected to this treatment should be under irrigation.

VIII. REJUVENATING OLD TREES

Old trees often produce fruits and difficult to harvest due to their size. Moreover, old trees harbour pest and diseases and it is difficult to reach the whole tree while spraying to control them. It is possible to cut these trees back to a more manageable size, but depending on the severity of the pruning one may lose two to three crops. Rejuvenation improves production, fruit size and quality once trees recover. But, rejuvenation of mango trees under rainfed condition is not recommended since the tree may not recover after pruning. There are four model approaches to take up rejuvenation in mango.

Model 1

In this model, the tall central trunks are cut back to about 3-4 m height from the ground. The actual site to cut back to should be at a point where there are side branches. A chain saw is necessary for the job to make a smooth cut. Here, one half of the tree is cut back and the remaining trunks and leaves will help protect the stump from sunburn (Plate.5).

The freshly exposed trunks and branches to the sun should be painted with white water-based paint diluted three or

four times. This is to prevent sunburn, which could attract borer on to the damaged bark. In a short time, numerous shoots will develop; select the most vigorous of these, spaced evenly around the stump and if possible at differing heights. Remove all the unwanted shoots. This process should be repeated as often as necessary until the selected shoots begin to dominate and take over. Then the rest of the tree can be cut back and the operations may be repeated. By this method, half the yield will be realized throughout the process till it regains the vigour.

Model 2

Old, unthrifty trees can often be rejuvenated by a moderate to severe pruning. This is in the form of skeletonising the tree, *i.e.* cutting back the branches of the tree till only the basic frame is left. Moderate skeletonising would entail cutting back the large branches to healthy wood, while at the same time maintaining the basic structure of the tree. Particularly large unthrifty trees would benefit from a more severe skeletonising, where all the main branches are cut back to the main trunk only leaving about a metre or so of branch. The whole trunk and remaining branches should be painted with diluted paint to prevent sunburn and borer attack. In both these cases there will be a proliferation of sucker growth. These should be treated as mentioned previously (Plate.6).

Model 3

In old and dense mango orchards, light interception and photosynthetic potentials of trees is reduced resulting poor yield. The branches existing on main trunk are considered as **first order branches**, the branches existing on first order branch are called **second order branches**, the branches existing on second order branch are called **third order branches**, similarly fourth and fifth order. At IIHR, Bangalore, pruning third order branches

30cm from point of origin recorded the maximum yield in Alphonso (86.3 kg/tree). Trial conducted at CISH revealed that pruning second order branches recorded maximum pooled fruit yield of twelve years after pruning (57.99 kg/tree) of Dashehari (Fig.3).

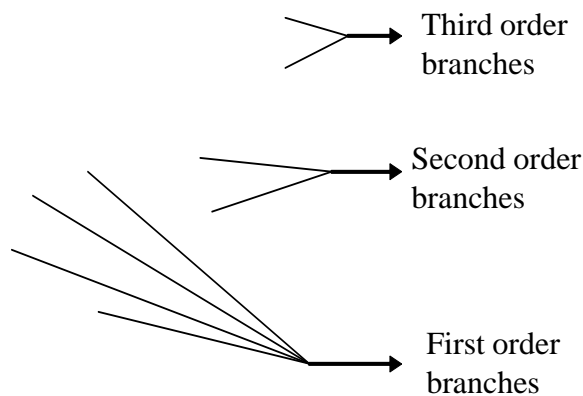


Fig.3. Pruning from third order branches retaining 30 cm from the origin

Model 4

Central Institute of Subtropical Horticulture (CISH), Lucknow had conducted a trial to rejuvenate 40-50 years old mango trees in the farmers field. In this process, main branches were pruned at a height of 5 M from the ground level during December. About 3-4 diverging branches were kept for developing healthy umbrella-shaped canopy and rests were removed from the base (Fig.4 & 5). Pruned surfaces were smeared with copper oxychloride paste immediately after

pruning to check the microbial infection. Pruned trees were kept under intensive care and management.

Cultural practices like nutrition, irrigation, hoeing, weeding *etc.*, were done properly. Profuse shoots emerged from prune branches from April onwards. Only 8-10 outward growing well spaced healthy shoots were retained per branch and the rest were removed. Plant-protection measures were seriously adopted especially against stem-borer, leaf cutting weevil and anthracnose.

Because pruned trees came into flowering and fruiting after 2 years of pruning, growers ended up with loss by missing crops for 2 year, hence, technology was refined to undertake the pruning work in alternate rows in the orchards. With alternate row pruning, availability of light to unpruned trees in two adjacent rows was greatly improved and their fruiting increased by 2-3 times. Thus, enhanced production from unpruned trees compensated the loss to some extent.

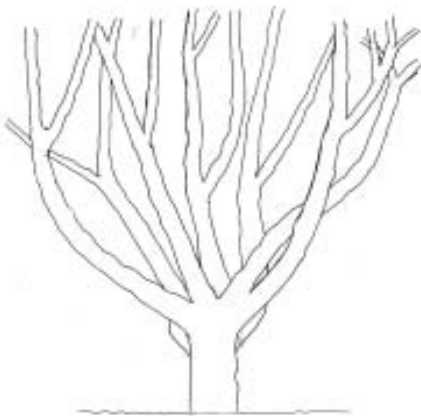


Fig.4. Before pruning

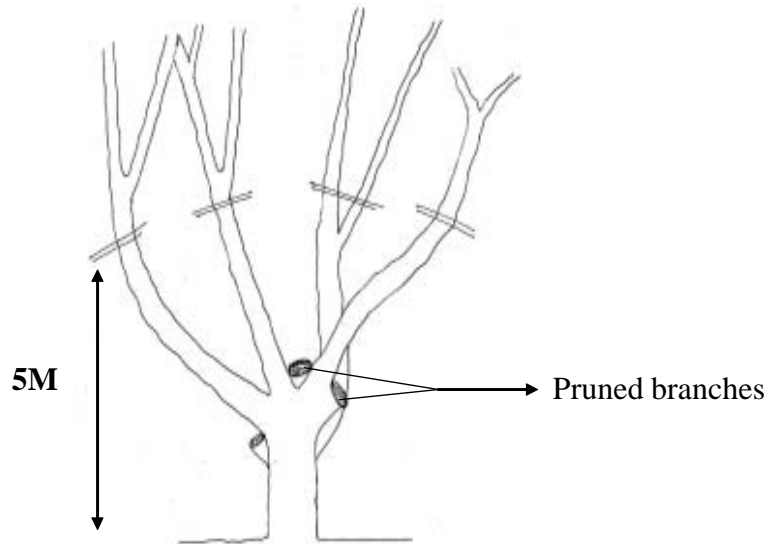


Fig.5. After pruning

IX.CANOPY MANAGEMENT IN ULTRA HIGH DENSITY PLANTING (UHDP) ORCHARDS

Canopy management is very essential and critical operation in UHDP to maintain fruiting shoots and contain the canopy. Pruning must be completed as soon as possible after harvest preferably before second week of June. Tertiary branches are to be headed back in such a way that the plant height can be maintained at 1.5 to 2 M and having 10 to 15 tertiary shoots per tree. Excess tertiary shoots are to be thinned out to avoid overcrowding. About one month after pruning, thinning of newly emerged shoots is essential to avoid excess shoots and overcrowding. On each tertiary shoot, 3 to 4 new shoots are to be allowed so that 40 to 60 panicles can be obtained in each tree. Dried panicle and dried shoots/ branches must be removed at the time of pruning.

To induce flowering, application of paculobutrazol @ 1 ml/plant from the third year onwards, that is for a tree having 2 m canopy diameter in the month of September is recommended.

Use of chemicals to induce flowering in mango

Among the macro nutrients, nitrogen plays an important role in flowering of mango. Several studies conducted in mango proved positive to urea and KNO_3 spray before flowering. Besides, micronutrients like zinc and boron were found to improve flowering in mango. In the following table, the name of the chemicals and its concentration are furnished which have improved flowering in mango, in studies taken up by researches

S.No	Nutrients	Concentration	Stage of application	Remarks
1.	Urea	0.5 % to 2 %	15 days before flowering	Shortened the span of flowering to 5-7 days, increased yield, TSS and total sugar
2.	KNO_3	2 %	20 days before flowering	Flower induction
3.	ZnSO_4 + Boric acid	0.5 % + 0.1 %	15 days after pruning and one month after pruning	Increased flowering, fruit size, TSS and Ascorbic acid
4.	NAA	20 ppm	At flowering stage	Improved fruit set
5.	Phosphoric acid	0.5 %	September-October	Increased flowering and fruit set

X. PRUNING TIPS

While cutting the larger branches with a saw, always do a cut of 20 to 40 mm into the underside of the branch to be cut before cutting all the way through from the top. This ensures a clean cut and prevents the branch tearing away as the cut reaches the end.

Large upright branches and trunks should be cut on a slight angle to prevent water sitting on the cut surface with the potential to cause rotting.

Large upright branches and trunks should be cut on a slight angle to prevent water sitting on the cut surface with the potential to cause rotting.

Large branches and main trunks should be cut off in sections, rather than in one cut where they could fall onto branches below and damage them.

Fungicide spray may be given after pruning to avoid any fungal growth from the cut surfaces.

Preparation of Bordeaux mixture (0.5 %)

1. Dissolve 50 g of powdered copper sulphate in 5 litres of water in a plastic bucket
2. Prepare milk of lime in another plastic bucket by dissolving 50 g of quick lime in 5 litres of water
3. Pour the copper sulphate solution and the milk of lime above two vessels into a third one by gently stirring the mixture all the while. This will give a final volume of 10 litres of 0.5 % strength
4. The mixture is to be tested before use for the presence of free copper, which is toxic to the plant. Dip a polished knife in the mixture. If the blade shows a reddish colour add lime to the mixture till the blade does not show staining on dipping.

For 1 % solution adds 100 g Copper sulphate and 100 g quick lime.

Bordeaux paste:

Dissolve 100 g of Copper sulphate and 100 g quick lime each in 500 ml of water separately. Mix together to make one kg of the paste.

XI. TOOLS AND EQUIPMENTS FOR CANOPY MANAGEMENT

Canopy management involves pruning and lopping of branches. Pruning done through manual methods are cumbersome. However, different pruning tools are available to make this operation simple and easy nowadays. Following tools/equipments can be used based on the need (Plate.7).

1. Secateur

Used to prune small twigs and terminal shoots of mango. Twigs around 1 to 1.5 cm diameter can be cut easily.

2. Pruning saw

Used to prune small branches of 1 to 2 inches diameter.

3. Tree pruner (Pruning shears)

Used to prune 2 to 2 ½ inches diameter branches of mango.

4. Chain saw:

It is a power operated saw used to prune big logs of any diameter.

5. Hydraulic fruit picking platform

It is a self propelled machine can be moved inside the orchard. It is fitted with chain saw and a cutter. Chain saw can cut any size, however, the cutter could able to cut a branch of 2 to 3 inches thickness. Having the hydraulic attachment, it can reach 25 to 30 feet from the ground.

6. Tractor trolley mounted hydraulic platform

This hydraulic machine can be used to move inside the orchard and reach upto a height of 25 feet from the ground. Pruning can be done using pruning saw, tree pruner and chain saw by standing in the bucket provided.



முதல் நிலை



இரண்டாம் நிலை



நான்காம் மற்றும் இறுதி நிலை



மூன்றாம் நிலை

புகைப்படம் -1 இளங்கன்றுகளில் கிளைபடர்வு மேலாண்மை



கவாத்து செய்வதற்கு முன்



கவாத்து செய்த பின்

புகைப்படம் 2- அறுவடைக்குப் பின் முதல் கவாத்து



கவாத்து செய்வதற்கு முன்



கவாத்து செய்த மரங்களில் காய்ப்பிடிப்பு

புகைப்படம் -3. பூப்பதற்கு முன்பு செய்யப்படும் - இரண்டாம் கவாத்து



புகைப்படம் -4. நுனி கவாத்து



புகைப்படம் -5. பாதி கவாத்து செய்யப்பட்ட மரம்



புகைப்படம்-6. சற்று அளவு குறைவாக கவாத்து செய்யப்பட்ட வயதான மா மரம்



வெட்டு கத்தரி



கவாத்து ரம்பம்



கிளை வெட்டும் கத்தி



மரம் அறுக்கும் தானியங்கி ரம்பம்



தானியங்கி மரம் அறுவடை மற்றும் கவாத்து
இயந்திரம்



டிராக்டரால் இழுக்கப்படும் தானியங்கி
அறுவடை மேடை