CANOPY MANAGEMENT IN FRUIT CROPS

Abstract

The term "canopy" describes the physical structure of a fruit tree, which includes the stem, branches, shoot, and leaves. The density of the canopy is influenced by the number and size of the leaves. In order to improve fruit quality and productivity, canopy management has been used for years in fruiting trees. One of the main technologies for effectively managing large, unmanageable trees to increase their productivity is management of canopy architecture. Canopy management is the alteration of tree canopies to maximise their capacity for producing fruits of the highest quality. Canopy management is concerned with the growth and upkeep of the structure of fruit crops in relation to their size and form for optimal yield with high-quality fruits. Utilizing the numerous procedures like training, pruning (dormant, summer, and root pruning), branch orientation (bending), scoring, girdling, selection of the right rootstock, use of plant growth regulators, optimal use of fertiliser, deficit irrigation, and use of genetically modified plants with altered architectural features will help maximise the consumption of light for an increase in the yield of quality fruits. Maximizing light interception, enhancing light dispersion within the canopy, and maintaining optimum airflow are the key goals of canopy management. Canopy management increases output, boosts fruit quality, supports cultural traditions, and aids in pest and disease management.

Key word: Canopy, Training, Pruning, Plant Growth Regulators

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I. INTRODUCTION

Canopy in a fruit tree refers to its physical makeup comprised of the trunk, branches, shoot and leaves. A plant's "spread of branches and leaves" is all that is meant. The quantity and size of the leaves determine density. The quantity, length, and orientation of the stem, branches, and shoots all affect architecture. The training system utilised has an impact on the tree architecture and canopy. Fruit trees are pruned and trained to develop a sturdy foundation that will handle big fruit loads, increased light penetration throughout the canopy, and easier management of the trees. Additionally, the plant canopy offers the conditions necessary for bug survival and spread. Fruit trees with a diverse distribution of pests have different-shaped canopies due to the variety in their microclimates, the availability of resources, and their suitability for pest control. Through tree training, many canopy morphologies have been created, each with unique light penetration, load carrying capacity, and pest dispersal characteristics.

II. IMPORTANCE OF CANOPY MANAGEMENT

Fruit that is cultivated naturally is of good quality, shape, and size. In order to reach the goal of a bigger yield and better quality fruits, fruit trees' natural form and shape must be adjusted through the process of pruning. Fruit growers want to scientifically control the growth and development of their trees. This is due to the fact that it is not always advisable to let a plant grow organically since certain undesirable parts may arise at the expense of those that are crucial from the perspective of the farmer. To balance fruit output and vegetative development optimally for human consumption, as well as to make fruit harvesting manageable, fruit tree canopies must be managed. An unmanaged canopy will grow all its fruit 25-30 feet in the air, which is difficult and just plain dangerous to get it. In the long run, managing a canopy will increase fruit production and enhance fruit quality while assisting in the development of a sturdy tree that will support big crop loads.

Maximizing light interception, enhancing light dispersion within the canopy, and maintaining optimum airflow are the key goals of canopy management. Canopy management increases output, boosts fruit quality, supports cultural traditions, and aids in pest and disease management. Initial training and pruning are given to build a solid framework in new plantations, however in older plantations, the goal of canopy management is to reduce tree height and provide for solar radiation inside the canopy by thinning out surplus biomass. The objectives of canopy management are

1. The most effective use of light
2. Avoiding built-up microclimates that are conducive to illness and pest infestation.
3. Convenience in executing cultural customs
4. Improving productivity through the production of high-quality fruit
5. Cost-effectiveness in acquiring the necessary canopy architecture
6. To encourage cultural customs
7. To improve the effectiveness of input use
8. Effective usage of fungicide and insecticide

III. PRINCIPLES OF CANOPY MANAGEMENT

The alteration of tree canopies to maximise the production of high-quality fruits is known as canopy management. The amount of sunlight absorbed by trees is influenced by canopy management, especially by its elements such tree training and pruning, as the structure of the tree impacts how the leaf area is exposed to incoming radiation. An optimal training plan focuses on the placement of plant components, in particular, to improve plant architecture that maximises the use of sunlight and encourages productivity.

Trees and their fruits require light to grow and flourish. The sunlight is captured by the green leaves, which then make sugars and carbohydrates that are then transferred to the locations where they are required buds, flowers, and fruits. The growth, productivity, yield, and fruit quality of trees are all improved by increased light penetration into the tree canopy. Light penetration in an orchard is also influenced by planting density and orientation. In general, rapid shadowing becomes an issue with close planting. Compared to tree orientations towards the west and south, an east-west row produces more shading. Larger fruits typically develop on strong bearing branches. The challenge for a fruit farmer is to first establish a sturdy and balanced framework for the trees before outfitting them with the proper fruits. It goes without saying that pruning done in the early years must be of the training variety to produce a sturdy structure with limbs spaced evenly or any other desired shape. There are certain fundamental guidelines for managing canopies.

1. Create a sturdy structure with the desired vigour.
2. More effective use of natural resources
3. Preventing the development of a microclimate that is conducive to illness and pests
4. Improving productivity while maintaining the soil's and plants' nutrient levels
5. Farmers will benefit economically.

IV. MODE OF GROWTH IN TREE

1. ***Pri*mary growth:** lengthening of the limbs This type of growth is the product of the "apical meristem's" activity, which produces undifferentiated cells (cells which have no particular function, but will eventually be differentiated to become blossoms, bark, etc.).

2. **Secondary growth:** Expanding and getting bigger (*i.e.* thickening of the limbs). It's critical to understand the age of the wood you're working with while controlling the canopy. For example, one year old wood, two year old wood, etc., are used to describe this in years.

3. **Current season growth:** This is the newly formed shoot that has grown from the previous terminal bud. The tree creates a new terminal bud at the conclusion of the growth cycle when the season is over and it goes dormant. After a year, that growth turns into wood. Old terminal buds (bud scale scars) and the age of the wood emanating from them will eventually become visible to you.

V. GROWTH HABITS IN FRUIT PLANTS

Knowledge of the perennial fruit tree's growth pattern is crucial for the development of a canopy that will increase production at a low cost and without the use of pesticides. It is necessary to understand their physiology properly. A tree's growth habit refers to its predisposition to a particular canopy shape.

1. **Acrotonic growth:** Strong growth at the top of the tree at the price of poorer growth on lower levels is known as acrotonic growth. This tendency is present in Red Delicious apples.

2. **Basitonic growth:** Lower branches surpass the tree's summit because they are stronger. Braeburn apple trees have a propensity for this.

Additionally, there are a variety of growth patterns in between, including canopies with columnar or conical shapes. When maintaining a canopy, we often aim to design the tree so that its top is smaller than its bottom. With a basitonic growth habit, this is simpler to do. However, regulating the canopy and structure of fruit trees depends on the tree's growth habits, flowering and fruiting cycles, as well as several physical and environmental variables. The structure of the branches will be visible as the leaves fall.

VI. DIFFERENT CANOPY STRUCTURES

Fruit trees are cultivated in a variety of shapes, occasionally to appeal to the eye but primarily to promote fruit yield. Fruit trees can have their form or shape changed through training and trimming. To establish the plant in a specific location under certain environmental circumstances, to boost fruit yield, and to improve fruit quality, a specific tree form is shaped and promoted. For instance, shaping a tree into a pyramid allows for the planting of trees closer to one another. An open bowl or cup shape allows more sunshine to reach the fruit, increasing fruit yield while keeping the tree short and easy to harvest.

1. **Bush:** A short trunk of less than 1 m with an open-centered crown. This is a well-known and conventional shape for apple trees. Bush trees are low-maintenance and start producing fruit at a young age. The final height ranges from 2 to 5.5 metres, depending on the rootstock that is utilised. The apple industry can use this system.

2. **Standard:** This is a larger-than-bush type with 2 m or longer trunks. Standard trees have a maximum height of 8 metres. They eventually yield big crops but are difficult to manage because they are large trees.

3. **Pyramid:** Although the primary leader shoots are allowed to keep their dominance, the shape is pyramidal, similar to the bush type.

4. **Spindle bush:** A type of pyramid where the lateral branches are fastened to the ground in a horizontal posture. This is currently the most well-liked training strategy for dwarf apple and pear seedlings in temperate regions. Otto Schmitz-Hübsch and Heinrichs created it for dense orchards in Germany in 1936.

5. **Cordon:** A single stem plant arrangement where fruiting spurs are encouraged to grow along the stem and are planted at an angle at 45°C. Pruning eliminates any auxiliary branches. More types may be grown in a smaller area because to cordons' smaller footprint and earlier cropping than most other forms, but the yields per tree are lower. The Bouché-Thomas setup is a unique cordon configuration.

6. **Espalier:** This training technique consists of a central stem and numerous horizontal pairs of branches that are all trained in the same plane. The main benefit of this training is that by training vertically, a branch's growth can be increased. Later, by training it horizontally, one can reduce growth while improving fruit output, such as with pear plants trained in this way.

7. **Fan:** A tree having a single, short central trunk and numerous radiating branches. It is frequently employed for stone fruits, which are unsuitable for espalier training or other constrained forms. Almonds, apples, cherries, figs, gooseberries, pears, peaches, nectarines, apricots, plums, and red currants are just a few of the many fruits that can be fan-trained.

8. **Step-over espalier:** Espaliers with simply one tier of vertical branches, spaced 30 cm apart. These create a creative and useful border for a food garden. A research on orchard mango trees in Nelspruit, South Africa, examined the central leader, palmette, open vase, closed vase, and pruning systems and suggested a modified pyramid, which falls somewhere between the two, for high-density mango orchards. The study looked at both post-fruit-set and post-harvest pruning, and found that while early cultivars may benefit from pruning right away after harvest, late cultivars benefit from trimming while bearing in late fall.

VII. METHODS TO MANAGE THE CANOPY IN FRUIT PLANTS

There are different methods are used to manage the canopy in fruit plants.

1. **Training:** Training describes the methodical elimination of parts to create a suitable shape for the plant that can support a big crop load. It is possible to imagine that training is influenced by the size and shape of plants. The main goals of training are to reduce vegetative vigour, improve fruit and foliage exposure to light, boost airflow to reduce the spread of disease, and simplify mechanised trimming and harvesting techniques. Utilizing both vertical and horizontal space should be taken into account while deploying the training systems. The selection of a training system affects planting distances, light interception, and ultimately the performance of the orchard in terms of the yield of fruit in terms of both quality and quantity. Pruning is one of the procedures used in training to guide the development of the tree's structural framework and its growth or form.

2. **Objectives of training**

- To create a sturdy tree framework
- To manage and regulate tree shape to facilitate easy orchard cultural operations, such as harvesting.
- To improve the crotch angle between the tree scaffolding's branches

- To make it easier for the sun's rays to pass through all of the tree's parts. to get rid of water sprout
- To achieve a balance between a tree's vegetative and reproductive growth

3. Principles of training

- Training should begin at the plant's very young age
- The majority of fruit trees are trained using the single stem method. Fruits like pomegranate, fig, and custard apple, however, are trained using a multi-stemmed training system since they are vulnerable to insect assault.
- To encourage the growth of side shoots in plants with considerable apical dominance, the terminal bud should be removed. After training, side shoots are selected to determine which of the better shoots will remain on the tree.
- Shoots with a narrower crotch angle are removed.
- Water sprout needs to be eliminated
- Drooping branches should be cut off

VIII. METHODS OF TRAINING

1. **Central leader system:** The main stem of the tree is let to grow unhindered in this method. The initial branch is permitted to develop 45 to 50 cm above ground level, and subsequent branches are permitted to grow 15 to 20 cm away from the primary stem. In this method, the main stem grows continually, giving the trees a sturdy shape. Lower branches receive less light interference, hence they are typically not productive. The area of the bearing is limited to the tops of the trees. Furthermore, the sturdy nature of trees makes it difficult to collect fruits and practise spraying, among other tasks. Additionally, due to their relatively tall structure, plants are vulnerable to wind damage. High altitude and hot, dry locations with high wind speeds are not suited for this type of training.

2. **Open centre system:** In this procedure, the plant is beheaded after it reaches a height of 40 to 50 cm. Four to five branches are chosen from the ensuing vegetative growth and are evenly dispersed around the primary stem. The tree grows less tall as a result of training. All of the tree's shoots have improved light absorption, and all of its branches are able to produce flowers and fruits. This technique makes it simple to carry out tasks like harvesting and tree-spraying. The plants in this design form a bowl, which provides a good base for the settling of frost. As a result, the open centre training technique is not appropriate for high altitudes where frost observance is widespread.

3. **Modified leader system:** This is a hybrid form of the central leader and open centre systems that combines their advantages. The primary stem in this system is given room to grow for four to five years. Then, it is cut between 120 and 150 cm above the ground. On the main stem, the initial shoot is chosen at a height of 40 cm above the ground, and 4–5 branches are chosen and placed all around the main stem at a distance of 15–20 cm. The plant taught using this approach grows to a respectable height. There is better output on the tree and enough lighting is provided to all maintained branches. This approach is incredibly useful and used in practically every region. This device makes it simple to carry out orchard activities including harvesting and spraying fertilisers and plant protection chemicals.

IX. APICAL DOMINANCE

The terminal bud of a tree contains a tissue known as the apical meristem, also known as the growing tip. At the tips of roots and shoots, it primarily performs the role of cell growth (forming buds, among other things). An active apical meristem pushes itself forward by planting new roots or shoots behind it.

A condition known as apical dominance occurs when a meristem at the main trunk's apex blocks or inhibits the growth of other meristems. This dominant meristem encourages vegetative development by secreting the hormone Auxin. As a result, the trunk's tip grows quickly and is not covered by branches. In the event that the dominant meristem is removed, one or more additional branch tips will take its place. In order to promote bushy development, the newly dominant branches will begin to grow more quickly. By making shoots and branches horizontal, you can train a tree by changing the direction of the auxin flow. The number of fresh breaking buds you will produce will increase as you draw the branch down.

1. **Pruning:** To get a decent and high-quality output, it is wise to choose remove undesirable plant components such roots, leaves, flowers, and fruits. Pruning can be done to enhance tree shape, control a tree's development, blossoming, and fruitfulness, enhance the quality of the fruit, fix damage, contain a plant, and promote light and spray penetration. Pruning creates the tree's structure, its form, and its framework, which supports the crop and makes mechanical activities easier. Pruning, as a tree ages, removes broken and diseased wood, encourages new growth, and provides crucial light distribution throughout the tree for the creation of healthy fruit buds and crucially acceptable fruit quality with proper fruit colour, soluble solids, and maturity.

2. **Objectives of pruning**

- To regulate fruiting and flowering
- To increase output in plants that produce new shoots
- To get a steady bearing
- To eliminate weak, sick, damaged, and insect-infested shoots.
- To thin out fruits and blossoms
- To make sure bearing shoots have access to sunshine.
- To achieve equilibrium between vegetative and reproductive growth

3. **Principles of pruning**

- Eliminate water sprout
- A shoot should be separated from the base in order to remove it fully.
- Avoid damaging the bark when pruning.
- To achieve this, clip the branches with a larger diameter from the surface below.
- Pruning needs to be finished well before the flowering season.
- Pruning should be done on deciduous plants before winter to reduce damage from low temperatures.
- After pruning, use Bordeaux paste to prevent the spread of diseases.

- It is best to eliminate any shoots that are crowded, intercutting, sick, damaged, or infected with insects.

4. Methods of pruning

- **Heading back:** Heading back is the removal of the shoot's terminal part while keeping the base intact.
- **Thinning:** Thinning is the selective and complete removal of plant components.
- **Ringing or girdling:** This procedure involves removing a 3 cm-long circular section of bark. By permitting a greater buildup of photosynthates in the upward region of the plant, it speeds up flowering and fruiting.
- **Notching:** Notching is the process of creating a notch above a bud by removing a piece of bark that was used to form a wedge. It inhibits hormone impact and promotes development.
- **Nicking:** Nicking is the process of cutting a wedge-shaped notch in the bark below a blossom. This makes sure that carbohydrates accumulate from the leaves to the bud, which may lead to the creation of fruit buds.

