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REVIEW ARTICLE

Senile Orchard Management System in Tropical Fruit Production

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ABSTRACT

For orchardists, traders, and scientists alike, the falling productivity of large, thick orchards that are abundant in recent years has become a serious worry. Due to an unsuitable location and climate, intercropping, insufficient nutrient levels, improper planting techniques, the use of unattractive planting materials, the occurrence of pests and diseases, and other biotic and abiotic challenges, orchards age prematurely. The use of rejuvenation technology, which includes top-working, reiterative pruning, and canopy rebuilding to increase production, may be a viable strategy for restoring the health and vigour of the trees and ensuring the profitability of orchards. There are two rejuvenation tenets: (1) Trees have dormant buds that, when they grow back, activate to form new branches and fruiting zones. (2) Branch heading back creates an unbalanced root to shoot ratio which is balanced by the tree by producing more branches. It was discovered that the fundamental reason of the guava's fall in terms of production and productivity was an overcrowded, ageing orchard planted in an ad hoc fashion that supports lower photosynthetic phenomenon and provides a suitable environment to house pests and illnesses. One of the causes of the low productivity in the mango industry is the vast number of ancient mango orchards that are 30-60 years old and older and have either stopped producing or have experienced a significant reduction in production. Sapota orchards grow senile and produce quality and quantity start to diminish over time as a result of irregular canopy management procedures. Timely broad spectrum fungicide spraying should accompany pruning activities.

HIGHLIGHTS

- Principles of senile orchard management.
- Senile orchard management in guava.
- Senile orchard management in mango.
- Senile orchard management in sapota.
- Constraints faced by farmers in adoption of new rejuvenation technologies.
- Farmers' difficulties adopting modern rejuvenation technology.

Keywords: Senility, orchard, tropical fruits, rejuvenation, pruning

Every living thing eventually loses its ability to perform a variety of functions, albeit the amount of time varies between species. Similar to other plants, fruit plants eventually yield less, both in terms of quality and quantity. As a result, orcharding is no longer profitable or economically viable. For orchardists, traders, and scientists alike, the falling productivity of large, thick orchards that are abundant in recent years has become a serious worry. In India, old, crowded, and sick orchards take up 30–35% of the land that is used for fruit cultivation (Baba *et al.* 2011). Due to an unsuitable location and climate, intercropping, insufficient nutrient levels, improper planting techniques,

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the use of unattractive planting materials, the occurrence of pests and diseases, and other biotic and abiotic challenges, orchards age prematurely. The first signs of a tree's decline include a sparse look, symptoms of yellowing and different types of foliage, undergrowth and a sickly aspect, dried-up top growth with few and less fruits. Tree branches begin to decay from the top down, which eventually produces fruits of poor quality (rough surface, thick skin and less juice). Senile orchards in India are the cause of the low average productivity of fruit orchards.

Consequently, managing senile orchards is necessary to boost productivity (Bakshi 2017). Old fruit orchards require revitalization because of a decline in yield and quality of fruit that can be attributed to any of the following: a reduction in photosynthetic surface area, a lack of productive shoots, an increase in insect pests and diseases, and less sunlight penetration due to overcrowding of branches, which prevents the fruits on the interior areas of the tree from developing proper colour (Baba *et al.* 2011). A large portion of the country's perennial fruit crop orchards are characterised by the presence of many aged, unproductive trees with diminished fruiting potential (30–35%). Their management techniques have been neglected for so long that they are essentially unproductive. The procedure of replacing the old orchards with a new plantation is more difficult. The use of rejuvenation technology, which includes top-working, reiterative pruning, and canopy rebuilding to increase production, may be a viable strategy for restoring the health and vigour of the trees and ensuring the profitability of orchards. Numerous advantages of rejuvenation procedures include early transformation and high-quality production from old, dormant, senile trees through improved sunshine absorption, use, and applied inputs (Kumar 2015).

Depending on the type of fruit trees and the state of the orchard, several rejuvenation technologies are used. Strategic planning and appropriate interventions are required for fruit production to meet the concerns of dietary and livelihood security and to increase yield and improve quality (Kumar 2015). Consequently, the rejuvenation technologies used in this article of major tropical fruits like guava, mango and sapota are discussed.

Principles of Senile Orchard Management

- Trees have latent buds which get activated by heading back to produce new branches and fruiting areas.
- Heading back of branches leads to imbalanced root to shoot ratio which is balanced by the tree by producing more branches.

Senile Orchard Management in Tropical Fruit Crops

(I) Guava

The guava (*Psidium guajava*) has chromosome numbers of 2n = 22, 33, or 44 and is a member of the Myrtaceae family. It is a little tree that can grow to a height of 33 feet (10 inches). The primary harvest in northern India ripens in the middle of winter, when the fruits are at their peak quality. During the wet season, a second crop is produced, but the fruits are watery and less plentiful.

Senility of Guava orchards

There are a number of production and productivity constraints that are crucial and serious for the deteriorating trends in the bearing potential of ancient guava orchards (Singh et al., 2005). The main reason of the problem was discovered to be an overcrowded, haphazardly planted ancient orchard that encourages reduced photosynthetic activity and creates an environment that is receptive to the growth of pests and diseases and decline in terms of production and productivity.

Rejuvenation technique

During the month of May, branches are headed back at a height of 2 metres above the ground. After rejuvenation pruning, the newly emerging shoots are allowed to reach a length of between 40 and 50 cm. These are further cut down to roughly 50% of their original length. In order to modify tree structure and maintain canopy size, these shoots are further pruned in the month of October to about 50% of their total length. This allows multiple shoots to emerge below the pruning portion. In the two years after that, in May and October, shoot management is continued for the same reason. After each pruning, a paste of copper and lime is applied,

as well as a paste of copper oxychloride on the cut surface.

Cultural practices in rejuvenated orchards

The trees are frequently watered to retain moisture for healthy growth of shoots and fruiting twigs, and each pruned plant receives 20 kg of vermicompost. After six months, integrated approaches to nutrient supply are implemented, with each plant receiving 30 kg of vermicompost, half a kilogramme of neem cake, 1300 g of urea, 1875 g of single super phosphate, and 500 g of muriate of potash in two separate dosages in the months of October and June.

(II) Mango

The mango's scientific name is *Mangifera indica.* It possesses chromosome 2n=40 and is a member of the Anacardeaceae family. Although they can reach heights of up to 30 m in some forest situations, mango trees normally reach heights of 3 to 10 m (10-33 ft) (100ft). Early to midsummer is when the fruit ripens, while mid- to late winter is usually when the tree blossoms. The canopy is evergreen and often expanding.

Senility of Mango orchards

The large number of old mango orchards, many of which are 30 to 60 years old and have either stopped producing or seen a considerable decline in productivity, is one of the reasons for the low production. This is due to sparse foliage and dense, intertwined branches that provide inadequate light availability to growing shoots within the canopy. This makes them unprofitable. In the north of India, tired trees can be revitalised by severe winter pruning to produce new shoots that can produce a good yield the following years.

Rejuvenation technique

Technique 1: In this method, the lofty centre stems are reduced in height to roughly 3–4 m. The area that has to be pruned should be where there are side branches. For the operation to be completed with a smooth cut, a chain saw is required. The tree's surviving trunks and leaves will assist shield the stump from sunburn in this instance where one-half of the tree has been pruned back. White water-based paint that has been diluted three or four times should be painted on the freshly exposed trunks and branches to the sun. This is done to avoid sunlight, which can entice borer infestation of the damaged bark. In a short period of time, multiple shoots will emerge; choose the strongest of them and place them evenly spaced around the stump, ideally at various heights. Eliminate all the undesirable shoots. Until the chosen shoots start to dominate and take over, this process should be done as often as necessary. The remaining portion of the tree can then be pruned, and the process can be repeated. By using this strategy, half the yield will be obtained up until it regains its vigour.

Technique 2: Moderate to severe pruning can frequently revitalise old, unproductive trees. This takes the form of "skeletonizing" the tree, which involves removing all but the most essential branches. The huge branches would need to be pruned back to healthy wood in order to moderately skeletonize the tree while preserving its basic form. Large unfrugal trees in particular would benefit from a more drastic skeletonizing, where all the main branches are removed, leaving only a metre or two of branch. To guard against sunburn and borer attack, the entire trunk and remaining branches should be sprayed with diluted paint. Both of these situations will result in an abundance of sucker growth. These should be handled as previously described.

Technique 3: Old and crowded mango plantations have lower light absorption and photosynthetic capability, which lowers production. First order branches are those that exist on the main trunk; second order branches are those that exist on first order branches; third order branches are those that exist on second order branches; and fourth and fifth order are similar. The highest yield for Alphonso was found at IIHR in Bangalore when third order branches were pruned 30 cm from their site of origin (86.3 kg/tree). After twelve years of trimming, a trial at CISH found that second order branches produced the highest pooled fruit output in Dashehari mango trees (57.99kg/tree).

Technique 4: In a farmer's field, the Central Institute of Subtropical Horticulture (CISH), Lucknow, launched an attempt to revive mango trees that were 40–50 years old. In this procedure, primary branches were clipped in December at a height of 5 m above the ground. For the development of a

strong umbrella-shaped canopy, about 3–4 diverging branches were left, and the rests were cut away from the base. Immediately after pruning, surfaces were covered with copper oxychloride paste to check for microbiological contamination. Trees that had been pruned were kept under close supervision. Cultural traditions like hydration, weeding, hoeing, and nutrition were carried out correctly. Beginning in April, several shoots proliferated from pruned branches. Only 8–10 healthy, outwardly developing shoots with adequate spacing were kept on each branch; the remainder were cut off. Because pruned trees began to flower and bear fruit after two years of pruning and growers suffered losses due to missing crops for two years, plant protection measures were seriously implemented, particularly against anthracnose, leaf cutting weevils, and stem-borers. As a result, technology was improved to allow for the pruning work to be done in these orchards' alternate rows. The availability of light to unpruned trees in two neighbouring rows was considerably enhanced by alternate row pruning, and their fruiting rose by two to three times. As a result, increased yield from unpruned trees somewhat offset the loss.

Cultural practices in rejuvenated orchards

1. **Inter cultivation:** The pruned mango orchards require regular cross-cultural practises to be maintained properly. It enhances the physical properties of the soil, ensures aeration by breaking up the crust on the soil's surface, and gets rid of weeds that compete with healthy soil for moisture and nutrients. The orchard soil needs to be ploughed twice a year in order to be managed. The first ploughing should be done in June, and the second one should be done in December. The initial ploughing aids in minimising runoff losses and maximising water uptake by the soil. The second ploughing of the year is required to control weed development and encourage vegetative shoots. June should be the month for the first ploughing, and December for the second. The initial ploughing helps to maximise soil water absorption and minimise runoff losses. The second ploughing promotes vegetative shoots and slows the growth of weeds.
2. **Orchard floor management:** Using this technology, intercrops can be grown on the orchard floors, regenerating trees while also generating income. In pruned orchards, intercropping is utilised to maximise the productivity of the use of space and land in order to generate additional income, particularly during the period of canopy development. After the mango orchard has been revitalised, it takes the tree around two to three years to establish a canopy and cover the area. However, it is important to choose the right intercrops for the rows of pruned mango trees. For up to three years after rejuvenation, it is simple to grow vegetables and legumes. Plants that prefer partial shade (such ginger, turmeric, and elephant foot yam) as well as cowpeas, beans, cabbage, cauliflower, chilies, okra, and other crops that yield a suitable return from the early canopy development stage are used as intercrops in orchards.
3. **Managing water:** The fact that the tree doesn't suffer greatly if it isn't watered during the hot months is the main financial incentive for producers to choose mango rejuvenation. A suitable amount of moisture is required to adequately start and develop shoot growth after branches have been trimmed back. Pruning trees requires constant watering during the dry season. The sprouting of new shoots and the regeneration process in the pruned trees are both adversely affected by moisture stress. Irrigation is essential in revived trees at regular intervals to ensure the start of shoots below the cut area. Every seven to ten days in the summer and every fifteen to twenty days in the winter, irrigation is required to maintain the healthy growth of tree canopies and fruiting twigs. This is in addition to the time of rainfall during the monsoon season.
4. **Surface mulching:** Black polythene sheets (100 micron or 400 gauge) or straw, dried grass, and banana leaves are utilised as a heavy surface mulch around the main trunk of pruned trees. It is best to apply organic mulch liberally (12 to 15 cm) in order to prevent weed growth while yet enabling

rainwater to reach the root zone. Black polythene sheets tend to develop water under the sheets through condensation, assisting tree growth in addition to limiting weed growth. Polythene mulched orchards use a great deal less water than orchards without it. Reduced water use may lead to lower input costs and higher output per square foot.

5. **Integrated nutrient management:** In revitalised orchards, this refers to maximising the benefits from all pertinent sources in a coordinated manner in order to maintain the soil fertility and plant nutrient supply to an optimal level for maintaining the desired crop productivity. Thus, it is a comprehensive approach in which we first comprehend the precise needs that plants have for the maximum level of production, the various forms that these nutrients can be applied in soil, the various timings that is best possible method, and the various forms that are best integrated to obtain higher productivity with efficiency of economically acceptable limits in an environmentally friendly way. Mango plants that have recovered require much more integrated nutrition and water control. In essence, the two inputs must be managed to provide the maximum possible result. How much fertiliser should be used depends on the kind of soil, the age, and the health of the tree. For healthy growth and a successful yield, fertiliser must be applied at the right dosage.

(III) Sapota

One of the key fruit crops in the Sapotaceae family is the sapota (*Manilkara zapota*). It has a 2n = 2x = 26 chromosomal number. Sapota begins to produce in the third year after planting, but commercial yields can only be attained in the fifth year. The two primary flowering seasons are October through November and February through March, and the two harvesting seasons are January through February and May through June. Sapota blooms profusely in a variety of flushes all through the year. As opposed to July-August (Mrig bahar) flowering, the fruit quality of October-November flowering (Hast bahar), which matures between August-September, is a little less desirable.

Senility of Sapota orchards

The majority of sapota orchards in India are dilapidated and unproductive. They age prematurely and yield less both in terms of quality and quantity as a result of irregular canopy management procedures.

Rejuvenation technique

Sapota plants get their first pruning in the first year, and in the following years, 3–4 healthy shoots with a favourable crotch angle are chosen to sustain the tree's main branch. The remaining shoots are periodically trimmed off to create a strong foundation with an open centre system. Thinning is done on secondary and tertiary branch trimmed trees. Tip clipping of terminal shoots, pruning of tertiary branches, pruning of secondary branches, and pruning of primary branches are the four types of pruning that can be done. Four types of growth regulator treatments, such as 20 ppm GA3, 50 ppm NAA, 100 ppm IAA, and 20 ppm 2,4-D as foliar spraying, are also possible. However, according to Sahu *et al.* (2018), tip trimming of terminal shoots and 50 ppm NAA hormonal therapy are associated with the highest yield.

Constraints Faced by Farmers in Adoption of New Rejuvenation Technologies

1. Lack of understanding and awareness of technology for rejuvenation
2. Reluctance to prune trees' deep roots.
3. Lack of confidence in rejuvenation methods and danger to the orchard following deep root pruning.
4. Concern over possible economic loss from missing two crops.
5. Lack of willingness to take risks.
6. A lack of equipment and skilled labour.
7. Aversion to the police and forest law.
8. Workload complexity.

CONCLUSION

It's crucial to manage senescent orchards if you want to boost the output of tropical fruit harvests. Timely broad spectrum fungicide spraying should accompany pruning activities. Applications of INM

and organic matter have had excellent results in the rejuvenation of some fruit trees. Although PGR application in senile orchard management is crucial, many farmers still do not take it into consideration. Consideration and solutions should be given to the difficulties that farmers encounter in this area.

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