IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

RECENT ADVANCES OF HIGH DENSITY PLANTING IN LITCHI

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Abstract

There has been a massive increase in the region and output of litchi in the last 50 years, but productivity has remained nearly constant, which is a cause for concern for all of us. As land, water, and other natural resources become more limited, there is every possibility of increasing productivity in litchi through high density plantation, canopy management, and precision production tools for horticulture in days to come. Litchi is a fascinating fruit that is common among people during the summer months (May-June) and is grown as a cash crop. High density orcharding is a relatively new concept for growing production without sacrificing fruit quality. It provides earlier output and return per unit area, reduces juvenility, and allocates resources efficiently. Dwarfing root stocks play an important role in allowing for a greater number of plants per unit area. For certain tropical and subtropical fruits, HDP has been found to be the most appropriate technique, allowing for a greater number of plants per unit area.

Keywords: high density planting, dwarfing root stock, juvenility, fruit quality.

INTRODUCTION

The litchi is a tasty and refreshing fruit with an attractive red skin that is native to various parts of the world. Litchi chinensis Sonn. is a subtropical fruit belonging to the Sapindaceae family, with chromosome number 30 and a climatic niche requirement that only allowed commercial cultivation in a few areas of the country as well as all over the world. The root is South China, and it was introduced to India in the late 17th century via Myanmar (Huang *et.al*., 2005). India is the world's second-largest producer of litchi, accounting for 91 percent of total global output. (Anonymous, 2011). In the last three years, India's litchi output has increased,

with a total production of 7.27 lakh MT in 2018-2019 on 0.95 lakh hectares with a productivity of 6.3 MT/ha (Anon, 2019). India exported 125.37 MT to various countries. in terms of quantity, with a cumulative revenue of Rs 106.28 lakhs (Anon, 2017). In 2013-14, Bihar was the leading producer of litchi, producing 234.3 thousand MT from 31.48 thousand ha with a productivity of 7.4 t/ha, compared to a national productivity of 7.0 t/ha (NHB database, 2014). As a result, it is also a perennial evergreen crop that helps to reduce global warming and pollution. Carbon trading is a term used to describe the process of trading. Litchi fruits are commonly consumed in their raw form. Fruits are also used to make various value-added items such as squash, jam, jelly, dehydrated nuts, and candy. It is highly specialized in terms of climatic and soil conditions. and, as a result, its production is limited to only a few countries in the world. the planet (Kumar *et.al*., 2014). Litchi ranks 10th in terms of area and 11th in terms of production among fruit crops in India, but sixth in terms of value. The most important fruits at the national level are banana and mango, but in Bihar, litchi is the most important fruit because it contributes significantly to total fruit production. Litchi has a small contribution due to its climatic and soil requirements.

Nonetheless, phenomenal advancements in tropical and subtropical fruit processing technology have occurred in recent decades as a result of the adoption of high yielding potential cultivars, efficient disease and pest control, and judicious use of water and nutrients, among other factors. With the population pressures, urbanization, and diminishing land, water, and other natural resources, fruit crop horizontal expansion space is becoming increasingly small. The best option could be to expand horticulture vertically by multi-story cropping models, density planting, meadow orcharding, and other methods. High density planting will help to increase productivity and close the gap between demand and supply of fruits in the future.

High Density Planting

The single most important factor that defines an orchard's yield is planting density. Since growing the area under fruit crop is virtually impossible, the only option left is to increase productivity. by maximizing the number of plants in a given area. With the advancement of technology, High density planting is a useful method for improving fruit quality. Productiveness. High density is becoming more and more common in various crops under various climatic conditions as the focus on high productivity per unit area grows (Chundawat *et.al*., 1992). HDP is a technique for increasing production per unit area in both short- and long-term horticultural crops.

Maintaining a balance between vegetative growth and fruiting is critical in a high-density planting method. The use of methods to monitor shoot growth and optimize light interception as the trees begin to bear fruit is critical to the success of this technology in most fruit crops (Menzel and Lagadec, 2014). The main goal of HDP is to meet the twin requirements of productivity and plant health and fruit quality by maintaining a balance between vegetative and reproductive development. The underlying concept of HDP is to allow the most efficient use of vertical and horizontal space per unit of time, as well as to maximize the return on inputs and natural resources per unit of input. However, the precise limit of plant density that qualifies as HDP has yet to be determined. It varies depending on the growing area, species, variety, rootstock, agro-techniques used for a specific crop, and orchard return. In India, high density plantings of guava (Lal *et.al*., 2007), litchi (Mishra *et.al*., 2014), mango,

and papaya have been successfully demonstrated (Ram,1996). The success of high-density perennial crop planting is dependent on effective orchard management in general, and litchi management in particular.

Advantages of HDP:

Higher production efficiency: The goal of high-density planting is to increase production efficiency, which is characterized as yield per unit of production capacity. The area of the ground covered by the tree canopy, the total area of the tree canopy, the total volume of the tree canopy, and the carrying volume of the tree canopy all affect the production potential. As a result, yield per unit of ground area, canopy area, canopy volume, or canopy bearing volume may be used to measure output performance. In a small orchard, the entire tree volume can be called productive or bearing, while large trees have an inner non-productive section that accounts for a substantial portion of the overall tree volume. This is a significant factor that favors the suitability of smaller trees to higher planting densities.

Precocity: In HDP, it's critical for trees to get a head start on development and produce a high yield of fruit before crowding occurs. A significant aspect of high-density planting is the induction of precocity by the use of rootstock, which is missing in litchi and needs to be standardized along with effective propagation techniques. In the absence of dwarfing root stocks, pruning (summer pruning, root pruning), girdling, and the use of growth regulators are the only options for inducing precocity (Luck will, 1978).

Early returns on investment: Though the initial investment per unit area in HDP is higher than in traditional planting, the higher initial investment is quickly repaid because HDP plants are smaller and have the potential for precocity and prolificity.

Better land utilization: The HDP allows for better land utilization to produce high-quality fruits, particularly in the early stages of fruiting. This allows farmers to achieve higher yields/unit area.

Easy management: In all agricultural activities, smaller trees are simpler and less costly to handle. As a result, operational costs are reduced. These trees allow for the use of orchard machinery.

Production versatility: The HDP also provides production flexibility because variety can be easily modified by planting dwarf trees that come into production in 4-5 years. It is, however, difficult in a litchi plantation.

Reduction in cost of production: It makes fruit crop production more mechanized and allows for more effective use of agricultural inputs.

HDP'S LIMITATION

It leads to intense competition for space, nutrients, and water in the long run. Overcrowding of the canopy leads to a buildup of high humidity and decreased cross ventilation in the orchard, all of which encourage the spread of pests and diseases. Closely planted trees quickly crowd each other, resulting in lower yields. Attempts to develop dwarfing rootstocks that can regulate the size of mature trees have largely failed. The most significant

obstacle to high density orchard success tends to be effective canopy management. Growth retardants are used in high-density orchards to limit growth. Some growth regulators have been found to remain in the harvested fruit and soil, according to studies (Menzel and Lagadec, 2014). Fruit size and consistency have been reduced.

High density planting techniques: factors such as site selection, site planning, and irrigation are more critical when it comes to establishing high density planting in litchi. It will determine the productivity of litchi because it is propagated by air layering and the use of rootstock, as well as standardized grafting techniques, has yet to gain commercial traction. Furthermore, for high density planting in litchi, planting geometry, nutrient management, and canopy management are critical considerations.

Despite the fact that work on high density planting in various locations in Litchi proved effective in increasing productivity. However, it requires more attention than other fruit crops, especially in Indian conditions.

Planting geometry: In litchi, cultivar vigor is most important, but the system of planting is determined by the size of the tree to be maintained and the number of viable plants that can be accommodated per unit area. Climate and soil conditions are also essential factors in determining the spacing of litchi orchards. In Litchi, there is very little detail on density planting. After ten years, a litchi plot consisting of Mauritius (Tai So) and Floridian cultivars planted at 5*5 m distances became overcrowded. Instead of thinning out the trees, mechanical pruning (topping at a height of 2.5m and hedging) was used for three years in a row, in combination with autumnal water tension. With these techniques, a small stature litchi plot with open spaces between the trees was maintained, resulting in reliably high yields (10 tons/ha/yr.). The findings suggested that planting litchi orchards at a high density (3*5m) might be possible (Goren *et.al*., 1993). For litchi cv. Bombai, Bose *et.al.* (1992) recorded an optimum plant density of 156 plants/ha, yielding 7t/ha (8*8m). Roe (1993) recommended that litchi and macadamia trees be planted at a final spacing of 10*10m to 15*15m. As a result, it took a long time for orchards to become successful in South Africa. As a result, he recommended that most litchi and macadamia orchards in South Africa be planted at a height of 5*5m to 7*7m, which would entail the least amount of tree manipulation. Goren (1990) found that pruning large existing trees of the cultivars Mauritius and Floridian annually between September and December reduced tree height without reducing flowering in Israel. According to Morton (1987), for a permanent orchard, trees should be spaced 40 feet (12 meters) apart in each direction. In India, 30 feet between trees is considered adequate, owing to the drier climate limiting overall growth. The sections of the litchi tree shaded by other trees usually do not bear fruit. As a result, for optimal efficiency, both sides must be exposed to light.

Nutrient management: It will be difficult to use soil management systems effectively because high density planting raises root mass per unit ground space and overall water use. As a result, drip irrigation and fertigation systems should be prioritized to ensure efficient water and nutrient use. On the basis of soil and leaf nutrient analysis, a nutrient application programmed will be planned.

Growth regulators: In mango and other fruit crops, pruning also results in heavy re-growth of shoots. To limit vegetative growth, plant growth regulators such as Paclobutrazol, Alar, Uniconazole, and prohexadione-calcium have been used. In South Africa, however, uniconazole was more effective than paclobutrazol at limiting avocado shoot growth (Kohne and Kremerkohne, 1989). Plant bio regulators such as daminozide (SADH or Alar) @1000-2000ppm, chloromiquat (CCC or Cycocel) @2000-3000ppm, paclobutrazol (Cultar)@1000-2000ppm, ethrel (Ethephon)@300-500ppm, TIBA 50-100ppm, and MH@1000-2000ppm play an important role in regulating tree size and increasing fruit crop precocity.

Canopy Architecture Management: Horticultural plants are cultivated for their low cost of production. In the current sense of diminishing natural capital, sustainable production of horticulture is a major challenge in developing countries like India. As a result, strategies for their management using "state-of-the-art" technologies for harnessing naturally available resources in a sustainable manner are needed of the society. The presence of a large number of old senile orchards among the fruit's crops, as well as the creation of a rejuvenation technology to restructure their canopy and enhance efficient and remunerative plant life, are clearly emerging issues in the field of canopy architecture and management. The productivity of the litchi crop is influenced by a number of agronomic/horticultural factors, the most important of which is poor canopy architecture management. Litchi canopy management is concerned with the growth and maintenance of the plant's structure in relation to its size and shape in order to achieve optimum production and high-quality fruit. For lowering production costs and rising yield and quality, tree architecture or canopy management, especially size control, has become a priority. Light interception is influenced by canopy nature and form, with guaranteed higher monetary returns.

Planting Density in Litchi

Litchi trees were traditionally planted with a small spacing of 9 or 10 m x 12 m or even 12 m x 12 m, with around 70-80 trees per hectare. After 15 years, such plantings can produce extremely high yields per tree, but they waste land in the early years. Large trees also pose challenges in terms of harvesting, spraying, and bird and bat defense. Plantations in India, Australia, and China used to be planted at a density of 80 to 150 trees per hectare. In Australia, new orchards are planted at a closer spacing of 6 m x 8 m, 4 m x 6 m, or 7 m x 3 m, equating to 200 to 600 trees per hectare (Menzel *et.al.*, 2000). Starting in the 1980s, litchi trees in China were planted in closer spacing, usually 5 m x 4 m or 6 m x 5 m, with 330-500 trees per hectare. There are several orchards that are extra dense, with 1500 trees per hectare (3 m x 2.5 m) (Chen and Huang, 2000). In recent years, a greater focus has been placed on increasing output per unit area by various means. One such approach is high density planting, which has proven to be effective in a variety of fruit crops. In India, the All India Coordinated Research Project is investigating different planting systems

(square, hedge row, double hedge, paired planting, and cluster planting) as well as density (204 to 453 plants/ha) in various locations. Hedgerow planting appears to be more profitable during early fruiting years, according to preliminary findings. The high-density system is a highly intensive farm production system with important implications for food and nutritional protection in a populated country like India. Productivity is rising in

advanced countries, but it is stagnating or declining in India. Due to the constant decline in land availability and natural resources, as well as the rising demand for fruits, it is important to establish an effective high density planting technique to increase litchi production. High density planting (HDP) is one such technology for increasing fruit production since it accommodates the most plants per unit area and produces the most fruits from the smallest amount of space and time. Mohammad and Wilson (1984) listed the HDP as medium high-density planting, with 500 to 15500 plants per hectare. Optimal high-density planting with 1500-15,000 plants per hectare, ultra-high-density planting (super intensive planting) with 10,000-20,000 plants per hectare, and meadow orcharding with more than 20,000 plants per hectare Obviously, the plant population in various locations differs the density of planting varies depending on the plant's condition, precocity, and bearing prolificacy, as well as the management involved.

Conclusion

Improving the yield and quality of litchi fruits necessitates a number of procedures. One of the most important factors in maintaining litchi fruit yield and quality is canopy management. The results of this study show that pruning treatments outperform control in terms of fruit quality, yield, and yield attributing parameters. The most suitable pruning treatment for high density planting is extreme pruning at a height of 2 m above ground level. It was found that after 12 - 13 years, yields in high density planting (6m x 4m) began to decline; therefore, to maintain litchi yield and quality while profiting from high density orchards, extreme pruning should be done in June after harvesting of litchi fruits. Various attempts to standardize HDP in fruit crops have had varying degrees of success, but commercial implementation in farmers' fields is still lacking. Mango, litchi, and guava are among the most vigorous tropical and subtropical fruit crops. Canopy control by pruning is poorly known, and the use of machinery for pruning is either non-existent or nonexistent in India.

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