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## Original Research Article

# Relationship between Plant Canopy Volume, Leaf Area Index and Yield in Mango (*Mangifera indica* L.) Cv. Alphonso

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**A B S T R A C T**

Mango is the leading fruit crop in India in term of area and production among various fruit crops. Now a days, the farmer's trend has been changed from traditional farming to high density planting and rejuvenation of old orchard. So, plant canopy volume and leaf area index (LAI) plays vital role in determining plant yield. Optimized light distribution in canopy and its interaction with different parts is critical for enhancing photosynthesis, flower bud development, fruit development and colour formation. This experiment is carried out in randomized block design with 7 treatments and 3 replications. LAI is measured by using LAI – 2200 Plant Canopy Analyzer (LI-COR Inc. Lincoin, NE). Maximum yield (48.76 kg/tree) was recorded in $T_3$ (plant canopy volume 155.02 $m^3$) with LAI 1.259 whereas, minimum yield (23.74 kg/tree) was recorded in $T_7$ (plant canopy volume 139.31 $m^3$) with LAI 1.206. During investigation it was observed that Plant canopy volume, LAI and yield are interrelated with each other. Yield of mango trees shows increasing trend with rise in both plant canopy volume and LAI.

**Keywords**

Mango, Canopy volume, Leaf area index, yield

## Introduction

Mango (*Mangifera indica* L.), one of the species among the 73 genera of the family Anacardiaceae in order of Sapindals, is important tropical fruit in the world. It is also known as "King of the fruits" (Purseglove, 1972). It originates from the Indo-Burma region, with 41 recognised mango species, which originate as a resinous and fibrous forest tree (Mukherjee, 1951 and 1967). In India, Mango grown on an area of 2500 thousands ha, with production of 18002 thousands M. tons, and productivity of 7.2 MT/ha.

Leaf area index is defined as the estimated area of leaves over a unit of land ($m^2$/ $m^2$), so one LAI unit means 10,000 $m^2$ of leaf area per hectare. The amount of leaves in the canopy of the plant is one of the essential ecological characteristics generally quantified by the leaf area index (LAI). LAI is one of the principal driving forces of net primary photosynthesis, use of water and nutrients and carbon equilibrium. It is an important variable used for the prediction of primary photosynthetic development and evapotranspiration. In theoretical ecology of development, LAI plays a key role. Light interception is directly related to the overall dry matter production of a number of crops (Duncun *et al.*, 1973) which is also ideal for fruit trees (Jackson and Palmer, 1977). Efficient light distribution within the foliage and its interaction with various parts is critical to maximizing photosynthetic activity, flower bud development and colour development (Rajan and Lal, 1999). Leaves are an active medium of energy, carbon and water exchange among tree canopies and the atmosphere. Assimilate production depends on the area of the leaf and its light exposure, expressed by the volume of the canopy, the density of the leaf and the interception of the leaf light. The Leaf Area Index (LAI) which regulates certain physiological processes, including evapo-transpiration, photo-synthesis, etc. can be used to define the leaf canopy component (Villalobos *et al.*, 1995). The leaf area index in coincidence with sunlight interception is useful as a basis for analyzing canopy productivity (Fischer, 2011). Photosynthesis is probably the mechanism most observed and modelled, not least because of its direct influence of $CO_2$ on the photosynthetic pace. Leaf area index varies with many variables (e.g. recurred climate, water and nitrogen availability and a certain level of CO2) (Drake *et al.*, 1997). Latest investigations have shown that canopy photosynthetic activity increases with the leaf area index (Rochette *et al.*, 1995). The Leaf Area Index (LAI) measures the quantity of leaf quantifiable in the ecosystem, imposing essential controls on photosynthesis, respiration, rainfall and other processes that connect plants to the environment.

The objectives of this work were to evaluate the use of a LAI – 2200 Plant Canopy Analyzer (LI-COR Inc. Lincoin, NE) for measuring LAI in mango trees (*Mangifera indica* L.) and studying relationship between plant canopy volume, leaf area index and yield in mango.

## Materials and Methods

The study was conducted on Alphonso cultivar at Department of Horticulture farm, Dapoli. 35 years old trees, planted at distance 10 × 10 m were selected for study. The experiment is carried out in Randomized block design with 7 treatments and 3 replications. The plant canopy volume was calculated by following formula:-

Plant canopy volume= 0.5238 × canopy height (m) × [canopy diameter (m)]$^2$.

The plants are grouped according to their canopy volumes. The leaf area index (LAI) of each plants of groups was measured by using LAI – 2200 Plant Canopy Analyzer (LI-COR Inc. Lincoin, NE).

## Results and Discussions

The data presented in Table 1 revealed that the maximum yield (48.76 kg/tree) was recorded in group of trees where average plant canopy volume was 155.02 m$^3$ which is significant to others with maximum LAI of 1.26. The minimum yield (2.374 kg/tree) was recorded in group of tree where average plant canopy volume was 139.31 m$^3$ with minimum LAI of 1.20. Linear correlation (r=0.98, n=7) was obtained between fruit yields and LAI values (Fig. 1). So, with increase in Leaf area index there is significant increase in fruit yield also. The linear correlation (r=0.97, n=7) was found between canopy volume and yield was. As plant canopy volume increases, the yield also increase significantly (Fig. 2). It was observed that plant canopy volume, LAI and yield are interrelated with each other. There is correlation relationship between yield, leaf area index and plant canopy volume. From above data, it is clear that yield of mango increases with increase in leaf area index and plant canopy volume.

Linear correlation (r=0.99, n=16) was obtained between fruit yields and leaf area index (LAI) values of the apple trees. With the increase in leaf area index, a significant increase in yield was also obtained (Senyigir *et al.*, 2013). Hardon *et al.*, (1969) found increases in bunch yield with increasing LAI in excess of 5.0 in oil palm. The mean overall and spur canopy LAI and light interception is strongly and favourably associated with fruit yields (Wunsche and Lakso, 2000).

**Table.1** Relationship between Canopy volume ($m^3$), Leaf are index and yield of the mango cv. Alphonso

| Treatments | Canopy volume ($m^3$) | Leaf Area Index | Yield (Kg/Tree) | Yield (Tons/ha) |
|---|---|---|---|---|
| $T_1$ | 148.73 | 1.23 | 37.04 | 3.704 |
| $T_2$ | 152.33 | 1.24 | 40.27 | 4.027 |
| $T_3$ | 155.02 | 1.26 | 48.76 | 4.876 |
| $T_4$ | 146.82 | 1.21 | 31.94 | 3.194 |
| $T_5$ | 145.90 | 1.22 | 34.42 | 3.442 |
| $T_6$ | 141.43 | 1.21 | 27.46 | 2.746 |
| $T_7$ | 139.31 | 1.20 | 23.74 | 2.374 |
| **SEm±** | **0.95** | **0.005** | **1.40** | **0.14** |
| **CD** | **2.32** | **0.015** | **2.96** | **0.29** |

**Fig.1** Relationship between Leaf Area Index and yield per tree of mango cv. Alphonso

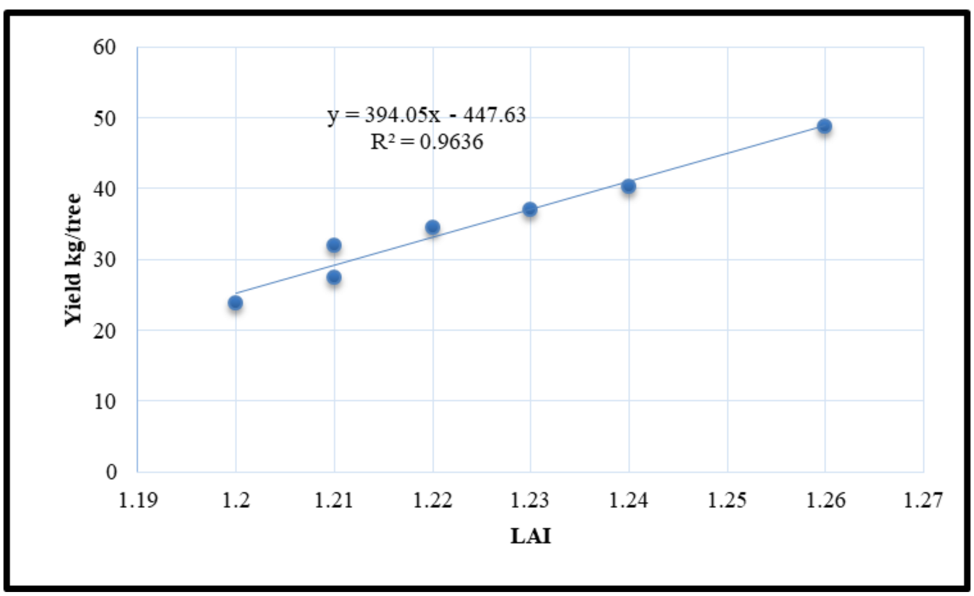
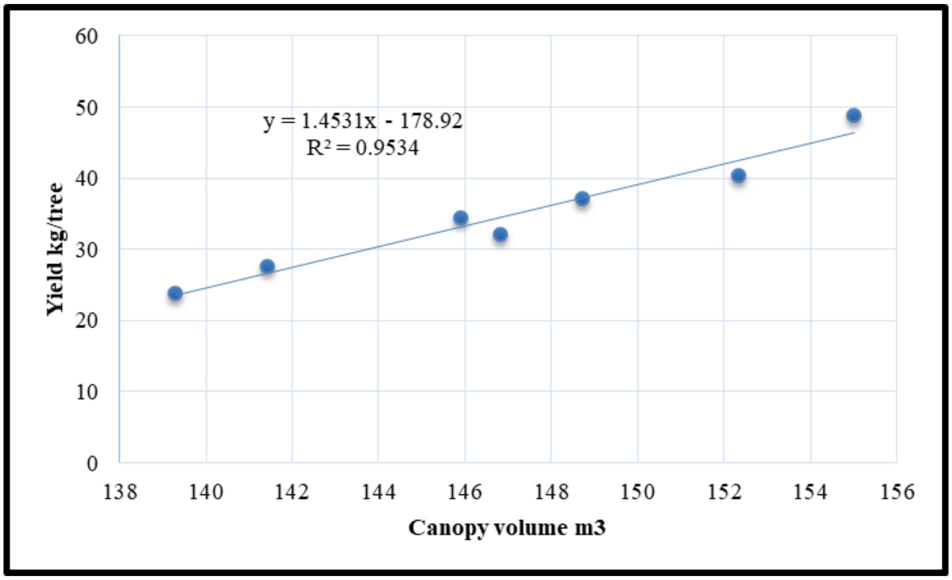


**Fig.2** Relationship between plant canopy volume and yield per tree of mango cv. Alphonso




In conclusion, the leaf area index (LAI) is an important parameter in crop growth. It reflects the leafiness of the crop. The leafiness in one way reflects the photosynthetic capability of the crop. A number of researchers had observed a strong association between fruit yield, leaf area index and plant canopy volume. The yield increases with the increasing leaf area index but, after some rise in the leaf area index, the yield and productivity decreases due to the reduced light distribution in the canopy. There is scope for canopy management, such as center opening, pruning, heading back of branches, thinning out, etc. It is possible to determine the yield on the basis of the relationship between the yield and the canopy volume of the plant and the leaf area index of the plant.

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