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Effect of planting distance on radiation interception behaviour of guava (*Psidium guajava* L.)

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ABSTRACT

Radiation interception by the guava tree increased with increase in planting distance and decreased progressively with the depth of tree canopy from top to the bottom on per tree basis. The radiation interception remained somewhat static from May to January in the upper third part of tree canopy while it decreased from January to March during the leaf shedding period. The radiation interception during January to March, however, increased in the middle third and lower third parts of tree canopy as more radiation penetrated in the inner parts of canopy. The upper third part of tree canopy showed maximum radiation interception during mid-day (1200-1400 hours) while less radiation was intercepted during morning (0800-1000) and late afternoon (1600-1800) hours.

Keywords : Guava, Radiation interception, Planting distance, Leaf area

Guava (*Psidium guajava L.*) is one of the most important tropical and sub-tropical fruits. Being hardy, prolific bearing and nutritive it can be grown successfully even under adverse situations. Closer spacing of guava trees is advocated to get high production per unit area. Moreover, as guava bears on current season growth and is amenable to pruning too so it is suitable for closer plantation. Under closer spacing, radiation is an important aspect which affects the vegetative growth and fruit quality. The radiation interception behaviour of temperate fruit crops like apple and peach have been studied but not much work has been done in tropical and sub tropical fruits particularly guava (Purohit, 1988). Information on the radiation interception behaviour of different parts of evergreen fruit tree canopy like guava is also quite meager. Therefore, the present study was planned to evaluate the radiation interception behaviour of guava at different spacings.

MATERIALS AND METHODS

The study was conducted on uniformly grown eleven-year-old guava trees (cv. Sardar) trained on modified leader system in the orchard of Punjab Agricultural University, Ludhiana. Guava trees were planted at 3 different spacings viz. 6mx6m, 6mx5m and 6mx4m. The incident solar radiation and reflected short wave radiation A, -A (albedo) were recorded 1m above the top of canopy over the 2-year period at fortnightly intervals on clear days three times per day (between 0800-1000, 1200-1400 and 1600-1800 hour). The average incoming solar radiation was also measured at the center of upper third, middle third and lower third part of tree canopy with a tube pyranometer Middleton Model CN-9). The average tree height was 4.79m, 4.84m and 5.29m at 6mx6m, 6mx5m, and 6mx4m spacings, respectively. Radiation interception for different parts of tree canopy was obtained as under:

Radiation intercepted in

$$\text{upper part} = \frac{I-(I_1+A)}{I} \times 100 = X\%$$

$$\text{middle part} = \frac{I-(I_2+A)}{I} \times 100 - X\% = Y\%$$

$$\text{lower part} = \frac{I-(I_3+A)}{I} \times 100 - Y\% = Z\%$$

Total interception by tree canopy = X % + Y %+ Z %

I = Incoming solar radiation received 1m above top of the tree canopy

I_1, I_2 and I_3 = Incoming solar radiation received in the upper third part, middle part and lower third part of tree canopy, respectively.

To compare the overall effect of three tree spacings and three parts (upper, middle, lower) of tree canopy, the radiation interception taken three times a day, twice each month over the 2-year period are presented as aggregated average for any month from the 12 set of observations. Further, the overall radiation interception for three times of the day are also presented from aggregated averages of observation each over the 2-year period.

RESULTS AND DISCUSSION

The radiation interception by different parts of tree canopy during March to August (Fig. 1) and September to February (Fig. 2) by guava tree at different planting distances reveals that among different parts of tree canopy, radiation interception at any time of the year was highest in upper third part of tree canopy at all three spacing treatments. The radiation interception in upper third part of canopy was the lowest in the month of March which gradually increased upto the month of May and remained somewhat static till August (Fig. 1). This may be due to the fact that during February-March, normally old leaves undergo senescence, turn yellow and start falling down and simultaneously new leaves show emergence. The new leaves as well as yellow leaves are known to have relatively high transmissivity. Thus, less radiation was intercepted during this period by the upper third part of tree canopy and more of it reached the lower parts. Moreover, due to less foliage, leaf area started decreasing and radiation interception being a function of leaf area decreases during this period. The leaf area again increased gradually due to new growth and reached a maximum from May to August. These results were found in consonance with the findings of Palmer *et al* (1992) who also reported increased light interception and a more even- distribution of light with higher leaf area.

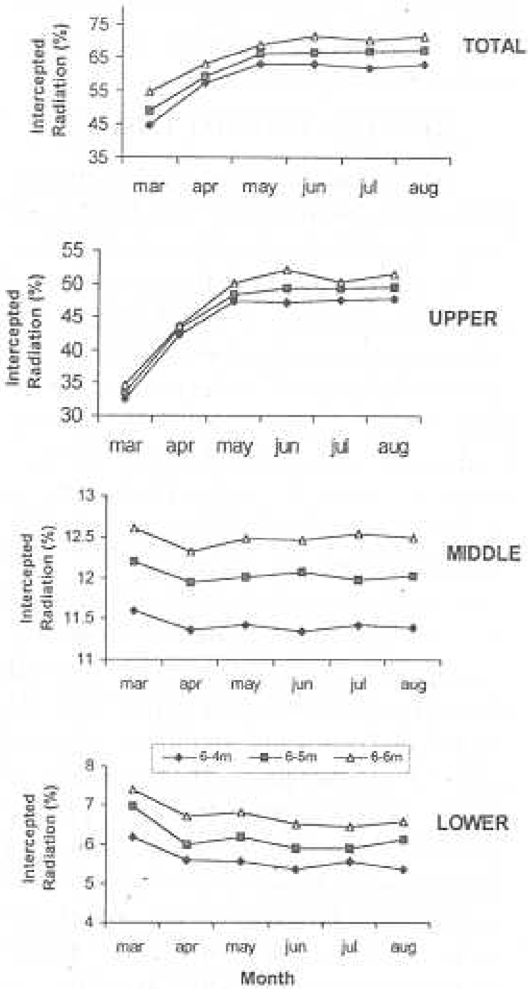

Fig 1: Average periodic radiation interception by upper, middle and lower part of guava tree canopy during March-Aug at different planting distances

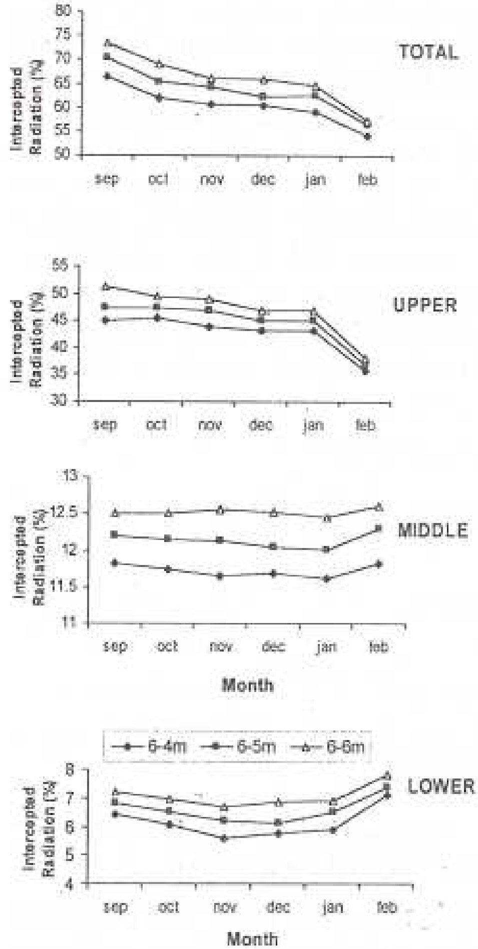

Fig 2: Average periodic radiation interception by upper, middle and lower part of guava tree canopy during Sept.-Feb at different planting distances.

The radiation interception in the middle and lower third parts of canopy was the highest during February-March and was low during April to January. This may be attributed to the fact that during May to August higher leaf area and biomass

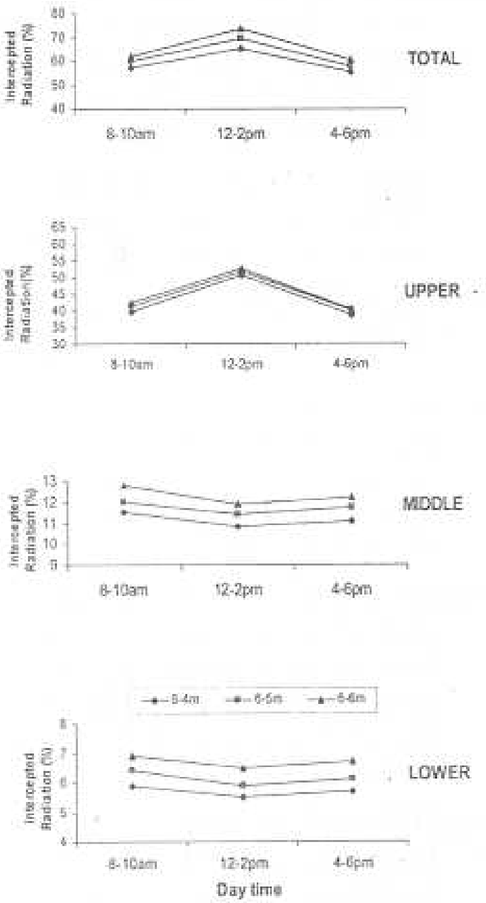

Fig 3: Average periodic radiation interception by upper, middle and lower part of guava tree canopy at different planting distances

intercepted more radiation in the upper third part of the tree and less radiation penetrated in the middle and lower parts of tree canopy.

During September to February, radiation interception in the upper third part of tree canopy remained almost static from September to January and decreased by February as leaf fall normally takes place during February-March leading to decreased three leaf area (Fig.2) whereas the radiation interception increased in the middle third and lower third canopy parts during this period. Similar results have been noted by Jackson (1970) in apple who reported that light intensity of full-sunlight (100%) available at the round headed apple tree canopy fell to 34 percent at a depth of 1m. Similarly, in citrus, 90 percent of the solar radiation was absorbed by the first 0.9m of the canopy (Greene and Gerber, 1967). Ferree (1980) also found that radiation transmission values declined in all the systems from top third of the tree to the bottom third and such a contribution of intercepted solar radiation in the upper canopy part had a positive effect on fruit quality.

The trees planted at 6mx6m spacing captured significantly more radiation (Fig. 1 and 2) than those spaced at 6mx5m and 6mx4m on per unit tree basis. It may be due to larger tree volume and more spreading branches in the 6mx6m spaced trees. The larger tree canopy volume would than also increased the sink strength which results in an increased fruit number and yield per tree as well as better fruit quality (Singh 2004), in agreement with those of Singh (2003) and Singh et al. (2004) in Peach (cv. Shan-i-Punjab) who also found maximum radiation interception in the trees spaced at 6mx6m compared to those spaced at 3mx3m, both trained to the modified leader system.

The periodic day-time radiation interception at different planting distances is shown in Fig. 3 which depicts sharp increase in radiation interception upto 1200 hour and then decrease by the evening hours in the upper third part of the tree canopy. However, in the middle third and lower third canopy parts, radiation interception was found more during the early morning and late afternoon hours but was lesser during the mid-noon hours. This may be due to changes in albedo from the canopy and contribution of diffused radiation within the canopy.

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