

Stomatal Density, Leaf Area and Canopy Volume of Guava Trees as Influenced by Exogenous Ethephon Application

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Abstract

Exogenous ethephon application significantly influences the tree canopy volume, leaf area and number of stomata in guava leaves. During both years of study the plant canopy volume was significantly restricted by ethephon application and was measured only 38.85 m³ in ethephon 1000 ppm treated plants as compared to 45.62 m³ in untreated plants. Similarly, least leaf size (32.20 cm²) was measured in ethephon 1000 ppm treated plants followed by 33.17 cm² in ethephon 500 ppm treated plants and maximum leaf area (34.70 cm²) in plants kept as control. The stomatal density exhibited negative association with leaf area. As the leaf area increased the stomatal density decreased. The plants with least canopy volume and reduced leaf area exhibited highest stomatal density. The plants treated with higher dose of ethephon gave the maximum stomatal density of 52.06 stomatas per 0.1 mm² area and minimum of 46.95 stomatas in unsprayed plants.

Key words : Guava trees, Ethephon, Stomatal density, Leaf area, Canopy volume.

The stomatal density is technique that provides an idea about the growth potential of plants in a short time. The relationship between stomatal density, and plant growth is investigated in many fruit crops like apple (1), mango (2), ber (3), citrus (4). They studied the relationship between stomatal density and growth potential of different vegetative vigor groups. However, these studies were only related to the genetic growth potential of plants. Very little information is available in modified growth or induced dwarfness and stomatal density. Therefore, the present investigation was conducted to examine the relationship between the plant growth, leaf area and stomatal density under the influence of exogenous ethephon application.

Methods

The present investigations were carried out in the New Orchard, Department of Horticulture, Punjab Agricultural University, Ludhiana during 2007 to 2009. The plants of guava cv L-49 was planted in March, 2003 at 6 × 5 m spacing. The plants were sprayed with the ethephon at 500 and 1,000 ppm in April and Sep-

tember, the area of fully developed leaves from third pair from the shoot tip were taken from all the experimental and control trees during both years. Leaves were taken from each side of the trees. For each treatment and replication 20 leaves were measured with the help of leaf area meter and expressed in terms of cm² leaf area. For recording stomatal density the replicates of lower side of the same leaves taken for measurement of leaf size were prepared by applying the transparent nail paint. The transparent nail paint was applied on the dorsal surface of the leaves and when completely dried it was removed in the form of thin film called 'replica' with the help of forceps. These

Table 1. Effect of ethephon on canopy volume, leaf area and stomatal density of guava plants (2007).

Treatments (ppm)	Canopy volume (m ³)	Leaf area (cm ²)	Stomatal density (0.01 mm ² area)
Ethephon 1000	38.85	32.20	52.06
Ethephon 500	40.70	33.17	48.60
Control	45.62	34.70	46.95
CD (<i>P</i> = 0.05)	1.33	0.71	1.22

Table 2. Effect of ethephon on canopy volume, leaf area and stomatal density of guava plants (2008).

Treatments (ppm)	Canopy volume (m ³)	Leaf area (cm ²)	Stomatal density (0.01 mm ² area)
Ethephon 1000	44.83	31.90	50.3
Ethephon 500	46.89	32.55	48.1
Control	53.76	33.69	47.7
CD (<i>P</i> = 0.05)	1.4	0.95	1.18

replicas were observed under the high power objective microscope (10 × 40X given field area of 0.0825648 mm²) and directly counted the number of stomata nearby areole (joining of 2 veins) having maximum stomatal density. For each treatment 10 random examinations were done and then average was calculated. For calculation of stomatal density following formula was applied.

$$\text{Stomata density (mm}^2\text{)} = \frac{\text{Number of stomata}}{\text{Area of microscopic field (mm}^2\text{)}}$$

Then, number of stomata per 0.1 mm² was calculated.

The tree canopy was calculated by following formula (5) in (m³).

$$V = \frac{4}{6} \pi h^2$$

Where, h = height of tree (m)

$$r = \frac{\text{Sum of E-W and N-S directions (in meters)}}{4}$$

E-W = East-West, N-S = North-South.

Results and Discussion

Tree canopy volume, leaf area and stomatal

density in guava leaves was significantly influenced by the ethephon treatments. During first year of study the plant canopy volume was measured highest i.e. 45.62 m³ in untreated plants and least of 38.85 m³ in ethephon 1000 ppm treated plants (Table 1). Similarly maximum leaf area (34.70 cm²) was measured in plants kept as control followed by 33.17 cm² in ethephon 500 ppm treated plants and least (32.20 cm²) in ethephon 1000 ppm treated plants. The stomatal density exhibited negative association with leaf area. As the leaf area increased the stomatal density decreased. The plants with least canopy volume and reduced leaf area exhibited highest stomatal density. The plants treated with higher dose of ethephon gave the stomatal density of 52.06 stomatas per 0.1 mm² area followed by 48.60 stomatas and minimum of 46.95 stomatas in unsprayed plants. Similar observations were recorded in the next year of study (Table 2) that ethephon significantly check the plant growth. Ethephon 1000 ppm application provided the plants with least canopy of 44.83 m³ followed by 46.89 m³ in ethephon 500 ppm treatments and maximum canopy (53.76 m³) was recorded in untreated plants. Similarly, the leaf area decreased with ethephon application. Leaf area was measured maximum (33.69 cm²) in untreated plants and minimum (31.90 cm²) in ethephon 1000 ppm treated plants. The restriction in plant canopy under ethephon treatment may be due to antagonistic effect of ethephon on the growth promoting properties of plants. Similar effect was observed in earlier investigations on guava (6) that the ethephon at higher concentrations (500—3000 ppm) proved to be quite effective in reducing the plant height. In Allahabad Safeda guava (7) and L-49 guava (8), significant effect of ethephon treatment on vegetative vigor was also observed. The increase in stomatal density in ethephon treated plants may be directly related to the reduction in leaf area. The density of stomata was found higher in smaller leaves. Negative association between stomatal density and leaf area in acid lime (*Citrus aurantiifolia* Swing.) is also well investigated (9). In a similar examination, the number of stomata increased with Alar 85 treatment under both short day and natural day in chrysanthemum leaves (10) as compared to untreated leaves.

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