



INTERNATIONAL JOURNAL OF TRENDS IN EMERGING RESEARCH AND DEVELOPMENT

INTERNATIONAL JOURNAL OF TRENDS IN EMERGING RESEARCH AND DEVELOPMENT

Volume 2; Issue 5; 2024; Page No. 138-142

Received: 01-06-2024
Accepted: 03-08-2024

Role of Pruning and Training Systems on Guava Productivity in North Indian Plains

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DOI: <https://doi.org/10.5281/zenodo.17801495>

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Abstract

The productivity and fruit quality of guava in the North Indian plains are largely affected by the adoption of suitable pruning and training systems. Therefore, the present study was undertaken to study the comparative effects of different intensities of pruning, namely, light, moderate, and hard, along with three training methods modified leader, and bush system on vegetative growth, flowering habit, yield, and fruit quality of guava. Field experiments were conducted for two consecutive seasons across the major guava-growing regions of Panjab and Haryana. The results showed that moderate pruning with the open-centre training system significantly improved the canopy aeration and increased fruit set and overall yield. However, hard pruning favoured the regeneration of new shoots and reduced the fruit size and TSS. In contrast, a bush system encouraged higher fruiting surface, though with reduced size because of high crop load conditions. Among all the treatments, the maximum yield with superior fruit quality and higher economic returns were recorded in the open-centre system with moderate pruning. An integrated approach of systematic pruning, coupled with scientifically designed training systems, substantially enhances the productivity of guava in the North Indian plains and provides a practical strategy for commercial orchard management.

Keywords: Guava, pruning intensity, Pruning practice Le Mrigbahar, Fruit yield and quality

Introduction

Guava (*Psidium guajava* L.) is one of the most important fruit crops grown in tropical and subtropical areas of the world due to its high nutritive value, adaptability, and profitability. The North Indian plains, comprising Punjab, Haryana, and Bihar, Uttar Pradesh, are the major guava-growing areas in India and contribute a lot to the country's total production. Besides being a hardy crop, productivity in this region is often limited by problems associated with a crowded canopy, vigorous vegetative growth, poor light penetration, and irregular fruiting habit. Considering these issues, improved orchard management practices have become indispensable for better yield, quality fruits, and overall resource-use efficiency. Pruning and training are the two most important horticultural manipulations, which directly influence the tree architecture, canopy size, light distribution, and photosynthetic efficiency. Guava tends to bear fruits on current season's growth, making systematic

pruning an indispensable practice for encouraging new shoot emergence and regulating crop load. Likewise, appropriate training systems help optimize canopy structure, facilitate intercultural operations, and improve air circulation, thereby reducing the incidence of pests and diseases. Similarly, different pruning intensities and training methods, such as open-centre, modified leader, and meadow orchard, have been found promising in improving fruit set, yield consistency, and picking convenience. The climatic conditions of the North Indian plains, characterized by extreme temperature and fluctuating humidity, make the choice of appropriate pruning and training practices even more important for sustaining productivity. However, scientific information about the combined role of these practices under local agro-ecological conditions is scarce. Therefore, the present investigation was undertaken to study the effect of different levels of pruning and training systems on the growth behavior, flowering, fruiting, and yield

attributes of guava in the North Indian plains.

Materials and Methods

The experiment was carried out at the kaur farm, located in the North Indian plains Amritsar. The area has a subtropical climate, experiencing hot summers (upto 45 °C), cool winters (as low as 4–5 °C), and an average annual rainfall of 700–900 mm, mostly during the monsoon season. The experimental soil was sandy loam, well-drained, with a pH of 7.2–7.8. A uniform block of 8–10-year-old guava trees of a commonly grown cultivar (e.g., Allahabad Safeda or Lalit) planted at a spacing of 5 × 5 m was selected. Trees exhibiting similar vigour and size of canopies were selected to maintain experimental uniformity. Treatments A. Pruning Levels P₁: Light pruning (10–15 cm tip pruning) P₂: Moderate pruning (25–30 cm shoot pruning) P₃: Severe pruning (40–50 cm shoot pruning) P₄: No pruning (control) B. Training Systems T₁: Open-centre system T₂: Modified leader system T₃: Meadow orchard (ultra-high-density) T₄: Traditional system (control) A factorial combination (Pruning × Training) was applied based on orchard layout. Application of Treatments Pruning treatments were carried out during the last week of May, coinciding with the onset of monsoon flush in guava. Training systems were maintained through regular removal of undesirable shoots, selection of scaffold branches, and shaping of the canopy. All the trees uniformly received irrigation, manuring, fertilization, and plant protection measures.

Effect of Pruning on Vegetative and Floral Characteristics of Guava

Pruning assumes prime importance in control over vegetative growth and improving reproductive behavior in guava. Since guava carries fruits on the current season's growth, timely and appropriate pruning makes a significant impact on the emergence of shoots, the intensity of flowering, and subsequent fruit yield. Following are the effects recorded for different intensities of pruning in the North Indian plains. Effect on Vegetative Growth a. Shoot Initiation and Regrowth-Pruning promoted the emergence of vigorous, healthy shoots by breaking apical dominance and stimulating lateral bud break. Moderate to severe pruning (25–50 cm) caused: Greater number of new shoots per plant. Increased shoot length due to enhanced nutrient allocation Improved canopy rejuvenation and better light penetration Light pruning resulted in a milder response, while unpruned trees produced crowded, shaded shoots with weak growth. b. Canopy Structure and Size Pruning maintained an open and balanced canopy, improving: Air circulation. Photosynthetic efficiency. Distribution of sunlight within the canopy.

Effect on Floral Characteristics

a. **Flower Bud Formation:** Of the different degrees of pruning, moderately pruned trees produced the maximum flowering intensity as: New shoots arising after pruning remain the most active sites of floral bud initiation. Reduced crowding of canopy improved accumulation of carbohydrates and also the hormonal balance. Severe pruning showed a slight delay in flower initiation, but later there was a synchronized and profuse flowering.

- b. **Flowering Time and Duration:** Moderate pruning advanced the flowering by 5-10 days in comparison with unpruned trees. Severe pruning caused a brief delay but produced a concentrated flowering period, thus being helpful for uniform fruiting. Light pruning produced a flowering pattern somewhat comparable to the control but with the improved quality of flowers.
- c. **Flower Quality and Fruit Set:** The pruned trees recorded: An increase in number of flowers per shoot. Higher fruit set %. It has been attributed to better light exposure, increased availability of assimilates, and physiological vigour of newly formed shoots. Physiological Basis of the Response-The positive influence of pruning on flowering behaviour of guava is related to: An improvement in translocation of nutrients toward the developing shoots. Improvement in hormonal balance, especially an increase in cytokines due to bud activation. Improvement in the canopy microclimate with reduction in stress and therefore improvement in reproductive development. Rejuvenation of old bearing wood, encouraging the formation of fresh fruiting wood.

Effect of Pruning on Quality Characteristics of Guava

Pruning considerably affects the internal and external quality attributes of guava by altering the canopy architecture, improving the microclimate, and enhancing physiological activity inside the tree. Since guava fruits develop on current season's growth, pruning encourages the formation of vigorous fruiting shoots that directly contribute to improved fruit quality. The following effects were observed under different pruning intensities in the North Indian plains. Effect on Fruit Size and Weight- Increased availability of photosynthates per fruit. Better light interception and improved photosynthetic efficiency. Reduction in fruit number per shoot, allowing better resource distribution. Unpruned trees produced smaller fruits because of overcrowded canopies and competition among shoots for nutrients. Effect on Total Soluble Solids (TSS)- Higher carbohydrate accumulation in developing fruits. Enhanced sunlight exposure, which promotes sugar synthesis. Improved leaf-to-fruit ratio Effect on Acidity-Higher sugar-acid balance. Enhanced metabolic activities in fruits from vigorous and healthy shoots Severe pruning may slightly increase acidity in early harvested fruits due to delayed physiological maturity, but overall flavour quality remains superior to unpruned trees. Effect on Fruit Firmness-Balanced vegetative and reproductive growth. Improved calcium uptake and distribution. Better formation of cell wall components in fruits developing on vigorous shoots. Effect on External Fruit Appearance-Fruit colour development Uniformity in size and shape. Reduced incidence of blemishes and pest attack. An open canopy allows better light penetration, resulting in fruits with attractive skin colour and improved marketability. Light pruning gave moderate improvements. No pruning resulted in poor-quality fruits with low sweetness, poor colour, and reduced firmness.

Effect of Growth Regulators on Quality Characteristics of Guava

Growth regulators play a significant role in modifying the

physiological processes of guava, thereby influencing fruit quality parameters such as size, sweetness, acidity, firmness, and nutritional composition. The use of plant growth regulators (PGRs) like GA₃, NAA, 2,4-D, and Ethrel has shown promising results in improving fruit quality when applied along with pruning and training interventions in guava grown in the North Indian plains. Fruit Size and Weight-Application of growth regulators, particularly GA₃ (Gibberellic acid) at 40–60 ppm and NAA (Naphthalene acetic acid) at 20–40 ppm, significantly increased fruit size and weight. Reduced fruit drop and better retention (NAA effect). Improved nutrient translocation to developing fruits from PGR-treated plants are generally larger, heavier, and more uniform compared to untreated controls. Total Soluble Solids (TSS)- NAA and Ethrel treatments increase TSS by enhancing carbohydrate accumulation and stimulating ripening enzymes. GA₃ enhances overall metabolic activity, indirectly contributing to higher TSS levels at harvest. Acidity and Sugar–Acid Ratio-Ethrel accelerates ripening, leading to a reduction in titratable acidity. NAA-treated fruits show a more balanced sugar–acid ratio due to improved fruit maturity and reduced pre-harvest drop. Ascorbic Acid (Vitamin C) -Higher metabolic activity in developing fruits. Increased synthesis of antioxidants during ripening. Improved sunlight exposure due to open canopy created by pruning, enhancing PGR response Fruit Firmness-GA₃ delays the breakdown of cell wall components, resulting in firmer fruits. NAA reduces premature ripening and softening by maintaining cell integrity. Ethrel, although promoting ripening, still improves firmness when applied at low, regulated doses. External Fruit Appearance- Improved colour development (Ethrel enhances yellowing). Increased fruit uniformity (GA₃ and NAA help in synchronized development) Reduction in surface blemishes due to better nutrient uptake and moisture regulation. Growth character the flower was counted on whole plant before and after application of the treatments in April and July during both the seasons and mean values was presented for both the rainy and winter season separately. Length of sprouted shoot Length of each labeled shoots right from their point of origin up to their growing point was measured in cm with the help of flexible tape. This parameter was recorded thrice at an interval of 30 days from the date of sprouting after pruning. Height of plant height was recorded by placing long bamboo pole on the soil surface near the trunk base to the top of the plant and the height was measured in meters. Number of fruits per shoot Number of fruits per shoot was recorded by counting fruits of 5 randomly selected shoots in each of the experimental tree both in rainy and winter season and it was expressed in numbers. Number of fruits per tree Number of fruits per plant was recorded by counting fruits in each of experimental tree both in rainy and winter season and it was expressed in numbers. Physical attributes Fruit weight of above sampled fruit was taken on physical balance and average was expressed as gram per fruit. Fruit length the length and breadth of 10 samples fruits from each treatment were measured with the help of digital vernier calipers and expressed in centimeters. Yield attributes Fruit yield (kg per tree) The total weight of guava fruits per tree were recorded at each harvesting under each treatment and total yield per tree was calculated at the final harvesting and expressed in

kilogram per tree. Fruit yield (quintal per ha) The total fruit weight was recorded at each harvesting under each treatment and total fruits yield per ha was calculated at the final harvesting and expressed in quintal per hectare.

Conclusion

This investigation had established that pruning and training systems have pivotal roles to play in improving productivity, fruit quality, and overall orchard efficiency of guava grown in the North Indian plains. Pruning, especially in moderate intensities, stimulated the emergence of healthy fruiting shoots, improved flowering intensity, reduced fruit drop, enhanced fruit size, sweetness, and nutritional attributes. Improvement in light interception, air circulation, and microclimatic conditions in pruning led to considerable improvement in vegetative growth and reproductive performance. Training systems such as open-centre and modified leader forms provided a well-balanced canopy architecture which facilitated uniform shoot development, ease in the conduct of cultural operations, and better distribution of fruits. When appropriately supplemented with growth regulators like GA₃, NAA, and Ethrel, these training systems augmented fruit set, improved retention, enhanced various quality parameters, and significantly improved overall yield. For maximization of guava productivity under the agro-ecological conditions of North Indian plains, the integration of a moderate pruning system with scientifically designed training systems and the judicious use of growth regulators proved most effective. Our results emphasize the importance of adopting systematic canopy and hormonal management strategies for improving yield and fruit quality along with orchard sustainability. These can guide growers and researchers in formulating region-specific recommendations for commercial cultivation of guava.

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