P-ISSN: 2618-0723
E-ISSN: 2618-0731

NAAS Rating: 5.04
www.extensionjournal.com

International Journal of Agriculture Extension and Social Development

Volume 7; SP-Issue 2; Feb 2024; Page No. 25-33

Received: 13-12-2023
Accepted: 19-01-2024

Indexed Journal
Peer Reviewed Journal

Studied the growth, yield and quality attributes of guava as influenced by Canopy management practices: A review

[1]Ravi Pratap Singh, [2]Arun Kumar Singh and [3]Pooshpendra Singh Dixit

[1]Department of Horticulture, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya, Uttar Pradesh, India

[2]Professor and HOD, Department of Fruit science, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya, Uttar Pradesh, India

[3]SMS, Department of Horticulture, DRI, Krishi Vigyan Kendra, Chitrakoot, Uttar Pradesh, India

DOI: https://doi.org/10.33545/26180723.2024.v7.i2Sa.315

Corresponding Author: Ravi Pratap Singh

Abstract

Guava (*Psidium guajava* L.) is important tropical fruit crop grown throughout the tropical and sub-tropical regions. Although it is native to tropical America, its cultivation has spread to all tropical countries, with India being particularly important (Samson, 1980). It is a resilient, prolific bearer, and very profitable fruit crop that may be produced successfully in a variety of soil and climatic conditions. As a result, canopy management aids in achieving high quality and productivity. Now a days, there is a global trend in fruit-producing countries to accommodate the largest number of fruit plants possible by employing canopy management and pruning procedures to regulate tree growth and structure, so limiting tree size while yet ensuring high fruit production of desired quality. Pruning not only helps to encourage new shoots after the harvest but has also been adapted for rejuvenation of orchards along with crop regulation. Canopy management includes training and pruning, rootstock and scions, high density planting system and application of plant growth regulators. Guava bears flowers on current season's growth. Therefore, a light annual pruning is considered to be essential to boost up new vegetative shoot emergence. The length of flowering shoots tended to decrease with delay in time of pruning but increased with the increasing severity of pruning irrespective of season **(**Bajpai *et al*., 1973; Gopikrishna, 1981; Dhaliwal *et al*., 1998). An increase in shoot length due to severity of pruning might be due to elimination of growing points which in turn encouraged the length of remaining shoots (Dhaliwal *et al*., 1998). Pruning by heading back encourages new, long, whip-like shoots growth with sparse flowering compared with cutting at fork (Nakasone and Paull, 1998). Canopy Management included, training and pruning of guava trees has been found to improve yield and fruit quality (Mitra and Bose, 1990). The trees should be kept open for better penetration of sunlight leading to more number of shoot and higher yield.

Keywords: Fruit, canopy, pruning, productivity, quality, season, yield

Introduction

Guava (*Psidium guajava* L.) is a plant of the Myrtaceae family. The guava fruit has grown in popularity as a result of its excellent nutritional content, attractive aroma, rich flavour, and affordable market availability (Bal and Dhaliwal, 2003) [8]. It is a good source of Vitamin C (250-300mg/100g of pulp), contains carotenoids and polyphenols which are the major classes of dietary antioxidant pigments among plant foods (Hassimotto *et al*., 2005; Jimenez-Escrig *et al*., 2001) [35, 39]. Due to its astringent properties, mature guava fruits, leaves, roots and bark are used in local medicines to treat gastroenteritis, asthma, high blood pressure, obesity and diarrohea (Joseph and Priya, 2011) [40]. Besides its high nutritive value, it yielded a heavy crop every year and gave good economics returns involving very little inputs. In general, guava bears in three season's namely rainy, winter and spring seasons in a year. Fruits of rainy season crop are insipid in taste, poor in quality, less nutritive and are also attacked by insect pests and diseases. On the other hand fruits of winter season crop are superior in quality, comparatively free from diseases and insect pests and fetch higher prices in the market (Rathore and Singh, 1976) [69].

Guava has a higher proportion of 'shade' to 'sun' leaves and their leaves are found photo synthetically inactive under deeper shade and act as unproductive sink (Singh and Singh, 2007) [84]. Therefore, vegetative growth, fruit yield and quality are functions of light interception and translocation of light energy into chemical energy. Quality fruit is function of absorption of light and light is directly proportional to the yield of fruit trees (Jackson, 1980; Palmer, 1989) [37, 63]. Light interception was more in guava trees planted, at wider spacing and decrease significantly with the depth of the canopies inspective of the planting densities (Singh *et al*., 2005) [83]. It was observed that fruit yield and quality of guava fruits decreased with poor light interception at higher planting densities (Singh and Dhaliwal, 2007) [89].

Guava is the fifth most important fruit in respect of area and production after Mango, Banana, Citrus, and Apple in India.

The area under guava in India is about 0.27 million hectares, producing 4.10 million tones, Productivity of 13.7 million tones/hectare. In India, largest area and highest production under guava fruit is Uttar Pradesh and highest Productivity is in Andhra Pradesh (NHB data, 2018-019). The foremost reasons for low productivity are low planting density, no canopy and floor management and no crop regulation. Canopy management strategies are responsible for 30-40% increased output. Despite the fact that it reduces tree size and enhances fruit quality, shoot trimming has recently been proven to be effective in regulating guava crop production. As a result, the number of trees per unit area can be increased. Moreover, observations have shown that after 8-10 years of age, guava trees show considerable decline in yield with sub-optimal fruit quality owing to vigorous vegetative growth and frequent intermingling of the branches particularly in the lower half of the tree leading to unfruitfulness, as fruitful buds become blind. Such unproductive trees can be made to bear profitable crop for more years by judicious canopy management. Canopy management is resorted as a tool not only to control size but also maximize yields. Pruning has been used for orchard renewal as well as crop regulation, in addition to encouraging new shoots following harvest. Pruning is an ancient cultural method used in temperate and sub-tropical fruit crops to balance vegetative and reproductive growth. The flowers and fruits of the guava are produced on the current season's growth. A light annual pruning is considered necessary to encourage new shoots after the harvest. A better understanding of the effect of pruning is the need of an hour. Guava pruning has received little attention, yet given its economic relevance, it is justified. Pruning increased the yield of guava cv. Sardar, according to Lal (1983) [49]. Salah and El (2005) [72] similarly found that severe and moderate pruning resulted in the most guava bud emergence. Moreover, Serrano *et al.* (2008) [76] reported that the light pruning increased the number of productive branches and number of fruits per branch of guava cv. Paluma.

Canopy management practices in Guava

Canopy management is the process of adjusting the tree canopy to increase the production of high-quality fruits. An optimal training method focuses on the arrangement of plant parts, in particular, in order to build a superior plant architecture that maximises the use of sunlight and increases output. Fruit tree canopies must be managed to achieve the best balance of vegetative development and fruit output. Managing a canopy will aid in the development of a sturdy tree capable of supporting big crop loads, as well as increased fruit yield and improved frost resistance. Because guava trees respond effectively to canopy change in terms of vegetative and reproductive growth (Singh and Canaan, 2005) [85], trimming the canopy and using particular growth regulators in high density orchards may be approaches to improve production efficiency. Guava has a higher proportion of ‘shade’ to ‘sun’ leaves and their leaves are found photo synthetically inactive under deeper shade and act as unproductive sink (Singh and Singh, 2007) [89]. As a result, light interception and transfer of light energy into chemical energy are functions of vegetative development, fruit output, and quality. Fruit quality is a function of light absorption, and light is directly related to fruit tree productivity (Jackson, 1980; Palmer, 1989) [37, 63].

Principles of Canopy Management

The basic principles of canopy management are as described by Shikhamany (2001) [82].

1. Maximum utilization of light.
2. Avoidance of build-up of micro-climate congenial for the disease and pest.
3. Convenience in carrying out the cultural operations.
4. Maximizing the productivity and quality.
5. Economy in obtaining the required canopy architecture.

Methods of Canopy Management

The methods of canopy management are given by Salah and El (2005) [72].

1. Training and Pruning
2. Use of growth regulating rootstock and scion
3. High density planting system
4. Use of plant growth regulater

Effect of canopy management on vegetative parameters

Because of the orientation of sunlight, Singh and Bal (2006) [91] observed that canopy spreading in an east-west direction was better than in a north-south direction. Lian *et al*. (2019) [50] observed the effects of pruning months (mid-April, mid-May and mid-June) and pruning severity (pruning of 25%, 50% and 75% of shoot length from tip) on growth and yield of guava cv. L- 49 planted at a spacing of 6 m x 6 m at Fruit Research Farm, Department of Fruit Science, College of Horticulture, Pasighat, Arunachal Pradesh during April to December 2017, with an aim to optimize the time of pruning and intensity of pruning for harvesting of winter guava crop. Pruning in mid-April was found to be the best for increasing plant growth characteristics such plant height, collar girth, E-W and N-S canopy spread, length of shoot, fruit set, and number of fruits/plant, but mid-May pruning produced the highest maximum fruit output (kg/tree). When the degree of pruning was compared to the length of the shoots trimmed, different reactions were noticed. According to Thakre *et al*., high density management and crop regulation are two important aspects of guava (*Psidium guajava* L.) cultivation (2016). In order to determine the most cost-effective method of managing high density planting and crop regulation, the current study was conducted on 6-year-old guava trees of cv. Pant Prabhat planted in a double-hedge row system in 2009-10 and 2010-11. Seven different forms of pruning [FBT: flower bud thinning by hand, FBTT: flower bud thinning by hand followed by removal of terminal one leaf pair, RLFO: removal of leaves and flower buds by hand, retaining one leaf pair at the top, RLF: removal of all leaves and flowers by hand, OLPS: one leaf pair shoot pruning, FSP: full shoot pruning, OLPF: one leaf pair pruning of fruited shoots only] were studied along with control (C).Minimum annual increase in tree volume (6.764 m^3) was recorded with the treatment OLPF, which was 2.31 times less than the control (15.682 m^3). A split-pot design was utilised to assign three pruning periods (mid-April, early May, and mid-May) and four pruning levels to each treatment, with three replications in each (0-, 10-, 20-, and 30-cm tip removal).

Effect on shoot numbers

In terms of growth, the 90 cm pruning intensity produced the longest shoots (46.22 cm), the most internodes (16.20), and the most shoots (9.88) in the last harvest (Choudhary and Dhakare 2018) [43]. Pruning from April to June resulted in an increase in the number of shoots (Singh *et al*., 2001) [90]. Serrano and his colleagues (2008) reported that the light pruning increased the number of productive branches of guava cv. Paluma. Mohammed *et al.* (2006) [60] reported that the 30 and 60 cm pruning level generally found to increase the number of shoots. According to Bhagawati *et al*. (2015) [9], gentle pruning increased the number of shoots the most. According to Sarker and Ghose (2006) [74], bending shoots increased the number of shootlets per branch. According to Dubey *et al*. (2001) [27], the highest number of branches that appeared following pruning (Lateral shoots) were obtained with pruning intensities of 100 and 25%.Ethephon (600 ppm) produced the highest number of new shoots in both seasons (Shaban and Haseeb, 2009) [77]. Pratibha and Shant Lal (2012) [65] reported that one leaf pair shoot pruning significantly influenced the emergence of new shoot. Guerra and Bautista (1999) [31] reported that the guava trees height and number of Shoots were greater in Mara 4 and Mara 6 trees than in Mara 8 trees after the first pruning. (Sawant *et al*.; 2018) [62] observed maximum no. of shoots per plant, minimum days required for flowering, minimum days required from pruning to fruit set, days from fruit set to harvesting, maximum no. of fruits per tree and maximum yield were recorded in 50%, 33%, and 25% heading back of tertiary branches.

Effect on linear and radial growth of shoot

The highest increase in new shootlet length was achieved by pruning at 45 cm length in May. (Meena *et al*., 2017) [42]. Pruning guava plants promoted vegetative growth and, as a result, increased shoot length (Bisla *et al*., 1988) [10]. The maximum shoot length in highly trimmed guava plants was measured by Bajpai *et al*. (1973) [7]. (100cm). Agnihotri *et al*. (2013) [2] found that foliar spraying with 60 ppm 2, 4-D increased shoot length. The usage of potassium sulphate (1%) significantly improved the branch length of the guava tree (Manivannan *et al*., 2015) [54]. According to Bhagawati *et al*. (2015) [9], the earliest emergence of buds and cumulative lengths of new shoots are due to vigorous pruning. According to Chandra *et al*., regenerated guava trees were the most successful in stimulating the growth of new shoots (2012). According to Sarker and Ghose, bending shoots resulted in increased shoot length (2006). Wang and Choo (1984) [100] reported that bending the branches was most effective in controlling vegetative shoot growth. Dubey *et al.* (2001) [27] studied that the greatest length of shoots emerged after pruning (Lateral shoots) with 100 and 25% pruning intensities.

The maximum gross return was likewise attained when the shoots were pruned three times a year to 50 percent of their original length (Mehta *et al*., 2012) [56]. The cost-benefit ratio of one leaf pair pruning of fruited shoots alone (OLPF) was similarly found to be beneficial when compared to other treatments, with a cost-benefit ratio of 1:2.96. This treatment also yielded the maximum return in both the rainy and winter seasons (Thakre *et al*., 2016) [99].

Days to sprouting of new shoots

Maji *et al*., (2015) [53] found that 60 cm trimming resulted in early sprouting and flowering. Mohammed *et al*. also made a similar observation (2006). Shootlets appear earlier, and the shoots bend (Sarker and Ghose, 2006) [74]. The production of laterals was 12.8 days earlier in guava trees that had their leaders pruned by 4 to 5 inches than in plants that had not been pruned (Aravindakshan, 1963) [4]. Based on the data, it can be stated that only one leaf pair pruning of fruited shoots is appropriate for profitable high density management and guava production regulation in a farmer-friendly manner (Thakre *et al*., 2016) [99]. The experiment found that pruning at 45 cm shoot length in May resulted in the biggest increase in new shoot length (1.83 cm) at 15 days after pruning (DAP), followed by 30 cm pruning in April, and the lowest (0.31 cm) in the control, which followed a similar trend until 120 DAP (Meena *et al*. 2016) [55].

Flower drop

Guava cv. Sardar trees were cut at 45cm level in the first week of March to prevent bloom decrease (Brar *et al*., 2007) [16]. Sarker and Ghose arrived at the same conclusion (2006). Flower drop and fruit set percentages were at their maximum with 100 percent pruning intensity (Dubey *et al*., 2001) [27]. Similar results were achieved by Singh *et al*. (1996) [87] and Rajput *et al*. (1977) [68]. They found that spraying NAA (200) on guava cv. Allahabad Safeda resulted in less blossom or fruit drop. Fruit drop was reduced when 60 ppm 2, 4-D was sprayed on the leaves (Agnihotri *et al*., 2013) [2]. However, in the winter season crop, treatment P4 (TNFS+OLP) had the highest percent fruit set, whereas treatment P7 had the lowest (TNFS).

Effect of canopy management on floral and yield parameters

Guava trees bloom twice a year, in April-May and August-September, with fruits ripening throughout the rainy and cold seasons (Gupta and Nijjar, 1978) [32]. Fresh growth develops in the leaf axil quickly after the breal of winter stress, and floral buds form. Floral buds appear shortly after the first pair of mature leaves, although there is no link between the appearance of the leaves and flower production (Menzel and Paxton, 1986) [57]. Flowers appear solitary or in cymoses of two or three at the leaf axils of the current season's growth (Braganza, 1990) [13].

Number of flowers

Bajpai *et al.* (1973) [7] and Sheikh and Hulmani (1993) [80] reported that pruning adversely affected flower production in guava and the maximum number of flowers were obtained in lightly pruned trees in comparison to unpruned trees of guava during rainy season. The amount of guava flowers varies based on the season, variety, and other cultural treatments such as PGR, among other things. To obtain maximal blooming, Chandra and Govind (1994) [20] utilised urea (25%) and ethrel (2000 ppm). Spraying of ethrel (1 ml/liter) caused greater ethylene-forming enzyme activity in leaves leading to maximum number of flowers and fruits (Castelan- Estrada and Becerril Roman, 1994) [18]. According to Agnihotri *et al*. (2013) [2], foliar spraying with 60 ppm 2, 4-D increased the quantity of blooms. In the

summer season flush, Singh and Varu (2017) discovered that the 30th May pruning resulted in the lowest number of flowers (0.54) and fruit set per shoot (0.06), but the maximum number of flowers (5.05) and fruit set per shoot (3.33) in the kharif season flush. The results showed that pruning treatment accelerated the development of flowers and increased the number of generative shoots, the number of flowers per tree, and the amount of fruit collected, according to Widyastuti *et al*. (2019) [75]. The rate of stomatal conduction, as well as the quantity of stomata, support the increased blooming response caused by trimming.

Fruit set

Guava has a high natural fruit setting rate (80-86%), however only 34-36 percent of the fruits mature (Mitra and Bose, 1990) [59]. Two foliar sprays of CCC (50 ppm) and PCPA (50 ppm) (One before flowering and one after fruit set) significantly increased fruit set in Sardar guava (Brahmachari *et al*., 1996) [14]. Significant increase in initial fruit set was found with moderate pruning and application of 4% potassium nitrate (Shaban and Haseeb, 2009) [77]. Fruit set was reduced by eugelol and ethephon at higher concentration (Curry and Williams, 1989) [23]. Choudhary *et al.* (1997) [22] observed that NAA (100 ppm) resulted in maximum percentage of fruit set. Significant increase in initial fruit set was found with moderate pruning and application of 4% potassium nitrate (Shaban and Haseeb, 2009) [77]. Fruit set was reduced by eugelol and ethephon at higher concentration (Curry and Williams, 1989) [23]. Choudhary *et al.* (1997) [22] observed that NAA (100 ppm) resulted in maximum percentage of fruit set. Boora *et al.* (2016) [12] reported that, the terminal portion of guava shoots should be pruned between 20th to 30th April. Application of the necessary fertilizer dose in June promotes vegetative development in July-August, allowing for optimal flowering in August-September for the winter season crop. It is critical to minimize fruit set during the rainy season and then boost fruit set during the winter season to regulate the guava crop.

Fruit number

The quantity of fruits per shoot reduces in the rainy season as chemical concentrations rise, but increases in the winter season. According to Kumar and Hoda, spraying guava plants with 125 ppm NAA at full bloom stage (April-May) during the wet season resulted in no fruiting (1977). ingh also reported similar findings (1986). At 60 and 30 cm pruning levels, there was a significant increase in the number of fruits and the weight of the fruits (Mohammed *et al*., 2006) [60]. According to Brar *et al.* (2007) [16], the plants grown at a height of 15 cm produced the most fruits and yield. With apical 10 cm of trimming branches in May, the number of fruits per tree increased (Sahar and Abdel-Hameed, 2014) [70]. According to Sarker and Ghose (2006), bending shoots increased the number of fruits per shootlet. According to Kumari *et al.* (2003) [48], trees trained into a vase shape produced the longest shoots (cm) with the most fruits. One leaf pair shoot pruning enhanced the quantity of fruits per tree, yield (kg/tree), and fruit quality, according to Pratibha and Shant Lal (2012) [65]. In the third week of June, 2012, Lakpathi *et al*. pruned guava cv. Allahabad Safeda under high density planting with three pruning intensities: leaving 10 cm, 20 cm, and 30 cm from the base of the shoot and maintaining 30, 40, and 50 fruits per tree. Singh and Varu (2017) reported in winter season crop, maximum number of fruits per plant (483) and fruit yield per plant (73.72 kg) and per hectare (20.37 t) was recorded with 30th May pruning.

Fruit weight

At 45 cm, Brar *et al*. (2007) [16] showed an increase in fruit weight. Bhagawati *et al*. (2015) [9] found that pruning intensities increased fruit output. The regenerated guava tree was shown to be the most effective for increasing fruit weight and yield, according to Chandra *et al*. (2012) [19]. Fruit weight and volume were best in May and June with apical 20 cm of new trimmed shoots (Sahar and Abdel-Hameed, 2014) [3]. Fruit thinning increased the weight of individual fruits (Zaman, 1996) [101]. Fruit retention, volume, and weight were all improved by severe trimming (Sheikh and Hulamani, 1994) [79]. In terms of individual fruit weight and per plant fruit output, the effect of thinning exhibited a similar trend (Biswas *et al*., 1989) [11]. Fruit weight was observed to rise when PBZ 500 ppm was used, especially during the wet season (Brar *et al*., 2012) [17]. Curry and Williams (1989) [23] discovered that at greater concentrations of ethephon, average fruit weight and length were significantly reduced. Raghbir *et al.* (1992) [67] studied that the highest fruit weight was obtained with 600 ppm NAA. Similar results were obtained by Kher *et al*. (2005) [46]. In winter season fruits, plants sprayed with PBZ 1000 ppm exhibited highest fruit weight (Brar, 2012) [17]. In both seasons, the amount of trimming and the timing of pruning enhanced the size and weight of the fruits (Adhikari and Kandel, 2015) [1]. The development of vegetative buds, maximum fruit diameter at harvest, average fruit weight, and fruit yield have all improved with ten centimetre (10 cm) pruning intensity (Lakpathi and Rajkumar) (2018) [33].

Fruit yield

According to Dutta (2004) [28], foliar spraying of K greatly increased the production of Sardar guava. Singh *et al*. also showed an improvement in guava yield by employing potassium nitrate (1992). Bagchi *et al*. (2008) [6] investigated biochemical changes in the leaf and bark of guava during offseason flowering and found that varied bending and pruning treatments resulted in enhanced overall fruit output. Shoot pruning can assist you manage your tree's size and fruit production (Singh and Bal, 2006) [91]. Plants with pruning treatments produce more fruit (Shigeura and Bulloc, 1976) [81]. Similar observations were made by others as well (Singh *et al*., 1997; Lopez *et al*., 1982; Quizada *et al*., 1999; Singh *et al*., 1996; and Maji *et al*., 2015) [88, 51, 66, 87, 53]. Bhagawati *et al.* (2015) [9] reported that the fruit yield, size and weight were found to increase with pruning intensities. Under high-density planting, Chandra and Govind (1995) [21] claimed that 25% pruning in February might regulate fruit yield without affecting fruit quality. For the winter crop, Mishra and Pathak (1998) [58] trimmed guava plants cv. L-49 (Sardar) by 25, 50, or 75 percent at monthly intervals between March and June, with 50% pruning in May producing the best fruit yield. The most successful management for reducing yield in the rainy season and increasing yield and quality in the winter season

was to prune guava plants at a 20 cm pruning level in early May. (Adhikari and Kandel, 2015) [1]. According to Katiyar *et al*. (2009) [44], the maximum yield was found in urea 2% + NAA 100 ppm. Manivannan *et al.* (2015) [54] investigated that application of potassium sulphate (1%) significantly enhanced the yield parameters *viz*., fruit length, number of fruits, fruit weight and yield per tree. Saini *et al.* (2016) [71] observed that all the treatments were effective in increasing the growth characters, however, heading back at the level of 200 cm and two pinchings were found most effective in increasing the growth characters i.e. number of sprouts per shoot, flowering intensity, fruit setting, number of fruits/plant and yield over control and other treatments. Harshitha *et al.* (2019) [34] In pruning at 75 cm and PBZ at 500 ppm, the interaction effect of pruning and chemical spraying on number of fruits per shoot (3.39), fruits per plant (343.97), and maximum yield of fruits per plant (49.14 kg) was shown to be significant (P2S1). When trimming at 75 cm and GA3 at 50 ppm, the greatest fruit weight (127.67 g) was recorded (P1S5).

Fruit Size

During the rainy season, pruning treatments (10cm and 20cm) on guava cv. Allahabad Safeda resulted in the largest fruit size (Singh and Bal, 2006) [91]. According to Brar *et al.* (2007) [16], pruning at 45 cm increased fruit weight. Trees that received 0% defoliation and 50% deblossoming had larger fruit diameters and sizes (Khan *et al*., 2011) [45]. Fruit size, weight, and organoleptic value all improved as well. Fruit thinning, according to Zaman (1996) [101], enhanced the size and weight of individual fruits. PBZ 500 ppm was observed to improve fruit size and weight, especially during the wet season, whereas ethephon 500 ppm-treated plants produced the best-quality fruits (Brar *et al*., 2012) [17]. Applying 2% urea + 0.4 percent ZnSO4 + 250 ppm ethrel (Ethephon) + 10 ppm NAA resulted in the largest fruits (Pandey *et al*., 1988) [64]. In all seasons, increasing pruning levels and delayed pruning enhanced fruit size and weight (Adhikari and Kandel, 2015) [1]. As the degree of pruning grew, so did the size, weight, pulp percentage, and seed percentage of the fruit. Maximum fruit polar diameter (9.02 cm) and equatorial diameter (9.28 cm), maximum fruit weight (305.21 g), and highest pulp content (54.34%) were discovered after 90 cm of pruning intensity. In 90 cm, a significant minimum percentage of seed (7.68%) was recorded. Choudhary and Dhakare (Choudhary and Dhakare, 2018) [43].

Effect of canopy management on quality attributes

Total soluble solids

During the wet season, Singh and Bal (2006) [91] found that pruning treatments (10cm and 20cm) on guava cv. Allahabad Safeda yielded increased TSS and Vitamin C. Bhagawati *et al*. obtained similar results (2015). TSS content was shown to be most effective in the rejuvenated guava tree from 1.5 to 2.0 metres above ground level (Chandra *et al*., 2012) [19]. In May and June, TSS values were highest with apical 10 and 20 cm of fresh trimmed shoots. TSS was shown to be higher in the larger fruits acquired after thinning (Biswas *et al*., 1989) [11]. Sindhajli rootstock had higher total soluble solids content, according to Jat (2003) [38]. Furthermore, the TSS content of fruits picked during the winter season was higher than that of fruits harvested during the summer season. With urea (10, 15, and 20%), higher TSS contents were achieved (Raghubir *et al*., 1992) [67]. The use of 60ppm 2, 4-D enhanced a number of quality metrics, including total sugars, reducing sugar, non-reducing sugar, and TSS (Agnihotri *et al*., 2013) [2]. At the 10 cm level of pruning, Singh and Bal (2006) [91] noted fruit quality (chemical characteristics).

Vitamin C

Teaotia and Phogat (1971) [98] studied the effect of rootstock on vitamin C concentration and found that *P. cujavillis* had increased vitamin C content. Sardar guava performed best on Portugal rootstock in terms of TSS, although Chittidar had the highest vitamin C content, according to Gill and Chahil (2013) [29]. Fruits derived from ethephon 1000 ppm treated plants during the rainy season and ethephon 500 ppm treated plants during the winter season had the highest vitamin C content (Brar *et al*., 2012) [17]. During the wet season, Badge and Kandalkar (1983) [5] found an increase in ascorbic acid content in guava with 80 ppm NAA. Discovered that fruits of the rainy season guava cv. had a greater vitamin C content. Sardar got it from PBZ-sprayed plants (500ppm). Fruit quality analysis revealed that pruning in May at 45 cm from the shoot tip yielded superior quality fruits with greater vitamin C levels of 235.17 mg/100g (Meena *et al*. 2017) [42].

Total sugars

According to Tahir and Hamid (2002) [97], fruit thinning increased the quality of the winter harvest, which produced more sugars. According to Singh *et al*. (1976), the fruit production of Allahabad Safeda was higher on P. cattleianum rootstock, but the TSS, total, and reducing sugar levels were highest on *P. cujavillis*. Manivannan *et al.* (2015) [54] found that adding 1% potassium sulphate to the fruit length, number of fruits, fruit weight, yield per tree, and quality metrics like TSS, acidity, total sugars, reducing sugars, and ascorbic acid significantly improved yield parameters. Various quality parameters namely total sugars, reducing sugar, non-reducing sugar were also improved with application of 60ppm 2, 4-D (Agnihotri *et al*., 2013) [2]. Rajput *et al.* (1977) [68] studied that total sugars and reducing sugars were not significantly affected with 60 and 80 ppm NAA in guava during rainy season. Wider spacing of guava fruits resulted in greater TSS, according to Lal *et al* (2000). In May and June, apical 10 cm of pruning shoots improved fruit set % and total sugars (Ali and Abdel-Hameed, 2014) [70].

Acidity

Brahmachari *et al*. (1995) [15] found that spraying 50ppm NAA in guava during the wet season lowered acidity marginally. Suleman *et al*. (2006) [96] sprayed ethephon in May and found that a higher dose of ethephon considerably lowered acidity. During the wet season, spraying guava with 40 and 80 ppm NAA reduced the acidity slightly (Rajput *et al*., 1977) [68] In the rainy season, Badge and Kandalkar (1983) [5] obtained similar results with 60 and 80 ppm NAA, and Brahmachari *et al* (1995) [15] with 50 ppm NAA. In the wet (0.26 percent) and winter seasons, Singh (1986) [94] found that NAA (100 ppm) lowered the acidity of fruits

(0.39 percent). Wider spacing along with pruning gave higher fruit weight, size, TSS, acidity, ascorbic acid and TSS: acid ratio of guava fruits than closer spacing (Pratibha and Lal, 2012) [65].

Conclusion

After a few years of growth, untrained or unpruned guava trees become enormous and unmanageable. The bearing area of the plant is diminished, and the interior of the plant is barren of fruiting. By removing crowded and criss-cross branches, trees are pruned to maximise the output of high-quality fruits. Pruning begins at an early stage of plant growth to develop single trunk trees with well-spaced scaffold branches to form the frame work. For optimal canopy design, apical growth should be inhibited within the first year of planting. Two to three months after planting, trees are topped to a consistent height of 60-70 cm from the ground level to encourage the appearance of new growth below the cut point, resulting in new shoots. Three to four equally spaced shoots are retained around the stem to form the main scaffold limbs of the tree. After topping, these shoots are left to develop for 4-5 months until they reach a length of roughly 40-50 cm. To include several shoots from the buds below the cut end, the selected shoots are further clipped to 50% of their original length. Newly developed branches are allowed to grow up to 40-50 cm before being clipped to allow new shoots to emerge. This is primarily done in order to achieve the required shape. The pruning operations continue during the second year after planting. After two ye the short branches within the tree canopy produce a compact and strong structure after two years. All of the plants are pruned into a hedge shape with a 2 metre inter row width and 2.5 metre height every year in January-February and May-June (Singh, 2008) [86]. The short branches within the tree canopy produce a compact and strong structure. All the plants are confined to a hedge shape of 2 meter inter row width and 2.5 meter height for which pruning is performed in January- February and May-June every year (Singh, 2008) [86].

References

1. Adhikari S, Kandel TP. Effect of time and level of pruning on Vegetative Growth, Flowering, Yield, and Quality of Guava. Int J Fruit Sci. 2015;15:290-301.
2. Agnihotri A, Tiwari R, Singh OP. Effect of crop regulators on growth, yield and quality of guava. Ann Pl Soil Res. 2013;15:54-57.
3. Ali F, Sahar F, Abdel-Hameed AA. Effect of pruning on yield and fruit quality of guava trees. J Agric Veterinary Sci. 2014;7(12):41-44.
4. Aravindakshan M. Effect of pruning on growth, flowering and fruit set in guava. Madras Agric J. 1963;50:87.
5. Badge TR, Kandalkar DS. Effect of growth regulators on quality of guava (*Psidium guajava* L.) variety Sardar. In: Magazine, college of Agriculture, Nagpur 54/55:19-22. Punjabrao Krishi Vidyapeeth, Akola, India; c1983.
6. Bagchi TB, Sukul P, Ghosh B. Biochemical changes during off-season flowering in guava (*Psidium guajava* L.) induced by bending and pruning. J Trop Agric. 2008;46:64-66.
7. Bajpai PN, Shukla HS, Chaturvedi AM. Effect of pruning and subsequent vegetative growth, fruit set, fruit drop and quality of guava (*Psidium guajava* L.) cv. Allahabad Safeda. Prog Hort. 1973;5:73-79.
8. Bal JS, Dhaliwal GS. High density planting studies in guava. Haryana J Hort Sci. 2003;32:19-20.
9. Bhagawati R, Bhagawati K, Choudhary VK, Rajkhowa DJ, Sharma R. Effect of Pruning Intensities on the Performance of Fruit Plants under Mid-Hill Condition of Eastern Himalayas: Case Study on Guava. Int. Letters Nat Sci. 2015;46:46-51.
10. Bisla SS, Dhiman BK, Daulta BS. Studies on pruning and spacing in ber (*Zizyphus mauritiana* Lamk). Effect on vegetative growth. Haryana J Hort Sci. 1988;17:177-82.
11. Biswas M, Azad AK, Ahmed A, Hossain AKMA. Effect of fruit thinning on fruit size, yield and quality of guava cv. Kazi Piara. Bangladesh Hort. 1989;17:1-4.
12. Boora RS, Dhaliwal HS, Arora NK. Crop regulation in guava. Agric Rev. 2016;37(1):1-9.
13. Braganza MA. Floral biology and varietal evaluation in genus Psidium. MSc (Agric.) Thesis, University of Agricultural Sciences, Bangalore; c1990.
14. Brahmachari VS, Mandal AK, Kumar R, Rani R. Effect of growth substances on flowering and fruiting characters of Sardar guava (*Psidium guajava* L.). The Hort J. 1996;9:1-7.
15. Brahmachari VS, Mandal AK, Kumar R, Ray R. Effect of growth substances on flowering and fruiting characters of Sardar guava (*Psidium guajava* L.). Recent Horticulture. 1995;2:127-131.
16. Brar JS, Thakur A, Arora NK. Effect of pruning intensity on fruit yield and quality of Guava (*Psidium guajava* L.) cv. Sardar. Haryana J Hort Sci. 2007;36:65-66.
17. Brar JS, Dhaliwal HS, Bal JS. Influence of paclobutrazol and ethephon on fruit Quality of 'Allahabad Safeda' guava. Hort Flora Res Spectrum. 2012;1:135-138.
18. Castelan-Estrada M, Becerril Roman AE. Physiology of production in *Psidium guajava* L. Proc Am Soc Trop Hort. 1994;3:152-156.
19. Chandra KK, Pandey SK, Singh AK. Influence of tree rejuvenation, IPNM and VA-Mycorrhizal fungi on shoot emergence, yield and fruit quality of *Psidium guajava* under farmers field condition. Int. J Biosci. 2012;2:9-17.
20. Chandra R, Govind S. Effect of urea and ethrel on growth, flowering and fruiting in guava under intensive planting system. Indian J Hort. 1994;51:340-345.
21. Chandra R, Govind S. Influence of time and intensity of pruning on growth, yield and fruit quality of guava under high density planting. J Trop Agric. 1995;72:110-113.
22. Choudhary R, Singh UP, Sharma RK. Effect of growth substances on flowering and fruit-set in guava cv. L-49. Orissa J Hort. 1997;25:10-13.
23. Curry EA, Williams MA. Fruit thinning with ethephon. Good Fruit Grower, Wenatchee, Washington. 1989;90:8-10.
24. Dalai SR, Gonge VS, Mohariya AD. Standardization of pruning intensity in old guava trees cv. L-49. Ad Pl Sci. 2004;7:283-286.

25. Dhaliwal GS, Nanara NK, Rattanpal HS. Effect of chemicals on flower drop, fruit set and yield on rainy and winter season crops of guava. Indian J Hort. 2002;59:31-33.
26. Dhaliwal GS, Nanara NK, Rattanpal HS. Effect of time and severity of pruning on shoot growth and flowering in guava. Haryana J. Hort. 1998;27:223-229.
27. Dubey AK, Singh DB, Dubey N. Deblossoming of summer season flowering of guava (*Psidium guajava* L.) by shoot pruning. Prog. Hort. 2001;33:165-168.
28. Dutta P. Foliar potassium spray in improving the quality of Sardar guava (*Psidium guajava* L.). Orissa Journal of Horticulture. 2004;32:103-104.
29. Gill MS, Chahil BS. Performance of guava cv. Sardar budded on ten different rootstocks. International Journal of Agricultural Sciences. 2013;9:317-319.
30. Gopikrishna NS. Studies on the effect of pruning on vegetative growth, flowering and fruiting in Sardar guava (*Psidium guajava* L.). Mysore J Agril. Sci. 1981;15:349.
31. Guerra E, Bautista D. Topological description of branching in three guava clones subjected to pruning. Agronomic Tropical Maracay. 1999;49:155-168.
32. Gupta MR, Nijjar GS. Crop regulation in guava. Indian J Hort. 1978;35:23-27.
33. Guguloth L, Rajkumar M. Effect of Pruning Intensities and Fruit Load on Yield and Quality of Guava under High Density Planting System. Int. J Curr. Microbiol. App. Sci. 2018;7(05):1853-1860.
34. Harshitha SN, Chovatia RS, Hemavathi GN. Influence of Different Levels of Pruning and Growth Regulators on Growth and Yield of Guava (*Psidium guajava* L.) cv. 'L-49'. Int. J Curr. Microbiol. App. Sci. 2019;8(04):1701-1706.
35. Hassimotto NM, Genovase MI, Lajolo FM. Antioxidant activity of dietary fruits, vegetables, and commercial frozen fruit pulps. J Agri. Food Chem. 2005;53:2928-2935.
36. Indian Horticulture Database. National Horticulture Board, Ministry of Agriculture, Government of India. 2018-2019.
37. Jackson JE. Light interception and utilization of orchard system. Horticulture Review. 1980;2:208-267.
38. Jat D. Response of different rootstock to yield, fruit quality and N P K status of guava (*Psidium guajava* L.) cv. Sardar. M.Sc. Thesis, Punjab Agricultural University, Ludhiana, Punjab (India). 2003.
39. Jimenez-Escrig A, Rincon M, Pulido R, Saura-Calixto F. Guava fruit (*Psidium guajava* L.) as a new source of antioxidant dietary fiber. J Agri. Food Chem. 2001;49:5489-5493.
40. Joseph B, Priya M. Review on nutritional, medicinal and pharmacological properties of guava (*Psidium guajava* Linn.). Int. J Pharma Bio. Sci. 2011;2:53-69.
41. Joshi P, Lal S, Nautiyal P, Pal M. Effect of plant spacing and pruning intensity on flowering, fruiting and yield of guava (*Psidium guajava* L.) cv. International Journal of Agriculture Sciences 2016;8(7):0975-9107.
42. Meena KR, Maji S, Meena SC. Use of shoot pruning for crop regulation and quality fruit production of guava (*Psidium guajava* L.). Int. J of Agril. Sci. 2017;13(2):184-191.
43. Choudhary K, Dhakare BB. Influence of Pruning Intensities on Growth, Yield and Fruit Attributes of Custard Apple. Int. J Curr. Microbiol. App. Sci. 2018;7:5311-5315.
44. Katiyar PN, Singh JP, Singh PC. Effect of nutrients and plant growth regulators on physico-chemical parameters and yield of guava (*Psidium guajava* L.) fruit cv. Allahabad Safeda. Int. J of Agril. Sci. 2009;5:173-174.
45. Khan SA, Khan MRG, Malik AU, Saleem BA, Rajwana IA, Ahmed I. Influence of defoliation and deblossoming on the vegetative and reproductive growth of guava (*Psidium guajava* L.) cv. 'gola'. Pak. J Bot. 2011;43:2891-2896.
46. Kher R, Bhatand S, Wali VK. Effect of foliar application of GA3, NAA and CCC on physico-chemical characteristics of guava cv. Sardar. Haryana J Hort. Sci. 2005;34:31-32.
47. Kumar R, Hoda MN. Crop regulation studies in Allahabad Safeda guava. Indian J Hort. 1977;34:13.
48. Kumari MBK, Babu RS. Effect of methods of training on yield and quality of guava (*Psidium guajava* L.) cv. Lucknow-49. J Res. ANGRAU. 2003;31:111-113.
49. Lal S. Effect of pruning on crop regulation in guava (*Psidium guajava* L.) cv. Lucknow-49. Prog. Hort. 1983;7:60-62.
50. Lian HN, Singh B, Senjam BD, Ramjan M. Effect of Shoot Pruning on Growth and Yield of Guava (*Psidium guajava* L.) cv. L-49 under Foothills of Arunachal Pradesh. Int. J Curr. Microbiol. App. Sci. 2019;8(03):2020-2027.
51. Lopez GJ, Manica VI, Koller OC, Ribold IJ. Effect of six pruning period on the yield of guava in Novo Hamburgo, Rio Grande do Sul, Brazil. Proceedings Tropical Region American Society for Horticultural Science. 1982;25:259-262.
52. Lotter JD, De-V-Lotter J. Vegetative and reproductive habit of the guava (*Psidium guajava* L.) cv. Fan Retief. Acta Hort. 1990;275:229-237.
53. Maji S, Das BC, Sarkar SK. Efficacy of some chemicals on crop regulation of Sardar guava. Scientia Horticulturae. 2015;188:66-70.
54. Manivannan MI, Irulandi S, Shoba TK. Studies on the effect of pre-harvest application of plant growth regulators and chemicals on yield and quality of guava (*Psidium guajava* L.) cv. L.-49. Int. J Agric Sci. 2015;11:138-140.
55. Meena KR, Maji S, Kumar S, Verma S. Influence of Shoot Pruning for Crop Regulation and Improving Fruit Yield of Guava. The Bioscan. 2016;11:1355-1359.
56. Mehta S, Singh SK, Das B, Jana BR, Mali S. Effect of pruning on guava cv. Sardar under ultra high density orcharding system. VEGETOS. 2012;25:192-195.
57. Menzel CM, Paxton BF. The pattern of growth, flowering and fruiting of guava varieties in subtropical Queensland. Aust J Exp Agric. 1986;26:123-128.
58. Mishra HK, Pathak RA. Effect of shoot pruning on crop regulation in guava (*Psidium guajava* L.) cv. L-49 (Sardar). Prog Hort. 1998;30:78-81.
59. Mitra SK, Bose TK. Guava. In: Fruits: Tropical and Subtropical, Bose TK, Mitra SK (Eds), Naya Prakash, Kolkata; c1990. p. 280-303.
60. Mohammed S, Sharma JR, Kumar R, Gupta RB, Singh S. Effect of pruning on growth and cropping pattern in

guava cv. Lucknow-49. Haryana J Horticultural Science. 2006;35:211-212.
61. Nakasone HY, Paull RE. Tropical Fruits. CAB International, Wallingford, U.K; c1998. p. 149-172.
62. NS Sawant, SR Kalam, UM Naglot. Performance of different levels of pruning on yield and quality of Guava (*Psidium guajava* L.) Var. Sardar. Int. J Chem Stud. 2018;6(5):2897-2901.
63. Palmer JM. The effect of row orientation, tree height, time of year and latitude on light interception and distribution in model apple hedgerow canopies. J Hort Sci. 1989;64:137-145.
64. Pandey DK, Pathak RA, Pathak RK. Studies on the foliar application of plant growth regulators in Sardar guava (*Psidium guajava* L.). I. Effect on yield and fruit quality. Indian J Hort. 1988;45:197-202.
65. Pratibha, Shanti Lal. Effect of shoot pruning and different planting systems on vegetative growth, yield and quality of guava cv. Sardar. The Asian Journal of Horticulture. 2012;7:65-71.
66. Quijada O, Araujo F, Corzo P. Effect of pruning and hydrogen cyanamide on bud break, flowering, fruit yield and quality of guava (*Psidium guajava* L.) in the municipality of Mara, state of Zulia. Revi.de la Facultad de Agro. Universidad del Zulia. 1999;16:276-291.
67. Raghbir S, Singh SN, Gupta MR, Dhaliwa GS, Kira SK, Singh R. Studies on winter cropping in guava cv. Allahabad Safeda. Indian J Hort. 1992;49:127-133.
68. Rajput CBS, Singh CN, Singh NP. Effect of certain plant growth substances in guava. Haryana J Hort Sci. 1977;6:117-119.
69. Rathore DS, Singh RN. Yield pattern in three cropping patterns of guava (*Psidium guajava* L.). Indian J Hort. 1976;33:7-13.
70. Sahar AF, Abdel-Hameed AA. Effect of pruning on yield and Fruit Quality of Guava Trees. J Agric Vet Sci. 2014;7:41-44.
71. Saini H, Baloda S, Vijay. Impact of heading back and pinching on vegetative and reproductive parameters of guava (*Psidium guajava* L.) under high density plantation. J Krishi Vigyan. 2016;4(2):47-53.
72. Salah A, El DM. Effect of pruning on growth, flowering and fruiting of some guava cultivars. M.Sc. Thesis, Fac. Agric. Cairo Univ; c2005.
73. Samson JA. Tropical fruits. Longman, London and New York; c1980. p. 215-216.
74. Sarker A, Ghosh B. Studies on growth, yield and economics, in guava cv. L-9 by shoot pruning and bending. J Inter Acdemicia. 2006;10:327-330.
75. Widyastuti RD, Susanto S, Melati M, Kurniawati A. Effect of Pruning Time on Flower Regulation of Guava (*Psidium guajava*). IOP Conf. Series: Journal of Physics: Conf. Series. 2019;1155:012013.
76. Serrano LAL, Marinho CS, Gabetto E, Silva M, Tardin FD. Phenological and yield characteristics of 'Paluma' guava tree pruned in different times and intensities, in north of Rio de Janeiro State, Brazil. Revista Ceres. 2008;55:416-424.
77. Shaban AEA, Haseeb GMM. Effect of Pruning Severity and Spraying Some Chemical Substances on Growth and Fruiting of Guava Trees. American-Eurasian J Agric. & Environ. Sci. 2009;5:825-831.
78. Sharma YK, Goswami AM, Sharma RR. Effect of dwarfing aneuploid guava rootstock in high density orcharding. Indian Journal of Horticulture. 1992;49:31-36.
79. Sheikh MK, Hulamani NC. Effect of pruning on yield and chemical properties in Navalur guava selections. Karnataka J Agril. Sci. 1994;7:473-475.
80. Sheikh MK, Hulmani NC. Effect of severity of pruning on flowering and fruiting of guava cultivar Navalur. Prog. Hort. 1993;25:157-160.
81. Shigeura GT, Bullock RM. Management of guava: cycling fruit set for continuous production. Proceedings Tropical Region American Society for Horticultural Science. 1976;24:166.
82. Shikhamany SD. Canopy management of the tropical and subtropical fruit crops. Indian J Hort. 2001;58:28-32.
83. Singh A, Dhaliwal GS, Hundal SS. Effect of planting distance on radiation interception behavior of guava (*Psidiumguajava* L.). Journal of Agrometeorology. 2005;7(2):220-224.
84. Singh A, Dhaliwal GS. Solar radiation interception and its effect on physical characteristics of fruits of guava cv. Sardar. Acta Horticulture. 2007;735:297-302.
85. Singh G, Canaan YR. Influence of pruning intensity and pruning frequency on vegetative and reproductive attributes in guava cv. L-49. Abstract: 1st Inter Guava Symposium, CASH, Lucknow; c2005, 52.
86. Singh G. High Density and Meadow orcharding of Guava; c2008, 20.
87. Singh G, Pandey D, Rajan S, Singh AK. Crop regulation in guava through different crop regulation treatments. Fruit. 1996;51:241-246.
88. Singh G, Rajan S, Pandey D, Singh AK. Effect of soil moisture stress on water relation by plant and cropping behavior in guava (*Psidium guajava* L.). Indian J Agricultural Sciences. 1997;67:303-306.
89. Singh VK, Singh G. Photosynthesis efficiency, Canopy microclimate and yield of rejuvenated guava trees. Acta Horticulture. 2007;735:249-257.
90. Singh G, Singh AK, Shailendra R. Influence of pruning date on fruit yield of guava (*Psidium guajava* L.) under subtropics. J Appl. Hort. 2001;3:37-40.
91. Singh HJ, Bal JS. Effect of pruning and growth regulators on physico-chemical characters of guava during rainy season planted at different spacing. International J Agril. Sci. 2006;2:533-537.
92. S Nithya, Arunkumar K Kamble, Praveen Jholgikar, Anand Nanjappanavar, Mallikarjun Awati, Anand G Patil. Standardization of grafting time in different red pulp guava (*Psidium guajava* L.) by softwood grafting. Int. J Hortic Food Sci. 2022;4(1):173-175. DOI: 10.33545/26631067.2022.v4.i1c.137
93. Singh R, Singh SN, Gupta MR, Dhaliwal GS, Kolra SK. Studies on winter cropping in guava cv. Allahabad Safeda. Indian J Hort. 1992;49:127-133.
94. Singh UP. Crop regulation studies in guava. Ph.D. thesis, RAU, Pusa Bihar Agriculture College Sabour, Bihar; c1986.
95. Singh UR, Pandey IC, Upadhyay NP, Prasad RS. Effect of different rootstocks on growth, yield and Quality of

guava. Punjab Hort. J. 1976;16:121-124.
96. Suleman M, Sharma JR, Kumar R, Gupta RB, Singh S. Effect of different chemicals on cropping pattern, and quality of guava cv. Sardar. Haryana J Hort. Sci. 2006;35:226-227.
97. Tahir FM, K. Hamid. Studies of physico-chemical changes due to fruit thinning in Guava (*Psidium guajava* L.). J Biol. Sci. 2002;2:744-745.
98. Teaotia SS, Phogat KPS. Effect of rootstock on growth, yield and quality in guava (*P. guajava* L.). Progressive Hort. 1971;2:37-45.
99. Thakre M, Lal S, Uniyal S, Goswami AK, Prakash P. Pruning for crop regulation in high density guava (*Psidium guajava* L.) plantation. Spanish J Agric. Res. 2016;14(2):8.
100. Wang SY, Choo K. Effect of pruning on crop regulation in Cochran, statistical guava (*Psidium guajava* L.) cv. Lucknow-49. Prog. Hort. 1984;7:60-62.
101. Zaman S. Effect of fruit thinning and growth regulators on the yield and quality of guava (Kazi piara). M.Sc. Thesis, Dept. of Horticulture, BAU, Mymensingh; c1996, 79.