STUDIES ON EFFECT OF PRUNING TIME ON FRUIT MATURITY, YIELD AND QUALITY OF GUAVA (*Psidium guajava* L.)

Thesis

Submitted to the Punjab Agricultural University
in partial fulfillment of the requirements
for the degree of

MASTER OF SCIENCE
in
FRUIT SCIENCE
(Minor Subject: Botany)

By

Ranveer Singh
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CERTIFICATE - I

This is to certify that the thesis entitled, **"Studies on effect of pruning time on fruit maturity, yield and quality of guava (*Psidium guajava* L.)"** submitted for the degree of **Master of Science** in the subject of **Fruit Science** (Minor subject: **Botany**) of the Punjab Agricultural University, Ludhiana, is a bonafide research work carried out by **Mr. Ranveer Singh (L-2015-A-92-M)** under my supervision and that no part of this thesis has been submitted for any other degree.

The assistance and help received during the course of investigation have been fully acknowledged.

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CERTIFICATE II

This is to certify that the thesis entitled, **"Studies on effect of pruning time on fruit maturity, yield and quality of guava (*Psidium guajava* L.)"** submitted by **Mr. Ranveer Singh (L-2015-A-92-M)** to the Punjab Agricultural University, Ludhiana, in partial fulfillment of the requirements for the degree of **Master of Science,** in the subject of **Fruit Science** (Minor subject: **Botany**) has been approved by the Student's Advisory Committee along with the Head of Department after an oral examination of the same.

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Date*:*

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ABSTRACT

The present investigation on "Studies on effect of pruning time on fruit maturity, yield and quality of guava (*Psidium guajava* L.)was conducted at Regional Fruit Research Station, Bahadurgarh, Patiala and Fruit Research Farm, Department of Fruit Science, Punjab Agricultural University, Ludhiana. On the entire tree, the 50 per cent portion from apex of one-year-old shoot was headed back on 15th and 30th of date of March, April, May and June months. Control trees were left unpruned. The tree growth parameters viz. net increase in tree height, spread and canopy volume recorded higher in control as compared to pruned trees. It was noticed that new shoot emergence and flowering delayed with delay in the pruning time. March-April pruning treatments recorded maximum flowering percentage during the months of April and May, while, May-June treatments shows maximum flowering percentage in the months of July and August. This shifting of flowering percentage in May pruned trees helps in the early fruit maturity and more yield during the winter season of guava. Maximum fruit weight, fruit number per plant, with highest fruit yield during winter season was obtained in trees, which subjected to pruning on 15th and 30th May. Times of pruning have non-significant effect on the total soluble solids and acidity of the guava fruit during both the seasons irrespective of variety; while, maximum vitamin C was found in May pruned trees. The present studies suggested that guava tree should be pruned between 15th and 30th May for early harvesting of quality fruits in winter season. The present studies suggested that guava tree should be pruned between 15th and 30th May for early harvesting of quality fruits in winter season.

Keywords : Guava, (*Psidium guajava* L.), pruning time, growth characteristics, flowering and fruiting characteristics, maturity time, fruit quality.

Signature of Major Advisor **Signature of the student**

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ਮੌਜੂਦਾ ਅਧਿਐਨ ''ਅਮਰੂਦਾਂ ਦੀ ਫ਼ਲ ਗੁਣਵੱਤਾ, ਝਾੜ ਅਤੇ ਫ਼ਲ ਦੇ ਪੱਕਣ ਸਮੇਂ ਉੱਪਰ ਕਾਂਟ-ਛਾਂਟ ਦੇ ਸਮੇਂ ਦੇ ਪ੍ਰਭਾਵ ਦਾ ਅਧਿਐਨ'' ਸਿਰਲੇਖ ਹੇਠ ਪੰਜਾਬ ਐਗਰੀਕਲਚਰਲ ਯੂਨੀਵਰਸਿਟੀ ਲੁਧਿਆਣਾ ਦੇ ਫ਼ਲ ਵਿਗਿਆਨ ਵਿਭਾਗ ਦੇ ਫ਼ਲ ਖੋਜ ਫਾਰਮ ਅਤੇ ਖੇਤਰੀ ਫ਼ਲ ਖੋਜ ਸਟੇਸ਼ਨ ਬਹਾਦਰਗੜ੍ਹ ਪਟਿਆਲਾ ਦੇ ਫ਼ਲ ਖੋਜ ਫਾਰਮ ਉੱਪਰ ਕੀਤਾ ਗਿਆ। ਇੱਕ ਸਮੁੱਚੇ ਰੁੱਖ ਉੱਪਰ ਇੱਕ ਸਾਲ ਪੁਰਾਣੀ ਸ਼ਾਖਾ ਨੂੰ ਸਿਰੇ ਤੋਂ 50 ਪ੍ਰਤੀਸ਼ਤ ਤੱਕ ਮਾਰਚ, ਅਪ੍ਰੈਲ, ਮਈ ਅਤੇ ਜੂਨ ਦੇ 15 ਅਤੇ 30 ਤਰੀਕ ਨੂੰ ਕੱਟ ਦਿੱਤਾ ਗਿਆ। ਕੰਟਰੋਲ ਰੁੱਖ ਵਿੱਚ ਕਾਂਟ-ਛਾਂਟ ਨਹੀਂ ਕੀਤੀ ਗਈ। ਕਟਾਈ ਕੀਤੇ ਰੁੱਖਾਂ ਦੇ ਮੁਕਾਬਲੇ ਕੰਟਰੋਲ ਰੁੱਖਾਂ ਵਿੱਚ ਰੁੱਖ ਵਿਕਾਸ ਮਾਪਦੰਡ ਜਿਵੇਂ ਰੁੱਖ ਲੰਬਾਈ, ਫੈਲਾਅ ਅਤੇ ਕੈਨੋਪੀ ਘਣ ਜਿਆਦਾ ਪਾਏ ਗਏ। ਇਹ ਵੀ ਦੇਖਿਆ ਗਿਆ ਕਾਂਟ-ਛਾਂਟ ਦੇ ਸਮੇਂ ਵਿਚ ਦੇਰੀ ਨਾਲ ਨਵੀਆਂ ਲਗਰਾਂ ਦੇ ਫੁੱਟਣ ਅਤੇ ਫੁੱਲਾਂ ਦੇ ਆਉਣ ਵਿੱਚ ਦੇਰੀ ਹੋਈ। ਅਪ੍ਰੈਲ ਅਤੇ ਮਈ ਦੌਰਾਨ ਮਾਰਚ ਵਿੱਚ ਕਾਂਟ-ਛਾਂਟ ਕੀਤੇ ਰੁੱਖਾਂ ਵਿਚ ਸਭ ਤੋਂ ਜ਼ਿਆਦਾ ਫੁੱਲ ਪ੍ਰਤੀਸ਼ਤਤਾ ਪਾਈ ਗਈ ਜਦਕਿ ਮਈ-ਜੂਨ ਉਪਚਾਰ ਵਿੱਚ ਸਭ ਤੋਂ ਜ਼ਿਆਦਾ ਫੁੱਲ ਪ੍ਰਤੀਸ਼ਤਤਾ ਜੁਲਾਈ-ਅਗਸਤ ਮਹੀਨੇ ਵਿੱਚ ਆਈ। ਮਈ ਵਿੱਚ ਕਟਾਈ ਕੀਤੇ ਰੁੱਖਾਂ ਵਿੱਚ ਫਲ ਪ੍ਰਤੀਸ਼ਤਤਾ ਵਿੱਚ ਬਦਲਾਅ ਨੇ ਜਲਦੀ ਫ਼ਲ ਪੱਕਣ ਵਿੱਚ ਮਦਦ ਕੀਤੀ ਅਤੇ ਸਰਦੀਆਂ ਦੇ ਸੀਜਨ ਵਿੱਚ ਅਮਰੂਦਾਂ ਦਾ ਝਾੜ ਵੱਧ ਪਾਇਆ। 30 ਮਈ ਨੂੰ ਕਾਂਟ ਛਾਂਟ ਕੀਤੇ ਰੁੱਖਾਂ ਵਿੱਚ ਸਰਦੀਆਂ ਦੇ ਮੌਸਮ ਦੌਰਾਨ ਸਭ ਤੋਂ ਜ਼ਿਆਦਾ ਫਲ ਭਾਰ, ਪ੍ਰਤੀ ਪੌਦਾ ਫ਼ਲ ਅਤੇ ਸਭ ਤੋਂ ਜ਼ਿਆਦਾ ਫ਼ਲ ਝਾੜ ਪਾਇਆ ਗਿਆ। ਕਾਂਟ-ਛਾਂਠ ਦੇ ਸਮੇਂ ਦਾ ਕੁੱਲ ਘੁਲਣਸ਼ੀਲ ਠੋਸ ਅਤੇ ਤੇਜ਼ਾਬੀਪਨ ਉੱਪਰ ਦੋਨੋਂ ਸੀਜਨ ਅਤੇ ਕਿਸਮਾਂ ਸਮੇਤ ਕੋਈ ਪ੍ਰਭਾਵ ਨਹੀਂ ਸੀ ਜਦਕਿ ਵਿਟਾਮਿਨ-ਸੀ ਸਭ ਤੋਂ ਜ਼ਿਆਦਾ ਮਈ ਵਿੱਚ ਕਾਂਟ-ਛਾਂਟ ਕੀਤੇ ਰੁੱਖਾਂ ਵਿੱਚ ਪਾਇਆ ਗਿਆ । ਮੌਜੂਦਾ ਅਧਿਐਨਾਂ ਨੇ ਸੁਝਾਅ ਦਿੱਤਾ ਹੈ ਕਿ 15 ਤੋਂ 30 ਮਈ ਵਿਚਕਾਰ ਸਰਦੀਆਂ ਦੇ ਮੌਸਮ ਵਿੱਚ ਕੁਆਲਿਟੀ ਫ਼ਲ ਪੈਦਾ ਕਰਨ ਲਈ ਅਮਰੂਦ ਦੇ ਰੁੱਖ ਨੂੰ ਕੱਟਿਆ ਜਾਣਾ ਚਾਹੀਦਾ ਹੈ ।

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ਮੁੱਖ ਸਲਾਹਕਾਰ ਦੇ ਹਸਤਾਖਰ **ਵਿੱਦਿਆਰਥੀ ਦੇ ਹਸਤਾਖਰ**

CONTENTS

CHAPTER-I

INTRODUCTION

Guava (*Psidium guajava* L.) also identified by the name "Apple of Tropics" is one of the most common fruits in India. Following mango, banana and citrus, guava claims to be the fourth most important fruit in area and production. It belongs to the family "Myrtaceae". It was introduced in India during the 17th century**.** It has attained a respectable position and popularity amongst the dietary list of common people in our country owing to its nutritious, deliciousness, pleasing flavour and availability for a longer period throughout the year. It has great demand for both table purpose and as raw material for the processing industries. It is a nutritious fruits rich in Vitamin-C (260 mg/100g). It also contains fair amount of Vitamin-A and minerals such as Iron, Phosphorus, Calcium, etc. Guava fruit being rich in pectin content is also used for making jam, jelly and other products.

Guava is a native of Tropical America (Mexico) and is commercially grown now in India, U.S.A., South America, Egypt, South Africa and Thailand. In India, it occupied an area of 262 thousand hectare with an annual production of 3648 thousand MT (Anonymous 2016). It is cultivated in U.P, Bihar, M.P., Chhatisgarh, Odisha, West Bangal, Maharashtra, A.P, Haryana, Gujarat and Punjab. In Punjab, it is cultivated on large scale, ranked second after citrus and occupies an area 8117 ha with an annual production of 182267 MT (Anonymous 2016).

Guava is an evergreen fruit plant, quite hardy and flowers twice a year, i.e. during April- May and again during July-August in Punjab and other Northern parts of India. There are no flowering and vegetative growth during winter season due to low temperature (Chadha and Pandey 1986). It is favours in accumulation of sufficient food reserve in plants, which results in maximum new vegetative growth in the following spring due to optimum temperature. This vegetative flush produces floral buds which produces flower during summer season (40 days after floral initiation) for rainy season crop (Sehgal and Singh 1967). The production is maximum during the rainy season (Dwivedi *et al* 1990). However, the fruits produced during rainy season are severely attacked by fruit fly which leads significant loss to the growers. These fruits also have poor nutritive value and keeping quality. On the other hand, quality of winter season crop is much superior and is free from the pest and diseases, having long storage life and fetches more remunerative prices in the market as compared to the rainy season crop (Rathore and Singh 1976). Keeping theses in view, it is always advantageous to take winter season crop only.

The flowering during April - May leads to fruiting during months of July - August (rainy season) and the flowering in July–August leads to fruiting from mid-November to February-March through December January. Further it is observed that fruits during peak

winter (mid December to January) become hard and are of inferior quality than the fruits harvested during November. The low temperature and frost during January also causes fruit drop and aggravate the problems of farmers. Hard and frost damaged fruit of guava fetch poor price in market and hence, causes economic loss to the growers. Keeping these in view there is an urgent need to develop the technology, so that whole fruit of guava could be harvested in November to maximum up to December. Fruit harvested during this period will be free from fruit fly damage and off course of good quality which can fetch premium price to the growers.

The new vegetative growth that occurs during the rainy season results in higher fruit yield during the subsequent winter season. As a result, different methods have been found to induce new vegetative growth during rainy season (Shigeura and Bullock 1976, Singh *et al* 2000). More systematic collaboration of the fruiting cycle will help in getting a continuous fruit supply during the majority of months (Lopez *et al* 1982, Manica *et al* 1982, Quijada *et al* 1999 and Shatat 1993). Irrigation, fertilization (Shigeura and Bullock 1976), defoliation and pruning (Singh *et al* 1996, Shigeura and Bullock 1976 Shatat 1993) can be used to promote new vegetative growth which will impact fruiting in guava. Various workers have quoted enhanced yield, size of fruit and various qualitative characters of guava as an outcome of pruning at different time periods. This improvement is due to more light penetration into fruit bearing portions of the tree canopy. Determination of the pruning effects on improved yield and fruit quality due to light penetration within guava trees may enable canopy designing.

As a traditional practice, farmers in some parts of India often practice bending and pruning of guava shoots to increase shoot numbers and to increase yield in the winter (Bagchi *et al* 2008). Pruning is usually practiced in the summer (April– May) before flower initiation. Studies have reported that the time and level of pruning influence growth, flowering, quality, and yield of guava (Chandra and Govind 1995, Dhaliwal and Kaur 2003; Sarkar *et al* 2005; Shaban and Haseeb 2009). Jadhav *et al* (2002) recommended a light annual pruning after fruit harvest to encourage growth of new shoots in which flowers and fruits are born. Similarly, Lal *et al* (2000) reported significant reduction of flowering and fruiting in the rainy season with pruning of shoots in summer.

In case of guava flowers are borne solitary on cymes of two or three flowers, on the current season's growth in the axils of the leaves. The rainy season crop in guava can be eliminated by removing current season growth through pruning or spraying chemicals (urea, NAA) or by removing rainy season flowers by hand. Whereas, hand de-blossoming is cumbersome process and due to adverse effect on plants and human health chemicals spray is not advisable for crop regulation. Hence, pruning can be become good alternate for regulation of crop in guava in such way that whole guava fruit will be harvested during November and before the mid December.

Therefore, in present studies pruning of guava tree was conducted from mid-March to

end June at 15 days intervals to find out its effect on time of harvesting and fruit quality of Shweta, Allahabad Safeda and Sardar cultivars of guava with the following objectives:-

i. To optimize the time of pruning in guava.

ii. To study the effect of time of pruning on fruit maturity, yield and quality of guava.

CHAPTER-II

REVIEW OF LITERATURE

In this chapter, literature pertinent to the present studies has been reviewed and documented under the following sub-headings:

2.1 Growth characteristics

2.1.1 Tree height (m)

2.1.2 Tree spread (m)

2.1.3 Tree volume (m^3)

2.1.4 Days to emerge new leaves

2.1.5 Annual shoot length (cm)

2.2 Flowering and fruiting characteristics

2.2.1 Percentage flowers

2.2.2 Fruit weight (g)

2.2.3 Fruit number (per tree)

2.2.4 Fruit yield (kg/tree)

2.2.5 Fruit size (cm)

2.2.6 Harvesting span (in days)

2.3 Chemicals characteristics

2.3.1 Total soluble solids (%)

2.3.2 Acidity (%)

2.3.3 Total Sugars (%)

2.3.4 Vitamin C (mg/100 g)

2.1. Growth Characteristics

2.1.1. Tree height

Lal (1992) reported that pruning treatments did not significantly influence the height of guava tree, when he was working on effect of pruning on crop regulation of guava. Likewise, Anez (1998) had observed that height of the guava tree was not affected by pruning treatments. Kindo (2005) reported no increase in tree height through various pruning treatments when he was studies on various methods of crop regulation in guava.

Chandra and Govind (1995) studied the influence of time and intensity of pruning on growth, yield and fruit quality of guava under high density planting and observed that with increase in pruning intensity up to 75 per cent tree height was increased. Kumar and Rattanpal (2010) studied that pruning significantly affect the tree height and it was decreased with increasing the severity of pruning. Basu *et al* (2007) conducted an experiment to study the response of pruning on rejumination of an old guava orchard (*cv.* L-49). Eleven year old guava trees were pruned drastically leaving only four scaffold branches per tree at monthly

interval from March 2003 to July 2003. The height of trees increased significantly after pruning as compared to control.

Pandey (2013) studied the effect of different dates of pruning on growth yield and fruit quality of guava under high density planting *cv.* Allahabad Safeda", and reported that maximum height in control trees. Likewise, Khan *et al* (1992) studies the effect of pruning on growth, quality and yield of ber and reported that unpruned trees have greatest height.

2.1.2 Tree spread

Pandey (2013) conducted "Studies on the effect of different dates of pruning on growth yield and fruit quality of guava under High Density planting c v. Allahabad Safeda" and reported that maximum tree spread in control trees. Lal (1992) reported that three leaf pair pruning results in maximum increase in tree spread, while, minimum increase was found with full shoot pruning in guava. Full shoot pruning reduced the net photosynthetic area for some time, which causes for the reduced spread of tree. As the same time reserve food was utilized by the tree for the recovery of pruned foliage. The various pruning treatments significantly affected the annual increase in guava tree spread, (Kindo, 2005). Basu *et al* (2007) while working on the eleven-years-old guava tree reported that spread of trees more in pruned trees as compared to control.

Lal (1983) reported that the number of new shoot emergence increased significantly in all the pruning treatments (1/4, 1/2, 3/4 and full shoot pruning in first week of May) and maximum number of new shoot emergence for winter season crop was observed in full shoot pruning in guava *cv.* Lucknow-49. Likewise, Tiwari (1985) also reported higher number of shoot emergence in guava *cv*. Allahabad Safeda with half shoot pruning.

According to Singh *et al* (2001) shoot growth was influenced greatly by different time of pruning treatments in different months. More number of new shoots emerged from the pruned branches as compared to unpruned ones. Pruning might shift the allocation of metabolites from rainy season crop in favour of increased vegetative growth due to flowers and fruitlets removal as a result of pruning. The vegetative growth response of guava trees to pruning treatments seems to vary with the month of operation and cultivar. In general, May month was found to be the best month for pruning, which resulted in shortening of shoot growth from 24.0-21.0 cm to 16.5-12.0 cm in Sardar and Allahabad Safeda, respectively.

Arvindakshan (1960) conducted studies on effect of pruning on growth, flowering and fruit set on sweet lime at Coimbatore and observed that pruning hastened the production and increased the lateral shoot growth, when tipping of the leader was done.

2.1.3 Tree volume

Pandey (2013) reported the maximum tree canopy volume in unpruned trees among different pruning dates. The effect of time and severity of pruning on tree growth of guava (*Psidium guajava* L.) *cv.* Sardar was studied by Jadhav *et al* (1998) and they reported the

most vigorous growth in trees subjected to pruning treatment 60 cm from the tip on 25th April. Kaur and Dhaliwal (2001) reported that highest net increase in tree canopy volume over the control with 30 cm pruning level in guava. The various pruning treatments significantly affected the annual increase in tree volume in guava trees (Kindo 2005).

Pruning in early May resulted in a significantly higher number of leaves per shoot. Interaction effect was non-significant in the rainy season but it was significant in the winter season. In the winter season, the maximum number of leaves per shoot was produced in trees pruned at the 30-cm level in mid-May (Adhikari and Kandel 2015). Dhaliwal and Singh (2004) conducted experiment on pruning intensity of guava and reported that severity of pruning level increase the canopy volume of the guava. They reported the maximum increment in the trees which were pruned at 30 cm level. Rabe (1993) reported that tree size can be controlled by pruning in citrus. Sosa (1985) registered improvement in the working conditions in the orchard by controlling the canopy volume by hedgerow pruning in Valencia Oranges.

2.1.4 Days to emerge new leaves

Several studies reported that pruning enhance the early emergence of new shoots in guava. Cutting down half the length of shoots helped to activate lower buds sprout earlier than the control. So, a pruned tree takes earlier new leaves emergence as compared to the control (Dasarathy 1951). Sundarrajan and Muthuswamy (1964) also reported the same results about the effect of pruning on certain *cv.* of guava at Coimbatore and noted that tipping the post season leader shoots, i.e., 4 to 5 cm from terminal portion, resulted in early initiation of lateral shoots. Similar results were observed by Aravindakashan (1960) of early emergence of shoot in a trial on guava in Coimbatore. Pruning in guava trees influenced the shoot emergence greatly than unpruned trees of guava (Bajpai *et al* 1973).

The early initiation/early growth of the shoots was also noticed in severely pruned trees of guava (Gopi Krishna 1981 and Sheikh and Hulmani 1997). Jadhav *et al* (2002) studied the effect of pruning dates and pruning intensities (30 and 60 cm from tip) on vegetative growth and fruit yield of guava and found that early pruning results in the early emergence of the shoots.

2.1.5 Shoot length

Pruning increase the length of shoot and promote the vegetative growth in severely pruned trees of guava (Bajpai *et al* 1973). Gopi Krishna (1981) also reported the increase in shoot length by severe pruning, i.e., 25 cm from the tip in both Jan-Feb and June growth flushes in Sardar guava. According to Singh (1996b), shoot length of the guava tree increased by the pruning treatments. Jadhav *et al* (2002) conducted an experiment on the effect of pruning dates and pruning intensities (30 and 60 cm from tip) on vegetative growth and fruit yield of 16-year-old guava cv. 'Sardar' and found that shoot length was reduced with delay in

pruning time.

Sheikh and Hulmani (1997) reported in an experiment conducted at Dharwad on 5 guava cultivars revealed that, severe pruning in January produced greater shoot growth and leaf area by April and August than mild or no pruning. Anez (1998) while studying the effect of pruning on growth of guava was reported that the growth rate was highest between May and June when tree subjected to light pruning. Singh *et al* (2001) reported that shoots produced after pruning (below cut point) in *cv.* Sardar exhibited more length than Allahabad Safeda. Shoots arising from the February and March pruned trees were larger than unpruned trees when measured after 4 months. Minimum shoot growth was found in May pruned trees in guava cultivars Allahabad Safeda and Shweta.

Bevington (1981) reported an increased length of shoot in Valencia orange by severe pruning. Tipping of the flowering and fruiting shoot also increased the vegetative growth from bud around the pruned portion in mango *cv.* Banaganapalli (Reddy 1983). Yahat *et al* (1995) also reported the increase the number and length of the shoots after summer pruning in Satsuma mandarin. Singh and Godara (1985) noted the significantly increase in shoot length and diameter by severe pruning (70-80 per cent removal of annual growth) in Ber *cv* .Umran. Khan *et al* (1992) also reported increases the shoot length by severe pruning in ber *cv.* Narikali.

2.2 Flowering and fruiting characteristics

2.2.1 Percentage flowers

Contradictory reports have been made regarding the influence of pruning time on emergence of flower. Aravindakshan (1960) reported that flower production was hastened by about a fortnight through the tipping of post season's leader shoot in guava. Similar results of earlier flowering in pruned shoots of guava were reported by Sundrarajan and Muthuswamy (1964). Early pruning took significantly less time for flower initiation in both seasons of guava. Pruning at 30 cm level in mid May took a longer time to initiate flowering in both the seasons. Early pruning favours in the early initiation of the new vegetative growth which results in the early emergence of the flowers. Delayed pruned trees initiated flowering later due to the late start of new vegetative growth in lately pruned trees. Pruned trees started new vegetative growth immediately after pruning and almost the entire amount of carbohydrates, which otherwise would form flower buds, might have been utilized in the vegetative growth of trees resulting in a late start of flowering in pruned trees (Dhaliwal and Singh 2004).

Singh *et al* (2001) while working on guava at Central Institute for Subtropical Horticulture, Lucknow reported that the per cent flower bud formation on new shoot was affected by different dates of pruning operations and May pruned trees produced maximum flowering shoots during July to September, in Sardar (70%) and Allahabad Safeda (73%) as compared to (26%) under control. Adhikari and Kandel (2015) reported in guava that early

pruned trees have significantly lower flowering duration in both seasons. Minimum flowering duration was observed in trees subjected to 30-cm pruning level in mid-April in both seasons. Early pruning took significantly less time for flower initiation in both seasons.

Preez and Welgemoed (1988) studied the effect of different pruning treatments on the flowering and fruit development of guava *cv.* Fan Retief in South Africa and Concluded that varied pruning times did not significantly affect the time of flowering and they obtained an interval of 35-42 days between flower emergence and anthesis.

2.2.2 Fruit weight

Pruning is important cultural practice to improve the fruit weight of guava. Adhikari and Kandel (2015) reported that size of the fruits increased by the delay in the pruning in both seasons of guava. The interaction effect of time and level of pruning on fruit weight was significant in both seasons. Pruning in month of May at 30 cm level produced heavier fruits in rainy season. The increase in number and area of leaves increases the amount of photosynthates that cause a significant increase in size and weight of fruit in the winter (Singh *et al* 2001).

Tipping the past season's leaders in guava significantly increased the fruit weight (Sundarajan and Muthuswamy 1964). Sheikh and Hulmani (1997) while working on 5 genotype of guava reported that pruning increase the fruit weight. Singh *et al* (2001) studied the effects of pruning dates on the fruit quality of 16-years-old trees of guava cultivars Sardar and Allahabad Safeda. Pruning was conducted on the first week of February, March, April, May or June. Sardar and Allahabad Safeda recorded the highest fruit weight when pruning was done in May. The improved fruit weight of guava during rainy and winter season without reduction in fruit yield of winter crop as a result of shoot pruning has also been reported by Dubey *et al* (2001). Dhaliwal and Kaur (2003) studied the effects of pruning dates (10, 20 or 30 April) and intensity (0, 10, 20 or 30 cm) on the development of flower-bearing shoots and fruit quality of guava (*cv.* Sardar) and reported that average fruit weight was highest with pruning treatment 30 April and with pruning intensity of 30 cm.

Ali *et al* (2014) concerning to pruning treatments in guava, pruning at 20 cm gave highest significant value. Regarding to date, pruning at May gave highest significant value. The interaction between two studies factors, pruning at 10 cm with May and pruning at 20 cm with May and June gave highest significant values in first season. In second season, concerning to pruning treatments, pruning at 20 cm gave highest significant fruit weight. Regarding date of pruning both May and June pruning gave higher significant values than July. The interaction between two studies factors, pruning at 20 cm at May and June had highest significant values. Sah (2013) reported that pruning effect the fruit weight of guava significantly in rainy season but it not affects the winter season fruit.

2.2.3 Fruit number

According to Anon (1942) there is no effect of pruning on increase in number of fruits of guava. However, Dasarathy (1951) reported the increase in number of guava by pruning treatments. Likewise, Sundarajan and Muthuswamy (1964) obtained an increase in number of fruits in guava by tipping of previous season leader shoots. Dhaliwal *et al* (2000) reported maximum fruit number of guava was at 50 per cent pruning intensity, while the minimum was at 100 per cent. There was less number of fruits per trees during winter on trees which were pruned on 20 April, 10 May and 30 May, but produce more number of fruits during winter season.

Pandey (2013) reported the maximum number of fruits per tree in 15 June pruned trees and minimum number of fruits per tree recorded in 15 April pruned trees in high density guava orchard. According to Adhikari and Kandel (2015) delayed pruning reduced the number of fruits per shoot in both the seasons. The interaction effect on number of fruits per shoot was found to be non-significant in both seasons. Kindo (2005) reported that maximum average number of fruits during rainy season was harvested in control followed by two leaf pair shoot pruning while no fruit was harvested from flower bud thinning by hand. Sah (2013) in an experiment, "Response of time of shoot pruning in meadow orchard of guava" reported that during rainy season, maximum number of fruits per tree was recorded in control. Whereas, minimum number of fruits per tree was recorded in trees pruned in April, July and October. During winter season, maximum number of fruits per tree was recorded in April and July pruned trees and minimum number of fruits per tree was recorded in control trees.

Mohammed *et al* (2006) studied that pruning decrease the rainy season crop and increase the number of winter season fruits in guava trees. Ali *et al* (2014) recorded that pruning at 10 cm gave highest fruit number per tree. Pruning at May gave highest significant value in both seasons.

2.2.4 Fruit Yield

Gopi Krishna (1981) reported that mild pruning (10 cm) favoured the production of more flowers in guava in July- August flowering flush and hence more fruit set for winter season crop. However, Lopes *et al* (1982) also carried out studies on 6-year-old guava trees in Brazil, to study the effect of six pruning periods on yield of *cv.* IAC-4. They pruned the trees on 15^{th} of every month from May to October and found that no significant effect of pruning on total yield and average fruit weight over the control. Pruning of top $3/4^{th}$ portion of new shoots were found better for obtaining good crop of guava during winter season (Lal 1983 and Pandey 1990). Singh *et al* (1996) reported that the pruning treatments produced a significant reduction in fruit set and yield in guava during rainy season crop and a subsequent significant increase was found during winter season in *cv.* Sardar and in Allahabad Safeda respectively. Mishra and Pathak (1998) studied on effect of pruning on crop regulation and reported that 50

per cent pruning in May produced the highest fruit yield in winter crop of guava over the control.

The influence of time and intensity of pruning on growth, yield and fruit quality of guava under high density planting was studied by Chandra and Govind (1995). They reported that pruning at 25 per cent in February could regulate fruit yield without affecting the fruit quality. Jadhav *et al* (1998) had reported highest fruit yield of guava *cv*. Sardar with single pruning 60 cm from the tip on 25th April. Dhaliwal *et al* (2000) reported that when three year old tree of guava *cv*. Sardar were pruned at 5 intensity levels (Controls, and 25, 50 and 100 %), and on 6 dates (from 20 February to 30 May at 20 day intervals). Per cent fruit set and fruit retention increased with increasing pruning intensity, while pruning date had no effect on these parameters. Maximum fruit number was in 50 per cent pruning intensity, while the minimum was at 100 per cent. Trees pruned on 20 April, 10 May and 30 May failed to produce rainy season crop, but produced fruits during the winter season.

Singh *et al* (2001) studied the effect of pruning dates on yield of guava cultivars i.e. Allahabad Safeda and Sardar for five consecutive years. The yield during winter season was increased significantly in May and June pruned trees than the unpruned trees of both the varieties. Sahay and Singh (2001) conducted an experiment on regulation of cropping in guava. During winter season, the yield per tree was recorded maximum in double spray of Urea 15 per cent followed by hand de-blossoming and 3/ 4 current shoot pruning.

May and June pruned trees significantly yielded higher than control in both the cultivars. This increased yield in winter was a result of significant reduction in rainy season crop load. The effect of pruning date on the shifting of rainy season crop to winter season was more pronounced. More winter crop was recorded on the trees pruned on 15th May and 30th June. This phenomenon was common in both the cultivars. Total yield (rainy crop + winter crop) was also higher under pruning treatments, with the major crop in winters. The effect of 15th and 30th May pruning appeared more pronounced than June pruning (Singh *et al* 2001).

Jadhav *et al* (2002) reported that the effect of pruning date (25 April, 25 May and 25 June) and intensity (30 and 60 cm) on the vegetative growth and fruit yield of 16 year old guava cv. Sardar were determined in a field experiment conducted in Akola, Maharshatra, India. The average weight of fruit per shoots and crop yield decreased with the delay in pruning. Dubey *et al (2002)* observed highest yield of quality fruit during winter season with trees shoot pruned moderately in May. These results agreement with the findings of Shaban and Haseeb (2009) they found that moderate pruning and treatments at 15th February on 25 years guava trees hybrid I a pronounced and significant increase in initial fruit set, also pruning treatments with spraying chemicals substances improved tree yield.

The pruning treatments have significant effect on number of flowers in comparison to control during rainy season because less current season wood was available due to pruning. In

the following winter the number of flowers per shoot and yield per tree increased with the increasing severity of pruning (Mohammed *et al* 2006). Pandey (2013) was reported the maximum yield in 1 June and 15 June pruned trees in her experiment. Fruit yield in the rainy season was decreased with a delay in pruning.

Maximum yield during winter season was observed when trees were pruned in early May. Interaction effect was a significant effect on yield in both seasons. Pruning in early May at 20-cm pruning level was the best combination for maximum fruit yield in the winter season (Adhikari and Kandel 2015).

Ali *et al* (2014) recorded the maximum yield of winter crop of guava when pruned the trees in May. The interaction between two studies factors, pruning at 10 cm with May pruning gave highest significant value in first and second seasons. According to Sah (2013), time of pruning significantly affect the yield of guava. Higher rainy season fruit yield was observed in unpruned trees. However, in winter season fruit yield was observed higher in all the treatments which were pruned in previous season.

2.2.5 Fruit size

Tipping of past season leader shoots resulted into increased fruit size of guava (Aravindakshan 1960). Sundrarajan and Muthuswamy (1964) also reported the same results in guava that size of fruits in pruned trees was larger than the unpruned trees. Bajpai *et al* (1973) found similar results of increased size of guava fruits in pruned trees. Gaur (1996) reported that pruning at top half of the current season's growth of Allahabad Safeda guava improved the fruit size during both rainy and winter season crops. Jadhav *et al* (1998) recorded that the fruit length and diameter were significantly influenced by time and severity of pruning. Maximum fruit size was recorded from the fruits which were harvested from the 60 cm pruned trees. Pruning done on 25th April produced significantly larger size of fruits. Dalal *et al* (2000) found that severe pruning increased fruit set and individual fruit size in 25-years-old guava *cv*. 'Sardar'.

Kindo (2005) reported the maximum fruit diameter and fruit length with one leaf pair shoot pruning during winter season. Mohammad *et al* (2006) studied that all type of pruning treatments increase the size of the fruit during winter season. Lal (1992) studied in guava variety Sardar and recorded that fruit size increased with increasing the pruning intensity in both the seasons. Lotter and Lotter (1990) found the increase the fruit size in pruned trees of guava.

Adhikari and Kandel (2015) reported that the size of the guava fruits was increased with increase the level of the pruning in both seasons. Fruits were significantly bigger in delayed pruning in both seasons. Singh *et al* (2001) reported in Sardar and Allahabad Safeda the highest fruit length and fruit diameter was obtained when pruning done in May. Ali *et al* (2014) while working on guava fruit quality related to pruning recorded that pruning at 20 cm

gave maximum fruit size. Mohammed *et al* (2006) stated that pruning level effect the fruit size of the guava *cv*. L-49.

Moore (1959) while studied on effect of pruning on Naval oranges in the USA and observed that all types of pruning resulted an increase in fruit size. Awasthi and Mishra (1969) found that girth of ber fruits was more in pruned tress as compared to unpruned trees fruits. They also observed that fruits produced on pruned trees were better in size as compared to control. Gill and Bal (2006) studied and reported the maximum fruit size from the ber trees which were pruned between 9 to 30 May by retaining 6 buds.

2.2.6 Harvesting span (in days)

Singh (2005) recorded that harvesting span of the guava fruit decline with the increase the severity of the pruning. He had stated that regular pruning results in significantly shortened the duration of flowering and fruit harvesting span in both the cropping seasons. Tipping of past season's leader shoot hasten the flower production by 15 days (Arvindakshan 1960).

2.3 Chemical characteristics

2.3.1 Total soluble solids

Generally it has been found that pruning increases the total soluble sugars. Bajpai *et al* (1973) reported increase the TSS in severely pruned guava trees fruits. Gopi Krishna (1981) also observed an increment in fruit TSS in both the rainy and winter seasons of guava fruits. Lal (1983) recorded higher total soluble solids of the fruits in all fruiting season in the trees subjected to top 3/4th shoot pruning or full shoot pruning in *cv.* Sardar.

Dhaliwal *et al* (2000) studied the three year old tree of guava *cv*. Sardar which were pruned at 5 intensity levels (Controls, and 25, 50 and 100%), and on 6 dates & from 20 February to 30 May 1993 at 20 day intervals). The highest total soluble solid (TSS) control was in fruits of trees pruned on 30th May. TSS increased with increasing pruning intensity. Singh *et al* (2001) studied that the highest TSS content was observed when Sardar trees were pruned in June and when Allahabad Safeda trees were pruned in May and June. Dhaliwal and Kaur (2003) suggested that the highest average TSS contents were obtained with pruning on 10 April recorded in guava. Prakash *et al* (2012) reported the maximum TSS in pruned tree fruits in both rainy and winter season of guava.

According to Pandey (2013) different dates of pruning of guava significantly affected the TSS of the guava fruits. The maximum TSS was found in 1- June pruned trees which are significantly different from 15- May pruned trees and the minimum TSS was found in Control trees which are at par with other treatments. However, Adhikari and Kandel (2015) reported that timing of pruning did not influence the TSS content in fruits in both seasons in guava. Similarly, interaction effect was also non-significant in both seasons.

Ali *et al* (2014) while studied the effect of pruning on yield and fruit quality of guava

trees reported that pruning at 10 cm gave maximum TSS fruits. Regarding to date, pruning at May and June recorded highest TSS values. The interaction between two studies factors, pruning at 10 cm and 20 cm with May and June showed highest significant values in first season. Regarding to date, pruning at May showed highest significant TSS value. The interaction between two studied factors, all pruning treatments with May and pruning 10 cm with June had highest significant values.

2.3.2 Titrable acidity

Lal (1983) observed higher acidity of the fruits in all fruiting season in the trees subjected to top 3/4th shoot pruning or full shoot pruning in *cv.* Sardar of guava. Pandey (2013) reported the maximum acidity in 15th June pruned trees of guava. Kaur (1999) observed that acidity of fruits increased significantly with the delay in pruning time of guava. Highest acidity was found in the fruits produced by the trees which were pruned on 20th and 30th April.

Adhikari and Kandel (2015) reported that acidity of the fruit was not influenced by pruning time or level in both seasons. Similarly, interaction effect was also non-significant in both seasons. Bajpai *et al* (1973) also reported there was no any significant effect of pruning on acidity of the guava fruits. Singh *et al* (2007) shows in their experiment that shoot pruning did not affect titrable acidity in guava. The maximum acidity was recorded in half shoot pruning in April and October, while the minimum acidity was noticed in pruning in April. High acidity was noticed in pruned trees as compared to unpruned trees (Sah 2013).

2.3.3 Total Sugars

Kindo (2005) reported that non-reducing sugar content in winter season fruits were non- significantly affected by different pruning treatments in guava. Maximum reducing sugars and total sugar were recorded with one leaf pair shoot pruning during both the season. According to Ali *et al* (2014) pruning at 10 cm gave highest significant value in both seasons of guava. Regarding to date, pruning at May and June gave highest significant values in both seasons. Tiwari (1985) observed that half shoot pruning in guava variety Allahabad Safeda results in the higher sugar contents. Sheikh and Hulmani (1997) studied that pruning did not affect the total sugar content in the guava fruits. However Singh *et al* (1996) conducted and experiment on pruning of guava and observed that total sugar content significantly increased in pruning treatment trees.

2.3.4 Vitamin C

Bajpai *et al* (1973) reported that pruning did not show any significant effect on the ascorbic acid content of guava. Gopi Krishna (1981) also recorded similar results in guava that pruning did not show any affect the ascorbic content. According to Lal (1983) ascorbic acid content was not affected significantly in all fruiting season in the trees subjected to top 3/4th shoot pruning. Singh *et al* (1996) studied and reported that pruning did not affect the

vitamin C content in guava. However, Anon (1984) observed the higher ascorbic acid content in pruned trees of *cv.* Fan Retief of guava. He reported an improvement in the ascorbic acid content when the pruning was done in the month of September to October.

Lal *et al* (2000) reported that ascorbic acid content of guava was not significantly influenced by spacing and pruning treatments. Dhaliwal *et al* (2000) found that ascorbic acid increased with increasing pruning intensity. Sarkar *et al* (2005) also reported the increased the vitamin C content of guava fruits in pruned trees, when they were working on effect of shoot pruning and bending on yield and fruit quality in guava cv. L-4. According to Ali *et al* (2014) highest vitamin C content was recorded in control trees of guava, which was significantly different from other treatments. Regarding to dates, pruning at May gave highest significant value in both seasons.

CHAPTER-III

MATERIALS AND METHOD

The experiment "Studies on effect of pruning time on fruit maturity, yield and quality of guava (*Psidium guajava* L.)" were undertaken in the Regional Fruit Research Station, Bahadurgarh, Patiala and Fruit Research Farm, Department of Fruit Science, Punjab Agricultural University, Ludhiana during 2016.

Plant material

The studies has been conducted on 7-years-old-tree of guava *cv.* 'Shweta', 11-years-old-tree of guava *cv.* 'Allahabad Safeda' at Regional Fruit Research Station, Bahadurgarh and 4-years-old-tree of *cv*. 'L-49' at PAU, Ludhiana. All the selected trees were maintained under uniform cultural practices. While selecting the trees care has been taken to select trees of uniform, vigour and healthy. The details of the pruning treatments were as follow:

Treatments	**Time of pruning**
T_1	15th March
T_2	30th March
T_3	15th April
T_4	30th April
T_5	15th May
T_6	30th May
T_7	15th June
T_8	30th June
T_9	Control (unpruned)

On the entire tree, the 50 per cent portion from apex of one-year-old shoot was headed back on 15th and 30th of date of March, April, May and June months. Control trees were left unpruned. The experiment was laid out in Randomized Block Design. Whole of the tree was taken as one unit and there were three replications. Thus 27 trees were deployed in each variety for experiment.

OBSERVATIONS RECORD

3.1. Growth characteristics:

3.1.1 Tree height

The height of the tree was measured from the soil surface to the highest crown level with the help of a measuring tape before pruning and again in the month of November. Increase in tree height was calculated by subtract first value (before pruning) from second value (November value).

3.1.2 Tree spread

Plant spread was measured in two opposite directions (East-West and North-South) with the help of measuring scale once before pruning and again in the month of November. Average spread of the plant was calculated in meter.

3.1.3 Tree volume

The tree canopy volume was calculated by formula as given by Westwood (1978).

Tree volume (m^3) = 4/3 a^2 b

Where,

a = half of the tree spread

b = half of the tree height

The increment in tree canopy volume was calculated by subtracting the tree canopy volume recorded just before pruning the trees from the tree canopy volume recorded in the month of November.

3.1.4 Days to emerge new leaves

The date of new leaf emergence was recorded when the green tissues of emerging leaf bud became visible on the branch. Four main branches randomly selected on the each side of the tree. Four main branches of tree were marked on each side of tree. Just-to-emerge buds were marked on each branch and date of leaf emergence was recorded.

3.1.5 Shoot length

Length of sprout was calculated by the measuring scale/measuring tape in November.

3.2 Flowering and fruiting characteristics:

3.2.1 Percentage flowers

Flowers were counted every month manually in every plants and percentage of per month was calculated.

3.2.2 Fruit number (per tree)

The number of fruits per tree that reached maturity was recorded separately for each treatment by counting, prior to about 15 days of harvesting.

3.2.3 Fruit weight

The average fruit weight of ten randomly selected fruits was determined by weighing the fruits on the pan balance.

3.2.4 Fruit yield

To determine the fruit yield, average fruit weight was multiplied by total number of fruits per tree recorded under the observation (3.2.2).

3.2.5 Fruit size

Ten fruits were randomly selected from the each replication. The size was measured by placing the fruits end to end to measure the length and breadth along a measuring scale in cm. The length per fruit was measured from stem end to calyx end and there average fruit

length and breadth was recorded.

3.2.6 Fruit firmness

Firmness of fruits is measured with the help of panetrometer (Model FT-327, USA) using stainless steel probe. About one square centimeter of the peel in the fruits from the shoulder was removed with the help of peeler and firmness of pulp was recorded and expressed in terms of pound force (lbf).

3.2.7 Harvesting span

The harvesting span was calculated in number of days, from the first harvest date to the last date of fruit harvest in each treatment.

3.3 Chemicals characteristics

3.3.1 Total soluble solids

The total soluble solids of the fruit were determined with the help of Hand refractometer. The juice from the fruit slices of ten randomly assorted fruits was extracted the slices in a pestle mortar and then squeezing them with hand. The drop of the extracted pulp was placed on the surface of the prism and the cover part was placed back. The refractometer reading was taken and the average of reading was calculated for each replication and the results were expressed on per cent basis.

3.3.2 Titrable acidity

The fruit were used for this purpose. The flesh was extracted from the fruits and chopped minutely. For recording the acid content, 2 ml of juice was taken in 50 ml beaker. This was then diluted to 10 ml with distilled water and titrated with 0.1N NaOH using phenolphthalein as an indicator. The change of colour from yellow to pink is considered as the end point. The acidity was calculated by using formula:

$$\text{Percent acidity} = 0.0067 \frac{\text{0.1N NaOH used (ml)}}{\text{Juice taken (ml)}} \times 100$$

3.3.3 TSS: acid ratio

The TSS: acid ratio of guava fruit was determined by dividing total soluble solids of the guava fruit with the total titrable acidity of guava fruit and mean values were presented for both rainy and winter season.

3.3.4 Total sugars

The reducing sugars were first converted into non reducing sugars for estimation of total sugars. Total sugars were estimated by taking 25 ml of above aliquot in 100 ml of measuring flask. To this solution 5 ml of 60 % HCl was added and left overnight at room temperature for acid hydrolysis. Water bath was given at 68°C for 10 min to the flask. NaOH (10 %) was used to neutralize the excess of HCl in the initial stage. Then the neutralized solution was titrated against Fehling solution A and B as in case of reducing sugar estimation.

The result was expressed in percentage (AOAC 1990).

$$\text{Total Sugar (\%)} = \frac{\text{Fehlings Factor (0.05)}}{\text{Volume of filtrate used}} \times \frac{\text{Dilution made}}{\text{Weight of sample taken}} \times \frac{\text{Final volume made}}{\text{Volume of filtrate taken}} \times 100$$

3.3.5 Vitamin C

Preparation of reagents

(a) Metaphophoric acid: 15 g of Glacialmetaphosphoric acid pallets were dissolved in 40 ml of acetic acid and 200 ml of water. The final volume was made 500 ml.

(b) Indophenol standard solution: 50 mg of dye (2,6- dichloroindophenol) was dissolved in 50 ml of water, to which 42 mg of sodium bicarbonate was added and diluted to 200 ml.

(c) Ascorbic acid standard solution: 100 mg of standard ascorbic acid was transferred to 100 ml volumetric flask and diluted to mark with reagent (a).

(d) Dye- factor: 2 ml of reagent (c) was taken in the 50 ml flask, containing 5 ml of reagent (a) and was titrated rapidly with reagent (b), until rose pink colour persisted for 5 sec. In like manner, three blanks i.e. 5 ml reagent (a) and 2 ml water was titrated. After subtracting average blanks from standard titration, concentration of Indophenol solution was calculated and expressed as mg of ascorbic acid equivalent to 0.1 ml of reagent (AOAC 1990).

(e) Sample determination: 5 ml of sample was titrated with reagent (b) after blending with 70 ml of reagent (a) and ascorbic acid as mg/ 100 g of a given sample was expressed as:

$$\text{Vit. C} = \frac{\text{Ascorbic acid}}{\text{Dye used}} \times \frac{\text{Titration Value}}{\text{Wt of sample}} \times \frac{\text{Stock solution}}{\text{Aliquot taken}}$$

Statistical analysis

The data were analyzed statistically. Differences were considered statistically significant at the levels ($p < 0.05$) using statistical analysis system software CPCS1.

CHAPTER- IV

RESULTS AND DISCUSSION

The results of experiment entitled "Studies on effect of pruning time on fruit maturity, yield and quality of guava (*Psidium guajava* L.) are presented in this chapter. The studies were conducted under the climatic conditions of Punjab with the objectives to advance the maturity time of winter season guava as well as to obtain good yield and quality fruits.

The results pertaining to the present studies are presented under the following heads and discussed in the length of available literature.

4.1. Growth characteristics:

4.1.1 Increase in tree height

The data of net increase in tree height under different dates of pruning are presented in Table 4.1. The results showed that in guava variety 'Shweta' maximum increase in tree height (90.14 cm) recorded in control trees which was statistically at par with treatments T_1 (88.33 cm), T_2 (82.66 cm) and T_3 (82.66 cm). The least increase in tree height (64.66 cm) was found when the trees were pruned on 30th June (T_8). Likewise, in variety 'Allahabad Safeda' significantly higher net increase in tree height (95.50 cm) was recorded in control trees as compared to other treatments. The minimum increase in tree height (59.50 cm) was recorded in treatment T_8 i.e. pruning done on 30th June.

In variety 'L-49', control trees (T_9) had significantly higher increased in tree height (92.25 cm) as compared to others treatments. The pruning treatment (T_7) was recorded minimum net increase in height (62.33 cm) among the various pruning treatments.

The results of present studies were conformity with findings of Pandey (2013) who has reported that the maximum increase in height in control trees of guava *cv.* Allahabad Safeda. Likewise, Lal (1992) obtained that tree height was non-significantly affected by various pruning treatments. Kumar and Rattanpal (2010) studied that pruning significantly affect the tree height and it was decreased with increasing the severity of pruning.

4.1.2 Increase in tree spread

The data with respect to increase in tree spread are given in Table 4.2 revealed that control (unpruned) trees had higher tree spread as compared to pruned trees. The beside control, among the pruning treatments highest tree spread (E-W) i.e. 1.08 m and (N-S) 0.95 m was recorded in treatments T_5 and T_7 respectively in variety 'Shweta'. However, in variety 'Allahabad Safeda' and 'L-49', the maximum tree spread (E-W 1.16 m, N-S 1.03 m in Allahabad Safeda; E-W 1.20 m, N-S 0.99 m in variety L-49) was recorded in trees pruned on 30th May (T_6).

Likewise, Pandey (2013) was found maximum increase tree spread in control as compared to the pruned trees. However, Lal (1983) and Singh (2001) also observed the

increase tree spread if guava trees were pruned in May.

Table 4.1: Effect of pruning time on increase in tree height of different cultivars of guava.

Time of pruning	Increase in tree height (cm)		
	Shweta	**Allahabad Safeda**	**L-49**
T_1 (15- March)	88.33	81.00	84.00
T_2 (30- March)	82.66	80.00	74.66
T_3 (15- April)	82.66	78.33	76.33
T_4 (30- April)	75.00	73.86	75.00
T_5 (15- May)	73.33	72.33	70.00
T_6 (30- May)	72.33	67.16	66.66
T_7 (15- June)	68.33	63.33	62.33
T_8 (30- June)	64.66	59.50	63.00
T_9 (Control)	90.14	95.50	92.25
CD at 5 %	7.60	7.10	7.60

Table 4.2: Effect of pruning time on increase in tree spread of different cultivars of guava.

Time of pruning	Increase in tree spread (m)					
	Shweta		**Allahabad Safeda**		**L-49**	
	E-W	**N-S**	**E-W**	**N-S**	**E-W**	**N-S**
T_1 (15- March)	0.64	0.58	0.59	0.74	0.66	0.77
T_2 (30- March)	0.67	0.66	0.65	0.67	0.78	0.76
T_3 (15- April)	0.72	0.69	0.71	0.77	0.92	0.67
T_4 (30- April)	0.91	0.76	0.89	0.87	1.00	0.89
T_5 (15- May)	1.08	0.92	1.09	0.96	1.13	0.93
T_6 (30- May)	0.97	0.94	1.16	1.03	1.20	0.99
T_7 (15- June)	1.00	0.95	1.08	0.93	1.03	0.86
T_8 (30- June)	0.96	0.89	0.99	0.82	1.11	0.80
T_9 (Control)	1.10	1.13	1.17	1.12	1.23	1.10
CD at 5 %	0.081	0.045	0.050	0.085	0.066	0.055

4.1.3 Increase in tree canopy volume

The data regarding net increase in the tree canopy volume are given in Table 4.3. The highest net increment in the tree volume (2.20 m^3) of guava variety Shweta was found in control trees. However, among pruning treatments (T_1-T_8), the guava trees pruned on 15th May (T_5) had significantly higher net increase in canopy volume (1.47 m^3). Similar results were observed in variety Allahabad Safeda and L-49 i.e. significantly higher net increase in canopy volume was recorded in control.

Rebe (1993) also obtained the maximum increase in canopy volume in control trees. Pandey (2013) also observed the same observation that pruning on 15th and 30th May results in more increase in tree canopy as compared to the other pruning months. Adhikari and Kandel (2015) also observed the more increase in tree canopy when trees were pruned in May.

Table 4.3: Effect of pruning time on the net increase in tree canopy volume (m^3) of different cultivars of guava

Time of pruning	Increase in tree canopy volume (m^3)		
	Shweta	**Allahabad Safeda**	**L-49**
T_1 (15- March)	1.19	1.26	1.06
T_2 (30- March)	1.22	1.29	1.19
T_3 (15- April)	1.28	1.28	1.24
T_4 (30- April)	1.36	1.39	1.31
T_5 (15- May)	1.47	1.42	1.38
T_6 (30- May)	1.41	1.44	1.35
T_7 (15- June)	1.37	140	1.29
T_8 (30- June)	1.31	133	1.27
T_9 (Control)	2.20	2.14	1.94
CD at 5%	0.196	0.183	0.294

4.1.4 Days to emerge new shoot

The data presented in Table 4.4 showed that the early pruning enhances the early shoot emergence. The results of variety 'Shweta' revealed that among the different pruning treatments, earliest shoot emergence was recorded in T_1 on 4th of April. Pruning treatment on 30th June recorded shoot emergence on 8th July. In control trees, new shoot emergence was recorded on 30th March. In variety 'Allahabad Safeda', pruning treatment on 15th March was observed shoot emergence on 6th April and shoot emergence of 6th July was recorded in T_8. In

control trees, new shoots were emerged on 31st March.

In guava variety 'L-49', it was recorded early shoot emergence (3rd April) in T_1. However, the treatment in which pruning was done in 30th June, shoot emergence was recorded in 6th July. In control treatment, shoot emergence was recorded on 30th of March.

The results of present studies are found in lines with that of Aravindakshan (1960), who reported that pruning, enhance the early shoot emergence in guava. Similarly, Gopi Krishna (1981), Sheikh and Hulmani (1993) also reported the early initiation/early growth of the shoots in severely pruned trees of guava.

4.1.5 Shoot length

The data with related to time of pruning on shoot length of guava pruned in Table 4.5. Data of date revealed that pruning has positive effect on shoot length of guava. In variety 'Shweta', higher shoot length (54.10 cm) was recorded in treatment T_1 (pruned on 15th March) follow by 52.00 cm shoot length recorded in T_2 (30th March). Likewise, in variety 'Allahabad Safeda', trees pruned on 30th March (T_2) had higher shoot length (52.30 cm). Whereas, in guava trees of 'L-49', the maximum shoot length (51.60 cm) was recorded in pruning treatment done on 15th March (T_1).

The results of our studies are in conformity with the finding of Anez (1998) who has also recorded maximum shoot length in early pruned guava trees. Similarly, Singh *et al* (2001) reported that shoots produced after pruning exhibited more length as compared to unpruned trees. Gopi Krishna (1981) also observed the similar results of increase in shoot length after pruning.

Table 4.4: Effect of pruning time on days to emerge new shoot of different cultivars of guava.

Time of pruning	Date of shoot emergence		
	Shweta	**Allahabad Safeda**	**L-49**
T_1 (15- March)	4 April	6 April	3 April
T_2 (30- March)	12 April	13 April	11 April
T_3 (15- April)	1 May	3 May	1 May
T_4 (30- April)	10 May	11 May	8 May
T_5 (15- May)	23 May	26 May	21 May
T_6 (30- May)	9 June	11 June	10 June
T_7 (15- June)	22 June	24 June	24 June
T_8 (30- June)	8 July	6July	6 July
T_9 (Control)	30 March	31 March	30 March

Plate 1: Shoot emergence after pruning in guava

Table 4.5: Effect of pruning time on shoot length of different cultivars of guava.

Time of pruning	Shoot length (cm)		
	Shweta	**Allahabad Safeda**	**L-49**
T_1 (15- March)	54.10	50.10	51.60
T_2 (30- March)	52.00	52.30	49.50
T_3 (15- April)	46.30	48.50	45.40
T_4 (30- April)	49.60	46.30	48.70
T_5 (15- May)	50.60	50.70	47.50
T_6 (30- May)	45.33	46.00	45.64
T_7 (15- June)	47.60	49.18	46.00
T_8 (30- June)	43.80	42.17	42.34
T_9 (Control)	50.10	50.10	48.00
CD at 5%	2.36	1.92	2.12

4.2 Flowering and fruiting characteristics

4.2.1 Percentage flowering

Data regarding the percentage flowering of different guava cultivars are given in Table 4.6. In variety 'Shweta', March pruned trees (T_1 and T_2) showed maximum flowering percentage (62% and 67% respectively) in April and May months (for rainy season crop) and remaining flowering in July and August months (for winter season crop). April pruned trees (T_3 and T_4) showed maximum flowering percentage during the months of May- June. In May and June pruned trees, maximum flowering percentage were recorded in July and August months i.e. for winter season crop. In variety 'Allahabad Safeda' and 'L-49' also showed similar results for rainy and winter season crops.

In present studies, it was observed that early pruning treatments i.e. March and April, enforced guava trees to sprout earlier consequently maximum flowering in April-May for rainy season crop. Whereas, late pruning i.e. in May-June helped for shifting of maximum flowering in July August i.e. for winter season crop. The results of present studies were in lines with findings of Sundrarajan and Muthuswamy (1964) who observed that early pruning favours in the early initiation of new vegetative growth which results in the early emergence of flowers and vice-versa. Singh *et al* (2001) also reported that the per cent flower bud formation on new shoot was affected by dates of pruning and May pruned trees also produced maximum flowering shoots during July-September.

Table 4.6(a): Effect of pruning time on flowering percentage of guava variety Shweta.

Time of pruning	March	April	May	June	July	August	September	October	November
T_1 (15- March)	-	50	12	-	20	18	--	-	-
T_2 (30- March)	-	40	27	-	13	20	-	-	-
T_3 (15- April)	-	-	50	10	15	25	-	-	-
T_4 (30- April)	-	-	20	15	27	38	-	-	-
T_5 (15- May)	-	-	-	5	60	35	-	-	-
T_6 (30- May)	-	-	-	3	56	41		-	-
T_7 (15- June)	-	-	-	5	60	32	3	-	-
T_8 (30- June)	-	-	-	-	28	56	6	10	-
T_9 (Control)	-	30	28	-	15	27	-	-	-

Table 4.6(b): Effect of pruning time on flowering percentage of guava variety Allahabad Safeda.

Time of Pruning	March	April	May	June	July	August	September	October	November
T_1 (15- March)	-	52	10	-	22	16	--	-	-
T_2 (30- March)	-	42	25	-	10	23	-	-	-
T_3 (15- April)	-	-	52	8	15	25	-	-	-
T_4 (30- April)	-	-	22	13	27	38	-	-	-
T_5 (15- May)	-	-	-	5	55	40	-	-	-
T_6 (30- May)	-	-	-	3	56	41		-	-
T_7 (15- June)	-	-	-	5	60	32	3	-	-
T_8 (30- June)	-	-	-	-	27	56	7	10	-
T_9 (Control)	-	32	26	-	15	27	-	-	-

Table 4.6(c): Effect of pruning time on flowering percentage of guava variety L-49

Time of Pruning	March	April	May	June	July	August	September	October	November
T_1 (15- March)	-	54	8	-	20	18	--	-	-
T_2 (30- March)	-	41	26	-	15	18	-	-	-
T_3 (15- April)	-	-	50	10	15	25	-	-	-
T_4 (30- April)	-	-	20	15	27	38	-	-	-
T_5 (15- May)	-	-	-	5	56	39	-	-	-
T_6 (30- May)	-	-	-	3	56	41		-	-
T_7 (15- June)	-	-	-	5	58	34	3	-	-
T_8 (30- June)	-	-	-	-	28	56	6	10	-
T_9 (Control)	-	29	29	-	15	27	-	-	-

4.2.2 Fruit number per tree

Data with regarding to fruit number per tree (Table 4.7 and 4.8) revealed that in variety 'Shweta', the maximum fruit number per tree (282.0) during the rainy season was recorded in control trees, which was significantly higher than the fruit number recorded in others treatments with minimum fruit number (45.6/ tree) in T_4. During the winter season, the maximum number of fruits per tree (326.0) was found in T_6 and it was significantly higher as compared to others treatment. The minimum fruit number (69.0/tree) during winter season was recorded in control. In variety 'Allahabad Safeda', control trees produced significantly more number of fruits (430.0) during rainy season compared to other treatments with minimum fruit number of 402.0 in T_4. During the winter season, maximum fruit number per tree was recorded in T_6 (498.0) and it was significantly different from the other treatments. Minimum fruit number per tree was recorded in T_1 (251.0). Similarly, in cultivar 'L-49', maximum number of fruits per tree (273.0) during rainy season was reported in control trees which was significantly higher than the other treatments with minimum number of fruits per tree (233.0) in T_1 and followed by T_2 (205.0). In winter season, maximum number of fruits per tree (326.0) was recorded in T_5 and it was at par with T_6 (320.0). Minimum fruit number per tree (182.0) was recorded in T_1 during winter season.

During the rainy season, more fruit number per tree was recorded in control trees. Similar results were observed by the Kindo (2005) maximum fruit number per trees in control trees during rainy season. Sah (2013) also reported similar results of maximum fruit number per tree in control during rainy season. During the winter season, maximum fruiting was observed in May pruned trees in all the three varieties. Ali *et al* (2014) and Dhaliwal *et al*

Table 4.7: Effect of pruning time on number of fruits per tree of different cultivars of guava during rainy season.

Time of pruning	Fruit number per tree		
	Shweta	**Allahabad Safeda**	**L-49**
T_1 (15- March)	252.3	404.0	233.0
T_2 (30- March)	266.0	429.0	205.0
T_3 (15- April)	176.0	425.0	196.0
T_4 (30- April)	45.6	402.0	184.0
T_5 (15- May)	-	-	-
T_6 (30- May)	-	-	-
T_7 (15- June)	-	-	-
T_8 (30- June)	-	-	-
T_9 (Control)	282 .0	430.0	273.0
CD at 5%	12.7	10.3	5.9

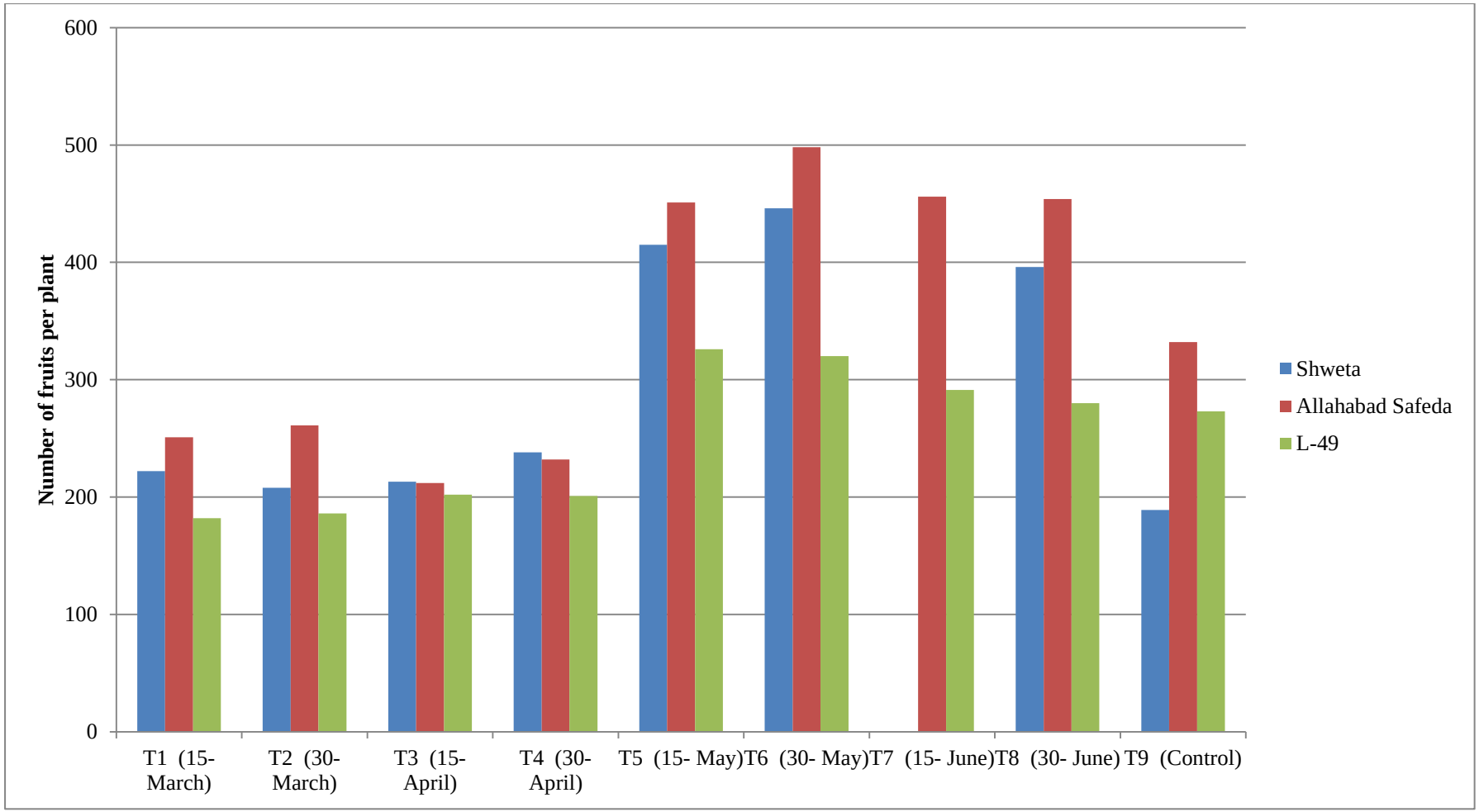

Fig 4.1: Effect of pruning time on number of fruits per plants during the winter season

(2000) also reported similar results of maximum number of fruits during winter season in May pruned trees. Less number of fruits in control trees due to more number of fruits during rainy season. The pruning treatments have significant effect on number of flowers in comparison to control during rainy season because less current season wood was available due to pruning. In the following winter the number of flowers per shoot and yield per tree increased with the increasing severity of pruning (Mohammed *et al* 2006).

Table 4.8: Effect of pruning time on number of fruits per tree of different cultivars of guava during winter season.

Time of pruning	Fruit number per tree		
	Shweta	**Allahabad Safeda**	**L-49**
T_1 (15- March)	102.0	251.0	182.0
T_2 (30- March)	100.0	261.0	186.0
T_3 (15- April)	93.0	212.0	202.0
T_4 (30- April)	118.0	232.0	201.0
T_5 (15- May)	295.0	451.0	326.0
T_6 (30- May)	326.0	498.0	320.0
T_7 (15- June)	304 .0	456.0	291.3
T_8 (30- June)	276.0	454.0	280.0
T_9 (Control)	69.0	332.0	273.0
CD at 5%	9.8	10.9	10.4

4.2.3 Fruit weight

Data regarding the fruit weight of guava are given in Table 4.9 and 4.10. The effect of time of pruning is significantly affected the fruit weight of guava in both the seasons. During rainy season in variety 'Shweta', the maximum fruit weight of 142.6 g was observed in T_4 (30^{th} April) which was significantly better than the other treatments. Minimum fruit weight (124.0 g) during rainy season was observed in control trees. During winter season in variety 'Shweta', the highest fruit weight (212.3 g) was obtained when the tree was pruned on 15^{th} May (T_5), followed by fruit weight (206.8 g) with the pruning time of 30^{th} May (T_6). Minimum fruit weight (177.3 g) during winter season was recorded in control trees (T_9).

In variety 'Allahabad Safeda' during rainy season, maximum fruit weight (130.6 g) was reported in T_3 and it was found significantly at par with T_4 (128.0 g). Minimum fruit weight (112.6 g) during rainy season was recorded in control trees. During the winter season, maximum fruit weight (189.0 g) was recorded in T_5, followed by the T_4 (188.2 g). Minimum fruit weight (169.5 g) recorded in control trees. In guava variety L-49, significantly higher fruit weight (139.0 g) during rainy season was recorded in T_3 (15^{th} April) and the minimum fruit weight (118.3 g) was recorded in control. During the winter season, maximum fruit weight (203.6 g) was recorded in T_6 and it was at par with fruit weight obtained in T_5 (198.2 g). Minimum fruit weight (171.6 g) during winter season was recorded in control trees.

Similar results of increased the fruit weight during winter season in May pruned trees were observed by the Singh *et al* (2001) and Adhikari and Kandel (2015) in guava. Likewise, Ali *et al* (2014) observed the maximum fruit weight in May pruned trees. Minimum fruit weight in all the treatments and varieties were recorded in control trees in both the seasons. These results also consonance with the results of Sundrajan and Muthuswami (1966), who has stated that pruning treatments increase the fruit weight of guava. The increase in number and area of leaves increases the amount of photosynthates that cause a significant increase in size and weight of fruit in the winter (Singh *et al* 2001). However, Sah (2013) reported that pruning effect the fruit weight of guava significantly in rainy season but it is not affects the winter season fruit weight.

Table 4.9: Effect of pruning time on fruit weight of different cultivars of guava during rainy season.

Time of pruning	Fruit weight (g)		
	Shweta	**Allahabad Safeda**	**L-49**
T_1 (15- March)	125.3	114.3	121.6
T_2 (30- March)	128.3	123.3	131.0
T_3 (15- April)	133.3	130.6	139.0
T_4 (30- April)	142.6	128.0	134.6
T_5 (15- May)	-	-	-
T_6 (30- May)	-	-	-
T_7 (15- June)	-	-	-
T_8 (30- June)	-	-	-
T_9 (Control)	124.0	112.6	118.3
CD at 5%	5.61	6.45	4.31

Table 4.10: Effect of pruning time on fruit weight of different cultivars of guava during winter season.

Time of pruning	Fruit weight (g)		
	Shweta	**Allahabad Safeda**	**L-49**
T_1 (15- March)	191.3	171.0	186.0
T_2 (30- March)	199.0	172.3	192.0
T_3 (15- April)	201.2	182.1	184.7
T_4 (30- April)	190.6	188.2	191.1
T_5 (15- May)	212.3	189.0	198.2
T_6 (30- May)	206.8	181.0	203.6
T_7 (15- June)	200.3	172.0	192.3
T_8 (30- June)	202.0	179.1	185.6
T_9 (Control)	177.3	169.5	171.6
CD at 5%	6.34	4.70	7.75

4.2.4 Fruit yield

Data regarding effect of time of pruning on fruit yield are presented in Table 4.11 and 4.12. In variety 'Shweta', higher fruit yield (34.97 kg/tree) during the rainy season was obtained in control trees while; during winter season significantly higher yield (67.42kg/tree) was recorded in trees pruned on 30th May (T6). The unpruned trees (control) recorded minimum yield (12.23 kg/tree) in winter season.

Likewise, in variety 'Allahabad Safeda', significantly higher yield (63.10 kg/tree) during rainy season crop was recorded in control. During winter season, maximum fruit yield (90.14 kg/tree) was reported in T_6, which was significantly higher than other treatment with minimum yield (42.91 kg/tree) was recorded in T_1 (15th March).

Similar trends i.e. during rainy season maximum fruit yield (32.20 kg/tree) in guava variety 'L-49' was recorded in unpruned tree. Whereas, in winter season the treatment T_6 (30th May) had significantly higher yield (65.20 kg/tree) as compared to other treatments.

In present studies, the pruning during the months of May and June failed to produce rainy season crop, because maximum new shoots were cut away with pruning hence, regulated in no flowering. On the other head, pruning in the months of May and June resulted in the shifting of rainy season crop to winter season. The increase in yield of May pruned trees was a result of removal of rainy season crop load. The results of our studies are in conformity with that of Singh *et al* (2001) was obtained heights yield of fruits from May pruned trees in guava variety Allahabad Safeda and Sardar. Singh and Kumar (1993) also reported the reduction in guava yield during rainy season as a result of pruning and subsequently increase the yield during rainy season. Likewise, Mishra and Pathak (1998) also reported higher yield in winter season as a result of May pruning in guava trees. Ali *et al* (2014) and Pandey (2013) also reported the same results of effect of date pruning on yield of guava tree.

Table 4.11: Effect of pruning time on yield per tree of different cultivars of guava during rainy season.

Time of pruning	Fruit yield (kg/tree)		
	Shweta (7 years old)	**Allahabad Safeda (11 years old)**	**L-49 (4 years old)**
T_1 (15- March)	31.61	46.18	28.33
T_2 (30- March)	34.12	52.9	26.85
T_3 (15- April)	23.46	55.51	27.24
T_4 (30- April)	6.50	51.46	24.76
T_5 (15- May)	-	-	-
T_6 (30- May)	-	-	-
T_7 (15- June)	-	-	-
T_8 (30- June)	-	-	-
T_9 (Control)	34.97	63.10	32.20
CD at 5%	2.79	3.11	2.18

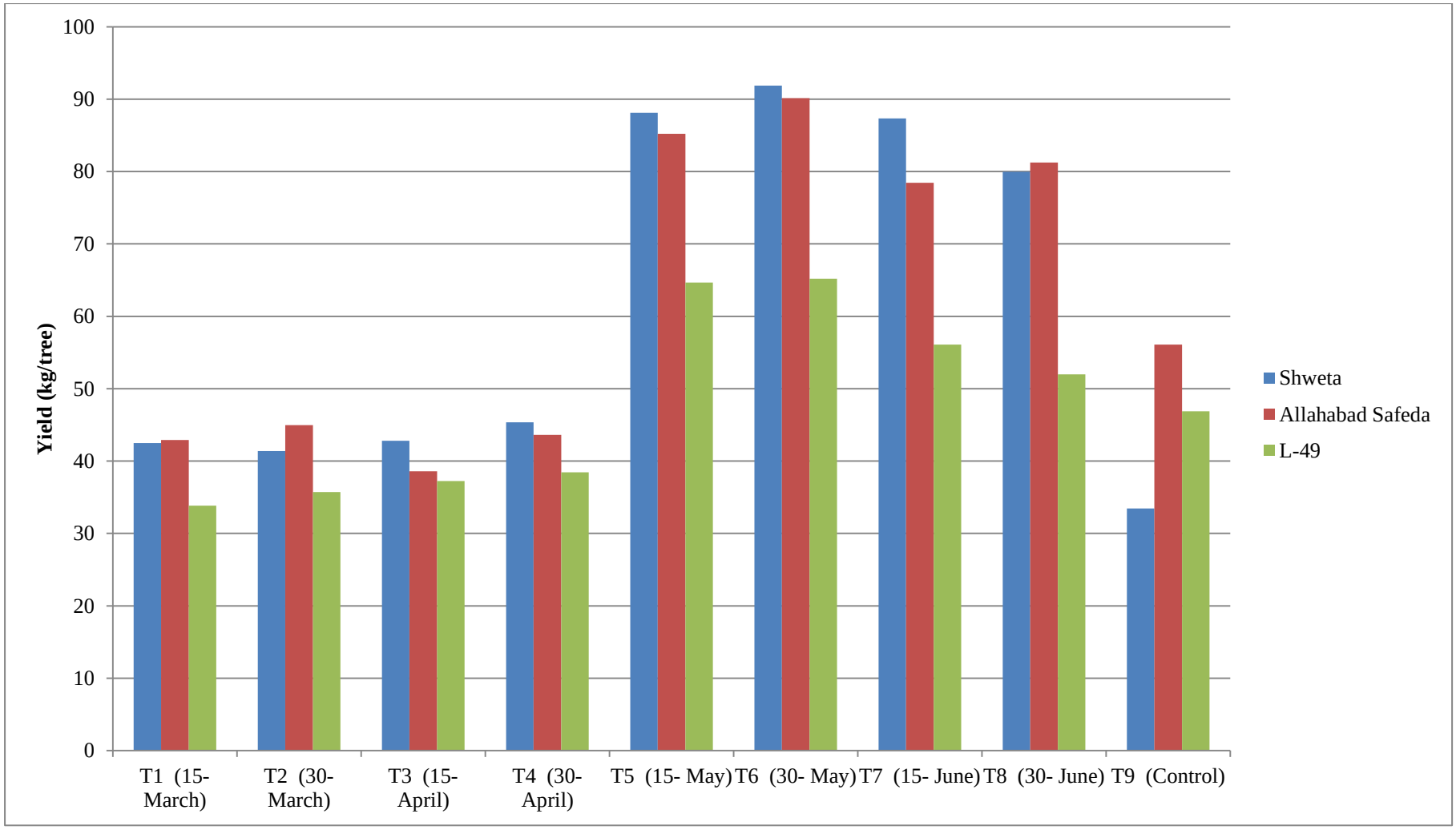

Fig. 4.2: Effect of pruning time on yield per tree of different varieties of guava during winter season

Table 4.12: Effect of pruning time on yield per tree of different cultivars of guava during winter season.

Time of pruning	Fruit yield (kg/tree)		
	Shweta (7 years old)	**Allahabad Safeda (11 years old)**	**L-49 (4 years old)**
T_1 (15- March)	19.51	42.91	33.84
T_2 (30- March)	19.90	44.98	35.72
T_3 (15- April)	18.71	38.57	37.24
T_4 (30- April)	22.49	43.60	38.45
T_5 (15- May)	62.63	85.23	64.65
T_6 (30- May)	67.42	90.14	65.20
T_7 (15- June)	60.89	78.44	56.09
T_8 (30- June)	55.75	81.25	51.97
T_9 (Control)	12.23	56.10	46.87
CD at 5%	2.65	2.43	2.95

4.2.5 Fruit size

1. Fruit length

Data regarding the fruit length of guava are presented in Table 4.13 and 4.14. In variety 'Shweta', time of pruning significantly effect on the fruit length during rainy season with maximum fruit length (5.81 cm) in treatment T_4 and it was at par with treatments T_3 (5.70 cm), T_2 (5.64 cm) and T_1 (5.50 cm). The smallest fruit length (5.30 cm) was obtained in the fruits harvested from the control trees. During the winter season, effect of pruning date on fruit length was non-significant, except the control. The maximum fruit length (7.15 cm) was recorded in T_5 with minimum fruit length of 6.40 cm in control trees. In variety 'Allahabad Safeda', during rainy season maximum fruit length (5.95 cm) was reported in T_3 which was significantly at par with treatments T_4 (5.84 cm), T_2 (5.76 cm) and T_1 (5.52 cm). Minimum fruit length (5.35 cm) was obtained in unpruned trees (control). During the winter season, time of pruning did not show much variation on fruit length and maximum fruit length of 6.78 cm was obtained in T_5 and minimum (6.31 cm) in T_9 (control).

In variety 'L-49', the maximum fruit length (5.79 cm) was obtained in fruits has harvested from the 15th April (T_3) pruned trees, followed by treatments T_2 (5.74 cm), T_4 (5.71 cm) and T_1 (5.38 cm). The minimum fruit length (5.28 cm) during the rainy season was recorded in control. During the winter season, higher fruit length (7.25 cm) was recorded in T_6 which was significantly at par with treatments T_5 (7.18 cm), T_2 (6.89 cm), T_7 (6.83 cm), T_4

(6.85 cm), T_3 (6.80 cm) and T_8 (6.78 cm). Minimum fruit length (6.45 cm) was obtained in fruits harvested from the control trees during winter season.

It was found that fruit length significantly affected by the time of pruning. Fruit harvested from pruned trees has higher fruit length than the fruits obtained from the unpruned or control trees. Mohammad *et al* (2006) also observed that the all type of pruning treatment resulted in the increase of the fruit size. Pandey (2013) also reported that maximum fruit length was recorded in May and June pruned trees of guava. Gaur (1996) reported that pruning at top half of the current season's growth of Allahabad Safeda guava improved the fruit size during both rainy and winter season crops.

Table 4.13: Effect of pruning time on fruit length of different cultivars of guava during rainy season.

Time of pruning	Fruit length (cm)		
	Shweta	**Allahabad Safeda**	**L-49**
T_1 (15- March)	5.50	5.52	5.38
T_2 (30- March)	5.64	5.76	5.74
T_3 (15- April)	5.70	5.95	5.79
T_4 (30- April)	5.81	5.84	5.71
T_5 (15- May)	-	-	-
T_6 (30- May)	-	-	-
T_7 (15- June)	-	-	-
T_8 (30- June)	-	-	-
T_9 (Control)	5.30	5.35	5.28
CD at 5 %	0.47	0.49	0.45

Table 4.14: Effect of pruning time on fruit length of different cultivars of guava during winter season.

Time of pruning	Fruit length (cm)		
	Shweta	**Allahabad Safeda**	**L-49**
T_1 (15- March)	6.75	6.50	6.71
T_2 (30- March)	6.86	6.58	6.89
T_3 (15- April)	6.94	6.65	6.80
T_4 (30- April)	6.85	6.69	6.85
T_5 (15- May)	7.15	6.78	7.18
T_6 (30- May)	6.89	6.63	7.25
T_7 (15- June)	6.78	6.53	6.83
T_8 (30- June)	6.80	6.60	6.78
T_9 (Control)	6.40	6.31	6.45
CD at 5 %	0.47	0.48	0.49

2. Fruit breadth

A critical examination of data in with respect to fruit breadth (Table 4.15 and 4.16) reveals that time of pruning has significant effect on fruit breadth in both seasons. In variety 'Shaweta', the maximum fruit breadth (5.78 cm) during the rainy season was observed in T_3 (15^{th} April) which was statically at par with treatments T_4 (5.65 cm) and T_2 (5.54 cm); while, unpruned control trees recorded significantly lower fruit breadth (5.25 cm). In winter season, significantly higher fruit breadth of 7.06 cm was reported in T_5 as compared to other treatments. The minimum fruit breadth (6.36 cm) was observed in fruits harvested from unpruned trees.

In variety 'Allahabad Safeda', it was found that fruit breadth significantly varied with time of pruning. The maximum fruit breadth of 5.82 cm during rainy season was obtained in T_3 which was statically at par with treatments T_4 (5.75 cm) and T_2 (5.70 cm). The minimum fruit breadth (5.26 cm) was recorded in control trees. During the winter season, fruit breadth not much varied among different pruning treatments and it was the maximum (6.74 cm) recorded in T_5, followed by the T_4 (6.63 cm), T_3 (6.60 cm), T_6 (6.55 cm), and T_8 (6.53 cm). The minimum fruit breadth (6.27 cm) was recorded in control. Similarly, in variety L-49, maximum fruit breadth (5.71 cm) during the rainy season was recorded in T_3 which was statistically at par with T_2 (5.64 cm) and T_4 (5.65 cm) with the minimum of 5.20 cm in control. During the winter season, maximum fruit breadth (7.17 cm) was recorded in T_6 which was statistically at par with T_2 (6.80 cm) and T_4 (6.79 cm) with minimum of 6.38 cm in control.

The findings of the present studies were in confirmedly of earlier findings of Pandey (2013) was obtained maximum fruit breadth during winter season in fruits harvested from the trees pruned in May. Aravindakshan (1960) reported that tipping of past season leader shoots resulted into increased fruit breadth of guava.

Table 4.15: Effect of pruning time on fruit breadth of different cultivars of guava during rainy season.

Time of pruning	Fruit breadth (cm)		
	Shweta	**Allahabad Safeda**	**L-49**
T_1 (15- March)	5.32	5.47	5.30
T_2 (30- March)	5.54	5.70	5.64
T_3 (15- April)	5.78	5.82	5.71
T_4 (30- April)	5.65	5.75	5.65
T_5 (15- May)	-	-	-
T_6 (30- May)	-	-	-
T_7 (15- June)	-	-	-
T_8 (30- June)	-	-	-
T_9 (Control)	5.25	5.26	5.20
CD at 5%	0.28	0.27	0.30

Table 4.16: Effect of pruning time on fruit breadth of different cultivars of guava during winter season.

Time of pruning	Fruit breadth (cm)		
	Shweta	**Allahabad Safeda**	**L-49**
T_1 (15- March)	6.70	6.43	6.65
T_2 (30- March)	6.81	6.42	6.80
T_3 (15- April)	6.85	6.60	6.74
T_4 (30- April)	6.78	6.63	6.79
T_5 (15- May)	7.06	6.74	7.08
T_6 (30- May)	6.80	6.55	7.17
T_7 (15- June)	6.70	6.46	6.77
T_8 (30- June)	6.74	6.53	6.71
T_9 (Control)	6.36	6.27	6.38
CD at 5%	0.24	0.32	0.38

4.2.6 Fruit firmness

Data presented in Table 17 and 18 indicated that dates of pruning did not have any significant effect on the fruit firmness during both the seasons and in all the three varieties. However, in variety 'Shweta', the maximum fruit firmness (1.087 kg/cm^2) during the rainy season was obtained in fruits which were harvested from the trees pruned on 15th April and minimum (1.03 kg/cm^2) was recorded in control. During winter season, maximum fruit firmness (1.29 kg/cm^2) was recorded in T_1, T_2 and T_6 with minimum (1.24 kg/cm^2) in T_8.

In variety 'Allahabad Safeda', the maximum fruit firmness (1.10 kg/cm^2) during rainy season was recorded in T_4 with minimum (1.04 kg/cm^2) in T_3. During winter season, maximum fruit firmness of 1.29 kg/cm^2 was recorded in treatment T_4 and least (1.21 kg/cm^2) in control trees.

Among different pruning treatments of variety 'L-49', maximum fruit firmness (1.08 kg/cm^2) during rainy season was recorded in treatment T_3 with the minimum (1.03 kg/cm^2) in treatment T_2. The maximum fruit firmness (1.31 kg/cm^2) during winter season was recorded in fruits which were harvested from the trees pruned on 15th May (T_5).

The results of present studies suggested that time of pruning have not any effect on fruit firmness in guava.

Table 4.17: Effect of pruning time on fruit firmness of different cultivars of guava during rainy season.

Time of pruning	Fruit firmness (kg/cm^2)		
	Shweta	**Allahabad Safeda**	**L-49**
T_1 (15- March)	1.04	1.06	1.07
T_2 (30- March)	1.03	1.08	1.03
T_3 (15- April)	1.08	1.04	1.08
T_4 (30- April)	1.03	1.10	1.06
T_5 (15- May)	-	-	-
T_6 (30- May)	-	-	-
T_7 (15- June)	-	-	-
T_8 (30- June)	-	-	-
T_9 (Control)	1.03	1.06	1.06
CD at 5%	NS	NS	NS

Table 4.18: Effect of pruning time on fruit firmness of different cultivars of guava during winter season.

Time of pruning	Fruit firmness (kg/cm^2)		
	Shweta	**Allahabad Safeda**	**L-49**
T_1 (15- March)	1.29	1.24	1.27
T_2 (30- March)	1.29	1.270	1.27
T_3 (15- April)	1.25	1.27	1.26
T_4 (30- April)	1.31	1.29	1.26
T_5 (15- May)	1.28	1.28	1.31
T_6 (30- May)	1.29	1.27	1.28
T_7 (15- June)	1.28	1.283	1.26
T_8 (30- June)	1.24	1.27	1.26
T_9 (Control)	1.26	1.21	1.27
CD at 5%	NS	NS	NS

4.2.7 Time of harvesting and harvesting span

Data regarding time of harvesting and harvesting span are presented in Table 4.19. Harvesting span of guava variety 'Shweta' decreased significantly with the delay in pruning time over the control. The maximum harvesting span (50 days) was recorded in control trees which were significantly at par with treatment T_2 (47 days). However, minimum harvesting span (33 days) was recorded in treatment T_8. Earliest harvesting (from 8th November to 12th December) of guava variety Shweta was reported in 30th May pruned trees.

Similar results was observed in variety 'Allahabad Safeda', maximum duration of harvesting span (51 days) was reported in control trees which were significantly at par with treatment T_2 (50 days), treatment T_3 (49 days) and treatment T_4 (48 days). Least harvesting duration of variety 'Allahabad Safeda' was recorded in treatment T_8 (32 days). The fruit

harvesting period started early in the 30th May pruned trees i.e. 12 November.

It was found that maximum harvesting span (49 days) of variety L-49 was reported in control which was significantly better from the other treatments. Minimum duration of fruit harvesting (28 days) was reported in treatment T_8. Early harvesting (from 17 November to 17 December) was recorded in treatment T_6 as compared to the other treatments.

Harvesting span during winter season was decrease with delay the pruning time. The maximum harvesting span is recorded in control trees. Duration of fruit harvest was lower in 30th June pruned trees in all three varieties. The results of present studies are in line with that of Singh (2005) who reported the similar results in guava. He reported the more fruit harvesting span in control trees as compared to the pruned trees. Kaur (1999) also reported similar results of decreased in harvesting span with delay pruning time in guava variety 'L-49'.

4.3 Chemical characteristics

4.3.1 Total soluble solids

Data regarding to total soluble solids content of guava are presented in Table 4.20 and 4.21. It was observed that time of pruning have non-significant effect on the total soluble solids of the guava fruit during both the seasons irrespective of variety. In variety Shweta, the higher TSS of 10.83 per cent during rainy season was obtained in fruits harvested from trees which were pruned on 30th April (T_4) and minimum TSS of 9.40 per cent in fruits which were harvested from control trees. During the winter season, highest TSS (12.86%) was registered in fruits of 15th May pruned trees. Fruits harvested from the control trees had less TSS (10.46%) value.

Similarly, the highest TSS (10.10%) was observed in the treatment T_4 in variety Allahabad Safeda during the rainy season. However, minimum TSS of 7.90 per cent was found in the fruits harvested from control trees. During the winter season, maximum total soluble solids of 12.56 per cent were reported in treatment T_6 with minimum of 10.10 per cent in control and 15th March pruned trees. In variety L-49, highest total soluble solids (10.13%) during rainy season were recorded in T_4 with minimum (8.56%) in control trees. During winter season, maximum total soluble solids (12.40%) were recorded in T_6.

Similar results were obtained by Singh *et al* (2001), who recorded maximum total soluble solids in May and June pruned trees of guava. Dhaliwal *et al* (2000) also reported the maximum total soluble solids of guava fruits which were harvested from the May pruned trees.

TSS of the pruned trees significantly higher than the control trees in both the seasons. All the pruned trees have higher TSS than the unpruned trees. These results are found in consonance with that of Gopi Krishna (1981), who reported higher TSS in pruned trees than the unpruned in guava.

Table 4.19: Effect of pruning time on time of harvesting and peak harvesting span of different cultivars of guava during winter season

Time of pruning	Time of harvesting and harvesting span (Days)								
	Shweta			Allahabad Safeda			L-49		
	Start	End	Peak Harvesting Span	Start	End	Peak Harvesting Span	Start	End	Peak Harvesting Span
T_1 (15- March)	30 Nov	13 Jan	46	30 Nov	11 Jan	44	30 Nov	12 Jan	45
T_2 (30- March)	29 Nov	12 Jan	47	28 Nov	16 Jan	50	28 Nov	8 Jan	43
T_3 (15- April)	2 Dec	13 Jan	45	4 Dec	20 Jan	49	1 Dec	11 Jan	42
T_4 (30- April)	1 Dec	12 Jan	44	2 Dec	17 Jan	48	1 Dec	7 Jan	39
T_5 (15- May)	15 Nov	22 Dec	38	12 Nov	26 Dec	45	18 Nov	23 Dec	36
T_6 (30- May)	8 Nov	12 Dec	35	12 Nov	19 Dec	38	17 Nov	17 Dec	31
T_7 (15- June)	24 Nov	27 Dec	34	21 Nov	23 Dec	33	24 Nov	24 Dec	31
T_8 (30- June)	27 Nov	29 Dec	33	22 Nov	23 Dec	32	24 Nov	21 Dec	28
T_9 (Control)	2 Dec	20 Jan	50	2 Dec	21 Jan	51	1 Dec	20 Jan	49
CD at 5%	-	-	4.05	-	-	4.52	-	-	2.50

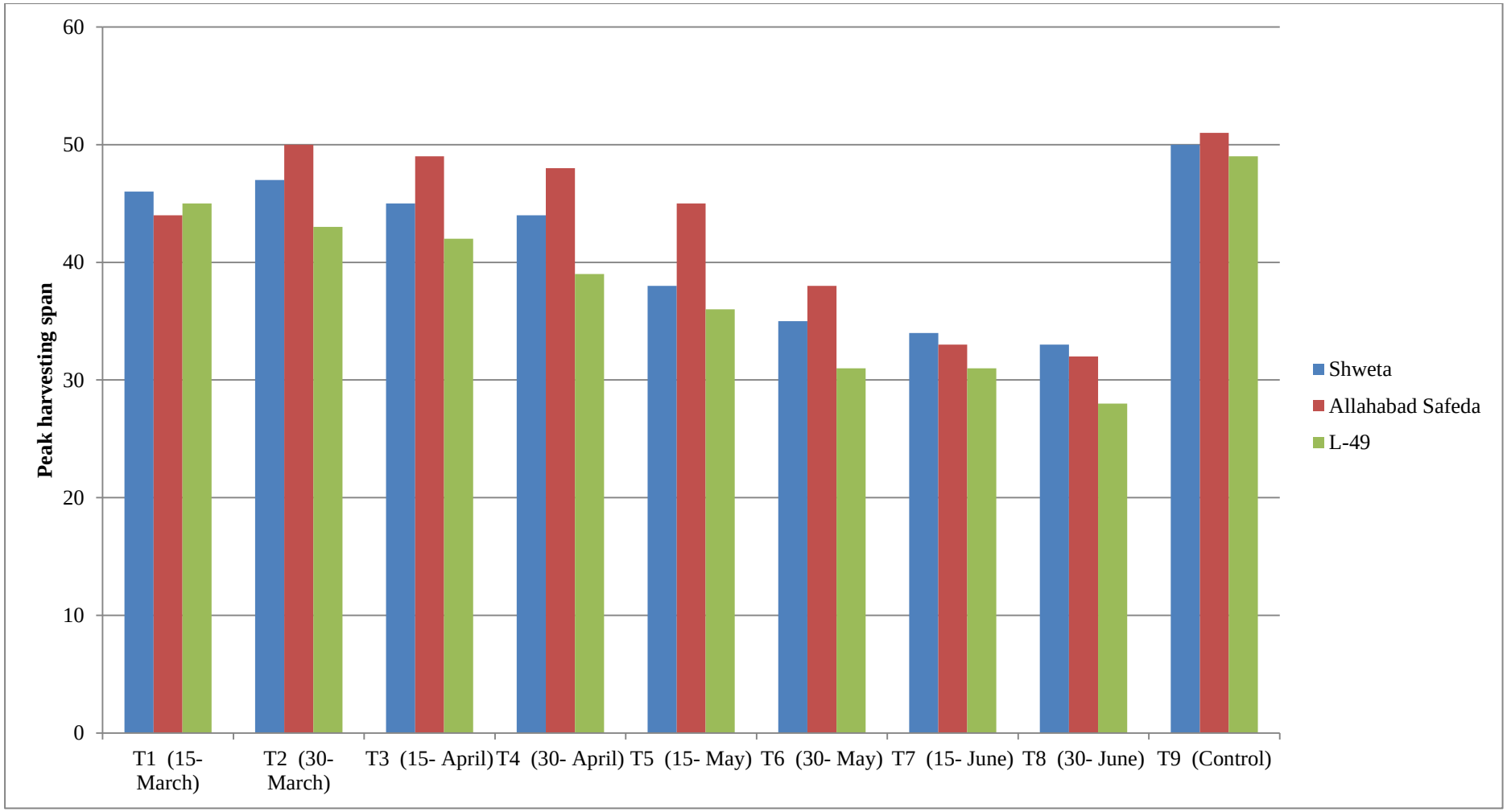

Fig 4.3: Effect of pruning time on peak harvesting span of different guava varieties

Table 4.20: Effect of pruning time on total soluble solids of different cultivars of guava during rainy season.

Time of pruning	Total soluble solids (%)		
	Shweta	**Allahabad Safeda**	**L-49**
T_1 (15- March)	10.73	9.33	9.96
T_2 (30- March)	10.43	9.43	9.53
T_3 (15- April)	10.56	9.76	9.33
T_4 (30- April)	10.83	10.10	10.13
T_5 (15- May)	-	-	-
T_6 (30- May)	-	-	-
T_7 (15- June)	-		-
T_8 (30- June)	-	--	-
T_9 (Control)	9.40	7.90	8.56
CD at 5%	NS	NS	NS

Table 4.21: Effect of pruning time on total soluble solids of different cultivars of guava during winter season.

Time of pruning	Total soluble solids (%)		
	Shweta	**Allahabad Safeda**	**L-49**
T_1 (15- March)	11.10	10.53	10.90
T_2 (30- March)	11.46	11.03	11.03
T_3 (15- April)	12.40	11.50	11.03
T_4 (30- April)	12.46	11.73	12.36
T_5 (15- May)	12.86	12.06	12.26
T_6 (30- May)	12.43	12.56	12.40
T_7 (15- June)	11.56	12.16	11.10
T_8 (30- June)	11.20	11.63	11.03
T_9 (Control)	10.46	10.10	10.90
CD at 5%	NS	NS	NS

4.3.2 Titrable Acidity

The data with respect to acidity content of guava as affected by different times of pruning are presented in Table 4.22 and 4.23. Data showed acidity per cent of guava fruits

was affected non-significant in both the seasons. However, the highest acidity (0.45%) of variety 'Shweta' was found in the fruits produced by the trees which were pruned on 15th March over the minimum per cent acidity (0.38) in the fruits produced by the control trees. During winter season, the maximum acidity (0.52%) was obtained from the fruits harvested from the trees of 30th April pruned trees, with the minimum acidity (0.37%) in 30th June pruned trees.

In cultivar 'Allahabad Safeda', the maximum acidity (0.44%) during rainy season was recorded in treatment T_3 and treatment T_1. Least acidity (0.37%) during rainy season was recorded in control trees. During the winter season, maximum acidity (0.56%) was recorded in treatment T_5, with the minimum acidity per cent of 0.38 in treatment T_8.

Similar results was observed in cultivar 'L-49' during winter season, the maximum acidity (0.49%) in 15th March pruned trees with minimum (0.35%) in fruits which were harvested from the control trees. During winter season, maximum acidity percentage (0.49%) was recorded in treatment T_5 with minimum acidity (0.29%) in treatment T_7.

Adhikari and Kandel (2015) reported that acidity of the fruit was not influenced by pruning time or level in both seasons. Bajapi *et al* (1973) and Singh *et al* (2007) also reported similar results in guava, that acidity not significantly influenced by time of pruning. In all three varieties, the minimum acidity was recorded in fruits produced by trees which received pruning on July. Lal (1983) reported the more acidity in guava fruits which were harvested from the pruned trees.

Table 4.22: Effect of pruning time on titrable acidity of different cultivars of guava fruits during rainy season.

Time of pruning	Titrable Acidity (%)		
	Shweta	**Allahabad Safeda**	**L-49**
T_1 (15- March)	0.45	0.44	0.49
T_2 (30- March)	0.44	0.42	0.45
T_3 (15- April)	0.44	0.44	0.43
T_4 (30- April)	0.42	0.37	0.37
T_5 (15- May)	-	-	-
T_6 (30- May)	-	-	-
T_7 (15- June)	-	-	-
T_8 (30- June)	-	-	-
T_9 (Control)	0.38	0.37	0.35
CD at 5%	NS	NS	NS

Table 4.23: Effect of pruning time on titrable acidity of different cultivars of guava during winter season.

Time of pruning	Titrable Acidity (%)		
	Shweta	**Allahabad Safeda**	**L-49**
T_1 (15- March)	0.41	0.45	0.35
T_2 (30- March)	0.43	0.42	0.43
T_3 (15- April)	0.47	0.44	0.44
T_4 (30- April)	0.52	0.44	0.44
T_5 (15- May)	0.43	0.56	0.49
T_6 (30- May)	0.45	0.46	0.35
T_7 (15- June)	0.42	0.40	0.29
T_8 (30- June)	0.37	0.38	0.32
T_9 (Control)	0.42	0.46	0.34
CD at 5%	NS	NS	NS

4.3.3 TSS:acid ratio

Data regarding to TSS:acid ratio are presented in Table 4.24 and 4.25. Effect of pruning time on TSS:acid ratio was non-significant in both the seasons. In variety 'Shweta', maximum TSS:acid (25.78) ratio during rainy season was recorded in T_4 and the minimum (22.92) in control. During the winter season, highest TSS:acid ratio (30.27) was obtained in T_7, with the minimum (24.90) in control.

In variety 'Allahabad Safeda' during rainy season, highest TSS:acid ratio (21.51) was obtained in fruits which were harvested from 30th April pruned trees, with the minimum (16.37) in T_3. During winter season, maximum TSS:acid ratio of 26.91 was recorded in T_8.

In variety 'L-49' during rainy season, maximum TSS:acid ratio (29.29) was registered in 30th March pruned trees and the minimum (23.41) was in control trees. During winter season of variety 'L-49', the maximum TSS:acid ratio (37.25) was obtained in fruits which were harvested from the 15th June pruned trees with minimum (24.91) in 15th April pruned trees.

Results showed that effect of pruning time on TSS:acid ratio was non-significant.

TSS 4.24: Effect of pruning time on TSS:acid ratio on different cultivars of guava during rainy season

Time of pruning	TSS:acid ratio		
	Shweta	**Allahabad Safeda**	**L-49**
T_1 (15- March)	23.84	17.73	24.97
T_2 (30- March)	23.70	19.32	29.29
T_3 (15- April)	24.00	16.37	27.19
T_4 (30- April)	25.78	21.51	27.25
T_5 (15- May)	-	-	-
T_6 (30- May)	-	-	-
T_7 (15- June)	-	-	-
T_8 (30- June)	-	-	-
T_9 (Control)	22.92	21.26	23.41
CD at 5%	NS	NS	NS

Table 4.25: Effect of pruning time on TSS: Acidity ratio on different cultivars of guava during winter season

Time of pruning	TSS:Acid ratio		
	Shweta	**Allahabad Safeda**	**L-49**
T_1 (15- March)	27.07	20.70	31.04
T_2 (30- March)	26.05	23.73	25.29
T_3 (15- April)	26.38	22.70	24.91
T_4 (30- April)	23.96	23.29	29.65
T_5 (15- May)	29.90	17.37	23.59
T_6 (30- May)	27.62	20.42	32.37
T_7 (15- June)	27.52	23.80	37.25
T_8 (30- June)	30.27	26.91	33.33
T_9 (Control)	24.90	19.41	32.20
CD at 5 %	NS	NS	NS

4.3.4 Total sugar

The data regarding to total sugar per cent are presented in Table 4.26 and 4.27. Total sugar percentage was slightly increased with delay in pruning time during rainy season. However, all the values of total sugar were noted to be non-significant during rainy season. However, during winter season, effect of pruning time on total sugar was found to be significant. It is clear from the data of variety 'Shweta' that during rainy season the maximum total sugar (5.61%) was observed in fruits which were harvested from the 30th April pruned trees, with minimum of total sugar (5.22%) in control trees. During winter season, highest total sugar (7.28%) was recorded in treatment T_6 which was statistically at par with T_8 (7.25%). Least total sugar of 6.03 per cent was observed in fruits which were harvested from the control trees.

In variety 'Allahabad Safeda' highest total sugar of 5.74 per cent was obtained in fruits of 30th April pruned trees with minimum of 5.06 per cent in control trees in rainy season crop. During winter season maximum total sugar (7.27%) was observed in treatment T_6 which was statically at par with treatment T_8 (7.18%) and treatment T_7 (7.17%). Minimum sugar percentage of 6.24 was recorded in treatment T_1.

In variety 'L-49', highest total sugar (6.00%) during rainy season was recorded in treatment T_4 with minimum total sugar (5.52%) in control. During winter season, maximum total sugar (8.16%) was obtained in fruits which were harvested from 30th May pruned trees, which was significantly at par with T_7 (7.88%). Minimum total sugar (6.83%) during the

winter season in variety L-49 was recorded in control trees.

Similar results have been reported in guava by Ali *et al* (2014) who recorded the highest total sugar in fruits which were harvested from May and June pruned trees. Tiwari (1985) and Singh *et a*l (1996a) also reported the increase in total sugar content of guava after pruning.

Table 4.26: Effect of pruning time on total sugar of different cultivars of guava during rainy season

Time of pruning	Total sugar (%)		
	Shweta	**Allahabad Safeda**	**L-49**
T_1 (15- March)	5.36	5.21	5.73
T_2 (30- March)	5.46	5.27	5.85
T_3 (15- April)	5.42	5.40	6.00
T_4 (30- April)	5.61	5.74	5.93
T_5 (15- May)	-	-	-
T_6 (30- May)	-	-	-
T_7 (15- June)	-	-	-
T_8 (30- June)	-	-	-
T_9 (Control)	5.22	5.06	5.52
CD at 5%	NS	NS	NS

Table 4.27: Effect of pruning time on total sugar of different cultivars of guava during winter season.

Time of pruning	Total sugar (%)		
	Shweta	**Allahabad Safeda**	**L-49**
T_1 (15- March)	6.10	6.24	6.86
T_2 (30- March)	6.36	6.47	7.06
T_3 (15- April)	6.30	6.42	7.28
T_4 (30- April)	6.38	6.59	7.40
T_5 (15- May)	6.80	6.81	7.62
T_6 (30- May)	7.28	7.27	8.16
T_7 (15- June)	7.03	7.17	7.88
T_8 (30- June)	7.25	7.18	7.83
T_9 (Control)	6.03	6.60	6.83
CD at 5%	0.220	0.220	0.293

4.3.5 Vitamin C

Data regarding to vitamin C contents are presented in Table 4.28 and 4.29. In cultivar 'Shweta', maximum vitamin C (173.76 mg/100 g) during rainy season was observed in treatment T_4 followed by T_3 (169.83 mg/100 g) and T_1 (165.44 mg/100 g). Minimum vitamin C (162.25 mg/100 g) was recorded in fruits which were harvested from the control trees. During the winter season, highest vitamin c (193.34 mg/100 g) was recorded in T_5, which was

significantly at par with T_6 (192.18 mg/100 g) and T_3 (189.71 mg/100 g). Least vitamin C (182.23 mg/100 g) was recorded in fruits which were harvested from control trees.

In variety 'Allahabad Safeda', the maximum vitamin C (173.45 mg/100 g) was recorded in treatment T_4 followed by the T_3 (171 mg/100 g) and T_2 (168.58 mg/100 g). Minimum vitamin c (165.42 mg/100g) was recorded in fruits which were harvested from control trees. During the winter season, highest vitamin C (193.12 mg/100 g) was recorded in treatment T_5 which was significantly at par with T_6 (191.49 mg/100 g), T_6 (189.94 mg/100 g) and T_3 (188.86 mg/100 g). Minimum vitamin C (183.76 mg/100 g) was recorded in control trees.

In variety 'L-49', during the rainy season maximum vitamin C (180.10 mg/100 g) was obtained from the fruits which were harvested from treatment T_4 followed by treatment T_3 (178.34 mg/100 g) and treatment T_2 (175.43 mg/100 g) with minimum (168.21 mg/100 g) in control trees. During the winter season, maximum vitamin c (196.48 mg/100 g) was recorded was recorded in treatment T_6 which was significantly at par with treatment T_5 (195.12 mg/100 g), treatment T_7 (193 mg/100 g) and treatment T_4 (192.45 mg/100 g). Minimum vitamin C (187.00 mg/100 g) during the winter season was recorded in treatment T_1.

Highest vitamin C during winter season was recorded in fruit which was harvested from the May pruned trees. Similar trends of vitamin C content was observed by the Ali *et al* (2014), who suggested the pruning during May gives the highest ascorbic acid content in guava fruits.

Table 4.28: Effect of pruning time on vitamin C content of fruit of different cultivars of guava during rainy season.

Time of pruning	Vitamin C (mg/100 g)		
	Shweta	**Allahabad Safeda**	**L-49**
T_1 (15- March)	165.44	166.46	172.88
T_2 (30- March)	163.14	168.58	175.43
T_3 (15- April)	169.83	171.00	178.34
T_4 (30- April)	173.76	173.45	180.10
T_5 (15- May)	-	-	-
T_6 (30- May)	-	-	-
T_7 (15- June)	-	-	-
T_8 (30- June)	-	-	-
T_9 (Control)	162.25	165.42	168.21
CD at 5%	9.45	6.30	5.44

Table 4.29: Effect of pruning time on vitamin C content of fruit of different cultivars of guava during winter season

Time of pruning	Vitamin C (mg/100 g)		
	Shweta	**Allahabad Safeda**	**L-49**
T_1 (15- March)	185.56	183.78	187.00
T_2 (30- March)	184.85	186.56	188.67
T_3 (15- April)	189.71	188.86	190.43
T_4 (30- April)	188.00	187.13	192.45
T_5 (15- May)	193.34	193.12	195.12
T_6 (30- May)	192.18	191.49	196.48
T_7 (15- June)	185.41	189.94	193.00
T_8 (30- June)	186.55	188.19	189.34
T_9 (Control)	182.23	183.76	187.56
CD at 5%	4.31	5.20	5.61

CHAPTER – V

SUMMARY

The "Studies on effect of pruning time on fruit maturity, yield and quality of guava (*Psidium guajava* L.)" was conducted at the Regional Fruit Research Station, Bahadurgarh and Fruit Research Farm, Department of Fruit Science, Punjab Agricultural University; Ludhiana. In subtropical conditions of Punjab guava flowers two times a year, in April- May and in July-August. Guava did not flower during winter months due to low temperature. The guava fruits harvested in rainy season are unfit for consumption because it is highly infected with larvae of fruit fly. Whereas, fruit harvested in winter are better in quality and relatively free from damage of fruit fly and fetches higher prices in the market. Hence, it is always beneficial to take winter season crop of guava. Further it is observed that fruit harvested during peak winter (mid-December to January) become hard and are of inferior quality than the fruits harvested during November. Hard and frost damaged fruit of guava fetch poor price in market and hence, cause economic losses to the growers. Keeping these in view there is an urgent need to develop the technology, so that whole fruit of guava could be harvested in November to maximum up to December. Fruit harvested during this period will be free from fruit fly damage and off course of good quality which can fetch premium price to the growers. Hence, the present studies were conducted with objectives to optimize the time of pruning in guava and to study the effect of time of pruning on fruit maturity, yield and quality of guava.

Present studies have been conducted on 7-years-old-trees of guava *cv.* Shweta, 11-years-old-trees of guava *cv.* Allahabad Safeda and 4-years-old-trees of guava *cv.* L-49. The trees of these cultivars was subjected to pruning at fortnightly intervals starting from mid-March to till end June.

The salient findings of studies are summarized as under:

- Unpruned tree (control) showed more increase in net tree height as compared to the pruned trees, whereas June pruned trees showed minimum increase in height.
- The maximum increase in net tree spread and canopy volume were recorded in the unpruned trees. Minimum increase in tree spread was recorded in March pruned trees.
- Early pruning resulted in the early emergence of the new shoots. 15th March pruned trees showed early shoot emergence as compared to other pruned trees. Date of shoot emergence delay with delay in pruning time.
- Shoot length was significantly affected by the time of pruning. Maximum shoot length was recorded in 15th March pruned trees.
- March-April pruning treatments showed maximum flowering percentage during the months of April and May, while, May-June treatments shows maximum flowering

percentage in the months of July and August. This shifting of flowering percentage helps in the early fruit maturity and more yield during the early winter season of guava.

- Fruit weight was significantly affected by the time of pruning. Significantly higher fruit weight was observed in winter season in guava trees pruned on May.
- The un-pruned (control) trees had higher numbers of fruit per tree in rainy season crop. In winter season, maximum fruits numbers were counted in trees which were pruned on 15th May and 30th May with minimum in control trees.
- During rainy season, maximum fruit yield was recorded in control trees. Pruning decreases the fruit yield during the rainy season. Maximum fruit yield in winter season was observed in 30th May pruned trees. However, Minimum fruit yield in winter season were registered in control (in variety Shweta) and 15th March pruned trees (in variety L-49).
- Harvesting span was significantly decreased with the delay in pruning time. Duration of fruit harvest in pruned trees is less than un-pruned trees. The shortest duration of fruit harvest during winter season was recorded in those trees which were pruned in month of June.
- Out of different pruning treatments, maximum TSS of the guava fruits was recorded in 30th April pruned trees in rainy season and May pruned trees during the winter season. TSS of fruit harvested from pruned trees was higher than the TSS of the un-pruned trees. However, the effect of pruning time on TSS was non-significant.
- Effect of pruning time on acidity of guava fruit was non-significant during both the season. Maximum acidity during the rainy season was recorded in 15th March pruned trees. During winter season, maximum acidity was recorded in 30th April and 15th May pruned trees.
- Maximum total sugar percentage was affected by the different time of pruning. Trees pruned in June and July had results in the higher sugar content in the fruits during winter seasons.
- Pruning in month of April was results in maximum Vitamin C contents during rainy season and in winter season maximum vitamin C recorded in the fruits which were harvested from the 15th and 30th May pruned trees.

Conclusion

The present studies suggested that guava tree should be pruned between 15th and 30th May for early harvesting of quality fruits in early winter season.

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