CHAPTER II

REVIEW OF LITERATURE
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Under north Indian conditions, two crops were produced in a year in guava, namely, Ambe Bahar (Rainy season crop) and Mrig Bahar (winter season crop) (Hayes, 1957; Singh et al. (1963). But according to Rathore and Singh (1974), three crops of guava were produced in a year, namely, Ambe Bahar, Mrig Bahar and Hasth Bahar (Spring season). Singh et al. (1963) in their classical work "Fruit culture in India" also reported that in Uttar Pradesh, and other parts of northern India, guava flowered twice a year viz. in February and June. Rathore and Singh (1974) found two peak periods of flowering in guava under North Indian conditions the first being from last week of April to first fortnight of May and the second from the last week of July to first fortnight of August.

Ojha (1985) also reported that Sardar and Allahabad Safeda cultivars bloomed twice in a year i.e. spring (April - May) and rainy (July - August) season. The flowers were borne on newly emerged shoots in the axils of leaves either singly or in cymes of two or three on the lateral as well as terminal shoots.

Under Allahabad conditions, the bulk of the guava crop was produced during rainy season, but due to the effect of prevailing weather conditions, the fruits remained rough,
insipid, poor in quality, less nutritive and got affected with fungus diseases and insect pests (Hayes, 1957, Gupta and Nijjar, 1978). The rainy season crop, thus, remained uneconomical. Since the plants exhausted by producing the bulk of the crop in rainy season, the size of the following better quality winter season crop greatly reduced. Various methods have been known to be in practice to regulate these two crops with the main objective of earning more profits.

1. Vegetative growth:

Strong and weak flushes of vegetative growth in a year have been reported in guava. Its vegetative growth was found to be related with its cropping pattern. Terminal shoots grew more than laterals. Both types of shoots grew more during rainy season than either of the two other seasons i.e. winter and spring. The growth of both types of shoots (terminal as well as lateral) was very fast initially during the first four months, then after decreased for three months and finally remained almost stand still for four months prior to drying or initiation of new growth by then (Rathore, 1978).

Studies conducted by Ojha (1985) under tarai conditions also revealed that shoot growth in guava tree was maximum in the beginning, after the emergence of new flush, followed by a gradual decrease and finally stopping completely during Winter season. In his experiments under Bangalore conditions Prakash (1976), however, reported three growth flushes in
a year namely January - February, June and September. He further observed that January-February flush was the major flush constituting 77.4% of the total new shoots produced in a year. The growth of flower bearing shoots ceased after fruit setting but the vegetative shoots continued their growth.

2. Flowering and Fruiting habit of guava plant

Dasarathy (1952), who probably made the first systematic attempt to study the floral biology of guava reported that the plant bore flowers solitary or in cymes of two or three flowers on the current seasons growth in the axils of the leaves. Normally the bearing twigs grew a few inches in length, putting forth only four or five pairs of leaves. If the flowers happened to set in the mean time, the terminal buds did not grow in that case; instead if they rested till the next growing season. Similar observation on the flowering and fruiting pattern in guava were made by Sehgal and Singh (1967).

In their studies with cvs "Allahabad Safeda" and "Habahi", Syamal et al. (1980) reported that their spring shoots produced 3.17 and 2.35 floral buds per shoot respectively. In June flush the respective numbers was reduced to 1.50 to 1.35 only. Thus spring flush showed more percentage of fruitful buds. In general, 3rd node gave maximum flower buds in spring flush followed by the second node.
Fourth node produced least number of flower buds under north Indian conditions.

Rathore and Singh (1974) reported that there were obviously three clear cut flowering seasons, viz. summer, rainy and autumn. Flowering was heavy in summer season, medium in rainy season and light in autumn season. Two peak periods of flowering in guava trees (i.e. first from last week of April to first fortnight of May and second from last week of July to first fortnight of August) were observed in summer and rainy season respectively, while autumn season flowering persisted for a longer period without showing any peak.

3. Fruit quality in relation to cropping season

Roy and Ahmed (1951) reported that monsoon crop was heavier in Sabour (Bihar) but the winter crop was superior in quality. In his famous book "Fruit growing in India" Hayes (1957) mentioned "the rainy season crop of guava should be avoided because the fruits of this crop are rather insipid and watery and do not keep well". Singh (1969) also advised to take only one crop in a year i.e. winter crop, which was of better quality and fruits of which escaped the attack of fruit flies.

Sachan and Pandey (1969) reported that rainy season fruits at the ripe stage contained 0.60% pectine, 140 mg/100 g
vitamin C and 8.61% sugars, the corresponding values for winter fruits were 1.00%, 325 mg/100 g and 9.67% respectively. The TSS content of winter fruits was also higher. Teotia and Pandey (1970) also reported that the winter crop was superior in quality over rainy season crop under Basti conditions. They found that the deblossoming of rainy season flower buds was most effective in achieving better quality fruits during winter season. In their studies on the maturity standards of guava, Kumar and Hoda (1974) reported that rainy season fruits reached the full mature stage at the specific gravity of 0.9912, total soluble solid content of 13.15%, acidity 0.2163% and vitamin C 150.63 mg/100 g. Fruits of the winter season crop were found superior having a specific gravity of 0.9948, TSS 14.15%, acidity 0.3782% and vitamin C 339.66 mg per 100 g pulp at the full mature stage. Similar observations were also made by Rathore (1976) while studying the chemical comparison of four cvs of guava. He found the fruits maturing in the winter season had more sugar and TSS and higher titratable acidity. Moisture content was higher in fruits of the rainy season crop. Lucknow-49 and Allahabad safeda fruits contained more ascorbic acid than the Red fleshed and chittidar, especially in winter crop. Further in their more extensive work, Rathore and Singh (1976) reported that winter season fruits were best in test as well as in nutritive value in comparison with the fruits of rainy and spring seasons. Winter season
fruits also had better storage life and could be transported over the long distances. Rainy season fruits were poor in nutritive value and keeping quality. The quality being further impaired by the attack of pests and diseases during rainy season. Because of the poor quality of guava fruits produced during rainy season, neither the crop could fetch good price in the market, nor the plants produced good quality crop during the winter season as the plants were already exhausted (Teotia and Pandey, 1970; Kumar and Hoda, 1977; Rajput et al., 1986).

It could, therefore, be concluded that it was always advisable to avoid the rainy season crop of guava and go in for the winter season crop as the later was much superior in quality and much better its fruits possessed better keeping quality fetching thereby more market price than the rainy season crop.

4. Regulation of cropping in guava

Attempts have been made by research workers in the past to regulate the cropping pattern of guava trees in the three main fruiting seasons of the year. The methods employed by these workers have been withholding of irrigation water from December onwards till the onset of rainy season (Cheema et al., 1954; Hayes, 1957; Singh, 1969), exposing feeding roots followed by their pruning (Cheema, et al., 1954).
weekly irrigation of guava trees from February to April
(Teotia et al., 1970). Irrigation at the time of flowering
(full bloom) during April-May (Kumar and Hoda, 1977), manual
removal of flower buds, flower and newly set fruits during
April-May (Teotia and Pandey, 1970; Rathore and Singh,
1974; Kumar and Hoda, 1977; Pandey et al., 1980), pruning
of new shoots (Arvindakshan, 1963; Sundarajan and Muthuswamy,
1964, 1966; Bajpai et al., 1977; Gopikrishna, 1981; Lal,
1983, Tiwari, 1985) etc.

Besides, various chemical methods have also been
reported in the literature for regulating the cropping
pattern of guava which have been reviewed in details and
given below:

Effect of Plant growth Regulators and other chemicals

In recent years several worker tried different concentrations of plant growth regulators to modify the cropping
pattern of guava under different climatic conditions Teotia
and Pandey, (1970); Chandawat et al., (1975); Rathore and
Singh, (1975); Kumar and Hoda, (1977); Pandey et al., (1980).
In the following pages literature available on the effect of
plant growth regulators and chemicals on guava and other
related fruit crops has been thoroughly reviewed and pre-
sent so that the present investigation could be discussed
in the light of findings reported by earlier workers.
1. **Effect of Naphthalene acetic acid (NAA) spray**

   (i) **Vegetative growth**

   Teoatia (1970) sprayed 100 ppm NAA on Red fleshed "Sardar" and "Allahabad Safeda" cvs of guava at full bloom stage but did not notice any increase in the vegetative growth of the tree. Rathore (1975) sprayed young guava trees of cv. Allahabad safeda with the aqueous solutions of NAA at 0.80 and 100 ppm in April, when about 10% of the flower buds were opened, and observed that the higher concentrations of NAA resulted in the increased number of new shoots which flowered during the following winter. Rajput *et al.*, (1977) reported that the growth of the terminal shoots increased by spraying 50 ppm NAA. They also observed a positive correlation between length of terminal shoots and the number of leaves. Agni-hotri and Bhullar (1979) studied the effect of 100 and 150 ppm NAA on guava cultivar "Allahabad safeda" and did not find any increase in vegetative growth of the tree. Tiwari (1985) sprayed aqueous solutions of 600, 800 and 1000 ppm NAA on "Allahabad safeda" twice at 15 days interval starting on 5th May and found a gradual decrease in shoot length and number of leaves per shoot with increasing NAA concentrations. He further observed that higher concentration of NAA proved detrimental and reduced the growth of the shoot.

   Chundawat and Singh (1980) studied the effect of 50, 75 and 100 ppm NAA on phalsa and found increased leaf size with lower concentrations of NAA when sprayed as soon as
some flower buds started opening followed by the second spray after 2 weeks.

(ii) Effect of NAA spray on flowering and Fruiting

Teotia and Pandey (1970) found increased production of main crop of guava by the application of 10 ppm NAA during full bloom (March-April). Chundawat et al., (1975) reported that sprays of 100, 200 and 400 ppm NAA resulted in the deblossoming of 24.51 and 82 per cent flowers of guava respectively in cv Banarsi Surkha. They also found that the spray of NAA was a better alternative to the conventional method of withholding water before the bloom period. Singh and Singh (1975) while studying the chemical deblossoming in guava to avoid rainy season crop reported that NAA, when sprayed at 1000 or 2000 ppm on the flower buds, resulted cent percent abscission of flower buds and opened flowers.

Agnihotri and Bhullar (1979) observed significant reduction in fruit set when they sprayed 100 and 150 ppm NAA on 12 years old trees of guava cv Allahabad safeda. Pandey et al., (1980) in their experiment with 6 years old guava trees of cv "Lucknow-49" also arrived at the conclusion that two sprays of 800 ppm NAA during the month of April-May at 20 days interval were quite effective in reducing the rainy season crop and increasing the winter season crop under tarai conditions of western Uttar Pradesh. Similarly Gupta and Nijjar (1982) studied the effect of different plant growth regulators in
deblossoming of guava in cv "Allahabad safeda" and found that the foliar spray of 600 ppm NAA at the time of full bloom (in May) suppressed the rainy season crop effectively. Tiwari (1985) reported higher concentrations of NAA were more effective in increasing the flower production for winter season crop than the lower concentrations. Foliar application of NAA at the time of flowering during the rainy season caused severe injury to blossoms which resulted in the drop of flowers and small fruits.

Luckwill (1953) advocated that NAA at higher concentration caused thinning of flowers and fruit lets by inhibiting the germination of pollen grains. Furthering Biggs and Murphy, (1977) reported that NAA was found to accelerate the abscission of flower due to production of ethylene, which was a potential accelerating agent for abscission at higher concentration. In the experiments with mango cv Dashehari, Singh et al. (1961) sprayed 20 ppm, 60 ppm and 80 ppm NAA on April 25 and May 5. In the first spray application on April 25, 20 ppm NAA slightly increased the fruit retention but a further increase in its concentrations had a great thinning effect and resulted in lower fruit yields. In the second spray on May 5, none of the treatments registered any effect on fruit retention. Arora and Singh (1964) sprayed 20-120 ppm NAA at pea stage of fruit in cv. Dashehari and reported that 40 ppm was the most promising treatment for retaining fruits on the tree. However, Singh and Chadha (1967) could not get any
positive response on fruit retention with 20 ppm, 30 ppm and 40 ppm NAA when sprayed in the month of April or May. Maurya et al. (1973) sprayed 20 ppm, 40 ppm or 60 ppm NAA on Dashehari fruits at fortnightly interval starting from the pea stage to harvest and found 54 percent increased fruit retention over control with 40 ppm NAA. Mishra and Dhuria (1977) found that 40 ppm NAA (when applied at full bloom stage) thinned 38.3 per cent fruits a in plum cv Methley.

(iii) **Effect of NAA spray on yield and physico-chemical Composition**

Kumar and Hoda (1977) found increased yield of winter season guava by the foliar spray of 125 ppm NAA during April-May at full bloom stage. Agnihotri and Bhullar (1979) observed significant reduction in fruit set, when they sprayed 100 and 150 ppm NAA on 12 year old trees of guava cv Allahabad safeda. Pandey et al. (1980) in their experiment with 6 year old guava trees of cv. Lucknow-49 also arrived at the conclusion that two sprays of 800 ppm NAA during the month of April-May at 20 days interval were quite effective in reducing the rainy season crop and increasing the winter season crop.

However, Tiwari (1985) found that higher concentrations of NAA (800 ppm and 1000 ppm) were more effective in regulating the cropping pattern of guava. He further reported that higher concentrations of NAA has increased the fruit size and quality of fruits of the winter season crop in respect of TSS, Sugar, acidity and vitamin C contents.
In case of mango cv Dashehari Singh (1962) found that the foliar application of 15 ppm NAA at mustard stage of fruit growth increased TSS content of fruits significantly. Similarly, Arora and Singh (1964) also found that three application of 80 ppm NAA at 10 days interval w.e.f. April 8 increased 27.76 per cent weight of Dashehari fruits in mango. However, Singh and Chadha (1967) reported that application of 20-60 ppm NAA was not effective for improving the fruit weight. Maurya et al., (1973), on the other hand improved physico-chemical characteristics of Dashehari mango fruits in terms of fruits size, TSS, sugar, ascorbic acid and total acidity contents by applying 20-60 ppm NAA at fortnightly intervals, starting from the pea stage.

Veera and Das (1973) reported that foliar sprays of 10, 20 and 40 ppm NAA on litchi cv purbi had increased the ascorbic acid content of fruits at higher concentrations. Mishra and Dhuria (1977) found increased fruit size and weight of plum cv Methley by the spray of 40 ppm NAA at full bloom stage. The spray of NAA had further improved the TSS, acidity and total sugar content of plum fruits. Similarly Sinha et al., (1977) also found increased size and weight of fruits and juice percentage in Nagpur Santra by 4 sprayings of 20 ppm NAA at monthly intervals.
2. **Effect of 2,4-dichlorophenoxy acetic acid spray**

(i) **Vegetative growth**

Singh (1980) sprayed 20 and 40 ppm 2, 4-D on Allahabad safeda trees in the month of July and reported that 2,4-D did not bring about any increase in the shoot length and leaf area. Pandey et al., (1980) in their experiment with guava cv Lucknow-49, while applying 500 and 1000 ppm 2,4-D twice in the month of April at 20-days intervals, reported that it was toxic to plants at 1000 ppm concentration as it resulted in the buring of the shoots after spraying.

Chandawat and Singh (1980) reported that 2.5 ppm 2,4-D treated plants showed retarded growth and the size of phalsa leaf was also significantly reduced. Singh (1980) sprayed 20 and 40 ppm 2,4-D on the mango cv Dashehari in 'On' and 'Off' years and found that higher concentrations of 2,4-D enhanced the status of metabolites. At 40 ppm concentration, it was however most effective in increasing the dry matter, ash, nitrogen and carbohydrate contents of mango leaves.

(ii) **Effect of 2,4-D spray on flowering and fruitings**

Kumar and Hoda (1977) sprayed 15 and 30 ppm 2,4-D during full bloom stage on the guava cv Allahabad safeda, and found that 30 ppm concentration was most effective in reducing rainy season crop. Maximum percentage of flower buds abscised in the rainy season crop of guava by applying 1000 ppm 2,4-D
twice in the month of April at 20 days interval (Pandey et al., 1980). Gupta and Nijjar (1982) studied the effect of different chemicals in deblossoming of guava cv Allahabad safeda under Ludhiana conditions and reported that 75 ppm 2,4-D resulted in the dropping of the highest percentage of blossoms and young fruits (77.9%).

Gill and Mukherjee (1967) found 30 to 50 percent more fruits with 2,4-D sprays applied at concentrations below 20 ppm in 'Chausa' cv of mango. At higher concentrations, fruit and seed development was retarded. Dhillon and Gill (1967) sprayed 10-60 ppm 2,4-D in the 3rd, 5th and 6th week after fruit set in cv Chausa and recorded 60 to 100 percent higher fruit retention. They also found that the effectiveness of this growth regulator increased up to 60 ppm but the development of the treated fruits was retarded above 30 ppm. In cv Langra Maurya and Singh (1979) reported that 20 ppm and 40 ppm 2,4-D sprays improved fruit retention when foliar spray was applied at pea stage followed by the second application a month later. Chadha and Singh (1963) obtained highest fruit retention (9.14 %) in cv 'Langra' by spraying 40 ppm 2,4-D on mango trees on May 8.

Mishra and Dhuria (1977) applied 2,4-D at full bloom stage, when 90 per cent flowers had opened and found that plum cv Methley at it remained ineffective for thinning in 50, 75 and 100 ppm concentrate.
(iii) **Effect of 2,4-D spray on yield and physico-chemical composition**

2,4-D has also been found to be effective in improving fruit quality. Kumar and Hoda (1977) found increasing yields of winter season guava crop with the increase in the concentration of 2,4-D sprayed during April-May. Similarly Gupta and Nijjar (1982) found reduced rainy season guava yields, with the spray of 75 ppm 2,4-D. The spray was done during May at the time of full bloom and only one spray was applied. Pandey et al. (1980) found lowest guava fruit yields in Lucknow-49 during winter season by applying 500 ppm 2,4-D.

In Dashehari and langra trees the spraying of 10 ppm 2,4-D mustard and then at marble stages of the fruit has been reported to increase TSS content significantly in both the cultivars. Arora and Singh (1964) also found increased fruit weight of mango fruits in cv Dashehari by spraying 10 to 40 ppm 2,4-D. Similar positive effects of 2,4-D have been reported by Maurya et al. (1973) in cv 'Dashehari' by using slightly higher concentrations from 20 ppm to 60 ppm 2,4-D which resulted in the increased fruit size, TSS, sugar and ascorbic acid and reduced total acidity. In cv Bangana-palley, Veera and Das (1977) reported that application of 2,4-D at 10 ppm, 20 ppm and 40 ppm increased fruit size, weight and ascorbic acid content (40 mg per 100 g) when
sprayed four times starting from the bud differentiation stage to marble stage of the fruit.

In Litchi also, the spraying of 20 to 40 ppm 2,4-D was found to increase the TSS/Acid ratio and ascorbic acid content significantly over control by Veera and Das (1973). Sinha et al. (1977) found increased size and weight of fruits and increased juice percentage in Nagpur santra fruits with increasing the concentrations of 2,4-D from 10 to 20 ppm in the form of foliar sprays. Pal et al. (1977) studied the effect of 2,4-D on fruit growth pattern of Kinnow Mandarin and reported that 10 ppm 2,4-D had increased the size of fruit. The quality of fruit was also not adversely affected by 2,4-D.

Baghel and Sarnaik (1985) studied the effect of 2,4-D (10, 20, 30, 40 and 50 ppm) on yield and physico-chemical composition of sweet orange and reported that number of seeds per fruit were significantly reduced with the spraying of 2,4-D as compared to control and 30 ppm concentration was found optimum for increasing the number of fruit per tree, diameter, weight and juice percent of the fruit.

3. **Effect of Urea spray**

   (i) **Vegetative growth**

   Sprays of urea on guava crop has been extensively tried for the over all improvement of guava. Various workers have reported increase in terminal shoot growth and number of leaves. Arora and Singh (1970) found that 1 and 2% urea
sprays improved the terminal shoot growth and augmented the number of leaves at low concentrations when sprayed in July. Singh et al. (1971) found significant effect of nitrogen on terminal shoots, leaf number per shoot in guava as a result of foliar feeding with urea at lower concentrations. Roy et al. (1979) reported that urea at appropriate level worked as a growth promoters, while at higher level than required, produced toxicity, which had affected the normal growth and development of plants. Prakash (1981) found that single spray of urea proved superior to double spray in so far as the vegetative growth of guava in terms of length of terminal shoots and number of leaves per shoot was concerned. He further reported that 2 per cent urea spray was found suitable for increasing vegetative growth. The double spray of urea inhibited the vegetative growth of guava. Tiwari (1985) also observed that the foliar application of 10 and 15 per cent urea on cv Allahabad Safeda per shoot, increased shoot length and number of leaves. Rajput et al. (1986) found that spray of aqueous solution of urea (10, 15, 20 per cent) in April defoliated leaves and killed flower buds. He reported that guava leaves dropped normally between 19 and 25 days from the date of spraying. Spray of 15 per cent urea could be used in April to defoliate guava trees to induce new shoots, flowers and better quality fruit during winter (Rajput et al. 1986). Tiwari and Rajput (1975) studied the effect of urea sprays at 2, 4 or 6 percent on mango cvs Langra, Dashehari and Totapari. Vegetative growth
in all the cvs increased with increasing urea concentrations. Singh et al. (1973) reported that foliar applications of 4 and 6 per cent urea increased the length of terminal shoots in mango cvs langra and chausa. The other vegetative characters like number of leaves per shoot and leaf area and water content had also increased. The highest urea concentration of 6.0% was most effective but caused slight leaf burning.

(ii) Effect of urea spray on flowering and fruiting

In general, foliar sprays of mineral nutrients had positive effect on yield of guava fruits. Urea in particular had a profound influence on the flowering and fruiting characteristics of guava. Tiwari et al. (1968) reported that nitrogen application increased number of flowers and fruit set in guava. Singh et al. (1971) working with guava reported that foliar sprays of nitrogen in the form of urea induced early flowering and extended the duration of flowering. Arora and Singh (1970) found enhanced total fruit yield, fruit weight and chemical composition of guava by the spray of 1 and 2 percent of urea in the month of July.

Shigeura et al. (1975) working on seedling trees of guava found that the trees sprayed with 25% were defoliated, which later flowered and set fruit normally in the coming season. In addition to this the harvesting period was shortened from 15 weeks for control trees to 4 weeks for sprayed trees. Similar results were also found with the young trees
of guava by Chapman et al. (1979). Prakash (1981) observed two sprays of urea significantly reduced the flowers of rainy season crop and that higher concentration of urea was more effective in this regard, which reduced rainy season crop and increased the winter season crop. Tiwari (1985) reported that spray of urea significantly deblossomed guava trees and increased the flower/fruit drop for rainy season crop and consequently there was an increased flower bud emergence and fruit set in winter season crop. Rajput et al. (1986) reported that sprays of aqueous solutions of urea (10, 15, 20 per cent) in April defoliated leaves and killed flower buds. There was no fruiting in rainy season. They suggested that urea could be used to defoliate guava for inducing new shoots, flowers and better fruit in the winter season crop.

(iii) **Effect of urea spray on yield and physico-chemical composition**

Arora and Singh (1970) reported enhanced total fruit yield; fruit weight, length, diameter and vitamin C and TSS content of guava fruits by the spray of 1.0% to 2.0% urea in July. They further observed an increasing trend in reducing, non-reducing and pectin content of guava fruits with 2 per cent spray of urea. Rajput et al. (1974) observed that nitrogen application obviously affected the chemical composition of guava fruits; better results for TSS, sugar, ascorbic acid and pectin were obtained in the fruit harvested
from the trees treated with four percent urea spray. Chapman et al. (1979) found three fold increase in fruit yields of guava over untreated trees. In addition to this, 25 per cent urea spray had also shortened the harvesting period. Prakash (1981) found that higher concentration of urea spray on guava reduced the rainy season crop and increased the winter season crop significantly. Physico-chemical composition of guava fruits was also influenced significantly by the application of urea. In general 2 and 4 per cent urea was found to be much effective for improving physico-chemical characters of guava fruits. Tiwari (1985) observed increased TSS and total sugar contents of guava fruit by the spray of 10 and 15 per cent urea at the time of flowering. Rajput et al. (1986) found that urea spray at 15 per cent during April was suitable for maximising fruit yields, improving fruit size reducing acidity and increasing the TSS and vitamin C contents of the fruits significantly.

4. Effect of Zinc sulphate spray

(i) Vegetative growth

Prasad and Mathur (1966) reported that zinc deficiency in guava caused intervienal leaf chlorosis, small leaf size, leatheryness of leaves, suppression of plant growth, die back of branches, production of few as no flowers and drying and cracking of fruits. Arora and Singh (1970) reported an increase in the growth of guava plants by the spray of 0.4 per cent zinc sulphate, in the month of July. Rajput et al.
(1975) found a significant increase in vegetative growth, flowering and fruiting in guava of cv Allahabad safeda by spraying with 0.3 or 0.4 per cent solution of zinc sulphate before flowering.

Zinc deficiency results in reduced internodal length producing the characteristic terminal rosette effect in many trees viz. apples and stone fruits (Chandler, 1932, 1937). Dull yellow green or bright yellow to ivory intervenial molting is often characteristic of zinc deficiency in apple and many deciduous stone fruit trees (Hoagland et al. 1935).

Excess of zinc commonly produced iron chlorosis (Chapman et al. 1940). Childers (1954) also emphasized that when concentrated zinc solution come in contact with roots of the trees, which open leaves or open buds, the branches connected with these roots dried up quickly. Other symptoms of toxicity were stunted growth with rather pale colour of the leaves.

Besides correcting deficiency symptoms other effects of zinc sprays have also been reported. For instance Tarasov (1966) and Heeney et al. (1964) reported that foliar sprays with zinc sulphate not only corrected zinc deficiency symptoms but also increased chlorophyll content of apple leaves.

Srivastava (1969) found significant improvement in leaf area and fresh and dry weight of pine apple plants by the spray of 2 ppm zinc sulphate. On the other hand Manchanda and Randhava (1972) reported that application of 15 ppm zinc had
decreased the miner, medium and acute chlorosis of sweet orange tree. Dixit et al. (1978) sprayed 0.5, 0.75 and 1.0 percent zinc sulphate on Kinnow in April and September and found that all the treatments had reduced the intensity of chlorosis and increased the yield.

(ii) Effect of zinc sulphate spray on flowering and fruiting

Rajput and Chand (1975) studied the effect of zinc on guava cv Allahabad safeda and found higher concentrations of zinc (0.3 or 0.4 per cent) led to significant improvement in growth and flowering of guava. Chonkar and Singh (1976) while studying the effect of zinc as a foliar spray on the guava fruits reported that zinc alone or in combinations increased the fruit yield per plant as compared to control in both Mrig and Ambe bahar seasons.

Awasthi and Tripathi (1973) found increased fruit set in Litchi by the spray of 0.5 per cent zinc sulphate.

(iii) Effect of zinc sulphate spray on yield and physico-chemical composition

Heeney et al. (1964) reported that foliar sprays of zinc sulphate made during flowering and again in August resulted in an increased enzymatic activity, which ultimately had increased the quality of fruits. Arora and Singh (1970) reported an increase in the yield of guava by spray of 0.4
per cent zinc sulphate solution during July. Rajput and Chand (1975) sprayed 0.1, 0.2, 0.3 or 0.4 per cent zinc sulphate before flowering on guava cv Allahabad safeda and found significant improvement in yield specially at two higher concentrations. Similar observations were also recorded by Chhonkar and Singh (1976) while studying the effect of zinc and other micronutrients on guava and found increased fruit yield per plant as compared to control. Increase in the weight of guava fruits were also observed under zinc spray. Chaitanya (1984) observed that foliar sprays of mineral nutrients had positive effect on yield and quality of guava fruits. He further reported that spray of 0.3 per cent zinc sulphate had given maximum yield along with maximum weight and volume of guava fruits.

Hoda et al. (1973) and Awasthi et al. (1973) found increase in TSS vitamin C, and decrease in acidity contents of Litchi with 0.5 per cent zinc sulphate spray. Sidhu et al. (1980) reported that 0.5 per cent zinc sulphate sprays had favourable effect in improving the quality of peach fruits by increasing their TSS and decreasing acidity. They further reported that 0.5 per cent foliar spray of zinc sulphate, when the leaves were half expanded increased the fruit yield in peaches cv Florida sun from 35.4 kg per tree in control to 75.1 kg per tree in treated trees. In case of mango Rath et al. (1980) reported an increase in fruit sugar, ascorbic acid and TSS contents by spraying zinc sulphate. They also
reported that 0.5 per cent zinc sulphate had increased fruit weight, fruit length and diameter. Desai et al. (1981) reported that spray of zinc sulphate at 0.5 per cent had significantly increased fruit weight and fruit size in sweet oranges. Srivastava et al. (1981) reported an increase in ascorbic acid content in coorg mandarins by applying micronutrients sprays. They found significant improvement in the quality of fruits by the application of zinc sprays. Similarly Raturi and Mukherjee (1981) found an increase in fruit size and fruit weight with the spray of 0.45% zinc sulphate on sweet orange.

From the literature reviewed above it is evident that informations regarding crop regulation of guava under Allahabad conditions are scanty. Experiment conducted at other places do not reveal the exact time of application of suitable concentration of plant growth regulators and chemicals to promote winter season crop. It was, therefore, essential to laid out an experiment on crop regulation studies in guava under Allahabad to benefit the guava growers, which was their long feld need.