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## Control of pre-harvest application of certain chemicals ripening on guava

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### Abstract

Fruit ripening is a natural process in which a fruit goes through various physical and chemical changes and gradually becomes sweet, coloured, soft and palatable. However, this natural process can also be stimulated by using artificial fruit ripening agents. Farmers and vendors often use artificial ripening agents to control fruit ripening rate. Different fruit ripening agents can be used to ripen fruits artificially and to provide fruits the desired color and taste within a short time. In recent years, the use of artificial fruit ripening agents is becoming much prevalent, the agents being mostly used for commercial purposes. During winter months ripening of guava is big problem due to low temperature. Ripening in guava fruit is irregular and follows over a prolonged period needing multiple harvests, thus hike in the cost of production. In other words, ripening is the process by which they attain a good flavor, quality, color and other textural properties. The reason for textural fruit changes and the fruit softening is the cell structure.

**Objectives:** Some phytohormones like ethylene are responsible for the fruit ripening. Certain PGRs can modify the perception, content, or action of such phytohormones, possibly fast-tracking fruit ripening process. To enhance ripening different substances are used. The effects of two ripening chemicals, ethephon and potassium sulphate on ripening process, are discussed in this review paper. Application of ethephon at 400-500 ppm on guava fruit on the plant, accelerated ripening. Ethephon generally slightly alter the fruit quality characteristics. Similarly observations were recorded when potassium sulphate is applied as pre harvest application. It has been reported that the foliar application of  $K_2SO_4$  @ 3% provides encouraging results for quality improvement guava fruit.

**Keywords:** Ripening, ethephon, potassium sulphate, yield, quality

### Introduction

Guava is one of the popular, delicious and is widely grown fruit in tropical and sub-tropical provinces of the world because of wider adaptability and commercial importance. It is a prolific bearer and a highly remunerative fruit crop. Under North Indian conditions, it flowers two times in a year *i.e.*, in the month of April-May and again during August-September. The fruit quality of winter guava is much better concerning to sweetness, sugar and ascorbic acid content. However, winter crop does not properly ripen on the tree due to less temperature in December and January. Sometimes fruits remain hard and small in sizes that are not liked by the consumers. Ethylene gas causes a change in properties of the fruit (Singh *et al.* 2018) <sup>[13, 14]</sup> while ripening is considered as an irreversible biochemical modification throughout the maturation of guava fruits. Due to simultaneous ripening in various crops there is market glut, results in huge spoilage loss and poor revenue to the grower. This review paper has been written with a view to adopt staggered ripening to avoid market glut. This will help to maximize the returns of the grower and may provide the fruit consumer for long time. Impact of ethephon and potassium sulphate on development and quality of winter season guava is discussed in this review paper under the following headings-

### Yield parameters

**Fruit number per tree (Fruit retention):** Number of fruit retention per tree was decidedly influenced by treatment with ethylene and potassium sulphate. Various authors have advocated this fact. Brar and Bal (2010) <sup>[1]</sup> recorded maximum mean fruit retention in cv. Allahabad Safeda treated with ethephon 500 ppm (62.56%). Manivannan *et al.*, (2015) <sup>[11]</sup> observed the improved number of fruits (145.1) per tree with foliar application of potassium sulphate (1%) in cv. Lucknow-49.

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### Average fruit weight

It was found in all the research experiments conducted by various researchers that fruit weight was expressively affected by applying different PGRs and nutrients. It was proved by Gill and Bal (2010) <sup>[3]</sup> that ripening and quality of winter season guava cv. Lucknow-49 was greatly improved and the weight of the fruit was weight-135.4 g when treated with K<sub>2</sub>SO<sub>4</sub>. Brar *et al.* (2012) <sup>[2]</sup> observed that the spray of ethephon @ 500 ppm on guava significantly enhanced the fruit weight (154.3 g) in comparison with the control. Lal *et al.* (2013) <sup>[10]</sup> reported that the fruit weight was expressively influenced by the application of ethrel (100 ppm) in cv. Allahabad Safeda. Kumar *et al.* (2015) <sup>[7]</sup> described that spray of potassium (0.5%) at fruit set stage in guava plants significantly fruit weight (126.60 g) increased. Rajput *et al.* (2015) <sup>[12]</sup> experimented and determined the optimal level of growth regulators for improved production and quality. They found that the foliar application of ethrel (750 ppm) along with micronutrients lead to in a noteworthy enhancement in fruit weight (78.03%) of guava. Manivannan *et al.* (2015) <sup>[11]</sup> stated that treatment with K<sub>2</sub>SO<sub>4</sub> (1%) in cv. Lucknow-49 significantly enhanced fruit weight (138.3 g).

### Fruit volume

Kumar *et al.* (2015) <sup>[7]</sup> recorded that application of K<sub>2</sub>SO<sub>4</sub>(0.5%) at fruit set stage significantly increased fruit volume (117.67 ml) as compared to control (83 ml) in cv. Pant Prabhat. Brar *et al.* (2012) <sup>[2]</sup> documented that spray of ethephon (500 ppm) significantly enhanced the fruit length and width. Whereas, Lal *et al.* (2013) <sup>[10]</sup> detailed that ethrel application (100 ppm) change in the length and girth of fruit in cv. Allahabad Safeda. Manivannan *et al.* (2015) <sup>[11]</sup> recorded maximum length (9 cm) and fruit diameter (7.4 cm) with application of potassium sulphate (1%) on guava cv. Lucknow-49. Rajput *et al.* (2015) <sup>[12]</sup> recorded maximum length (6.50 cm) and width (6.67 cm) of fruit by the spray of ethrel (750 ppm) in combination with micronutrients. Kumar *et al.* (2016) <sup>[8]</sup> revealed that potassium sulphate (0.5%) sprayed after 2 weeks from fruit set on plants of guava recorded maximum fruit size (30.84 cm<sup>2</sup>).

### Yield

It has been reported that PGRs and nutrients had encouraging effect on yield (kg/tree). Brar and Bal (2010) <sup>[1]</sup> reported the significant fruit yield increase with the spray of ethephon (500 & 1000 ppm) in the winter season guava. Improvement in fruit yield was observed with higher levels of potassium, particularly with potassium sulphate as compared to the lower concentrations of potassium. Lal *et al.* (2013) <sup>[10]</sup> found that the fruit yield of guava cv. Allahabad Safeda was significantly influenced by the spray of ethrel (100 ppm). Manivannan *et al.* (2015) <sup>[11]</sup> resulted that the spray of potassium sulphate (1%) on guava (cv. Lucknow-49) significantly enhanced yield per tree (20.06 kg).

### Parameters related to Fruit Quality

#### Fruit firmness

It has been observed that spray of different plant nutrients and growth regulators greatly influenced the fruit firmness. Kumar *et al.* (2017) <sup>[6]</sup> observed maximum fruit firmness (7.33 kg/cm<sup>2</sup>) in guava plants sprayed with potassium sulphate 3 per cent followed by (7.17 kg/cm<sup>2</sup>), trees sprayed with potassium sulphate 2 per cent respectively, which might be related to an increase in fruit tissue pressure potential. The

softening of Sardar guava was simplified through action of ethrel on cell wall hydrolysis and alterations in complex materials to simpler ones, which occurred during ripening due to ethylene gas (Jain and Dashora 2011) <sup>[4]</sup>. Guava fruit firmness declined continuously with various treatments of ethephon. Better fruit firmness was also recorded in control. It also showed declining trend towards end of storage period (Singh, 2018) <sup>[13, 14]</sup>.

#### Fruit color

It has been observed that spray of different plant nutrients and growth regulators greatly influenced the fruit color. Gill and Bal (2010) <sup>[3]</sup> observed the impact of nutrients and PGRs on quality and recorded attractive YG 145B (yellowish-green) by the ethephon (400 and 500 ppm) treatment in Sardar guava. Brar *et al.* (2012) <sup>[2]</sup> revealed that the colour of rainy season fruits of guava cv. Allahabad Safeda was found to be enhanced with ethephon @ 500 and 1000 ppm applications i.e. yellow green (Y 144 C) and yellow (Y 12 C), in that order. Gill *et al.* (2016) conducted research studies to improve ripening quality of winter crop of Sardar guava. Trees were sprayed with ethephon @ 300, 400 and 500 ppm. It was recorded that colour development was greatly improved by applications of ethephon. It may be summarized that fruit colour changed very quickly with pre-harvest application of ethephon particularly with ethephon 750 ppm and 1000 ppm. Colour development was very early and the fruit size in not fully developed. But ethephon 250 ppm and 500 ppm gave satisfactory results regarding shelf life and total yield of the crop (Singh, 2018) <sup>[13, 14]</sup>

#### Organoleptic rating

Jakhar and Pathak (2016) <sup>[5]</sup> recorded the highest organoleptic quality over the control with the treatment of potassium sulphate (1%) along with other nutrients in mango. Kumar *et al.* (2016) <sup>[8]</sup> premeditated the impact of mineral nutrients application at various growth stages of guava and revealed that fruits of plants treated with 0.5 percent potassium at two weeks after fruit set had better organoleptic score (8.2 out of 9.0).

#### Total soluble solids

Maximum TSS (10.70%) was recorded when treated with ethephon (1000 ppm) (Brar *et al.*, 2012) <sup>[2]</sup>. On the contrary, untreated fruits lead to minimum TSS (10.20%). Kumar *et al.* (2015) <sup>[7]</sup> established that 0.5 percent foliar spray of potassium on guava plants at the time of fruit set recorded the maximum TSS (11.50 Brix). Rajput *et al.* (2015) <sup>[12]</sup> detailed highest TSS (11.33%) with the foliar spray of ethephon 1000 ppm in combination with nutrients in cv. L-49. Manivannan *et al.* (2015) <sup>[11]</sup> noted maximum total soluble solids (9.5%) with the spray of potassium sulphate (1%) in cv. Lucknow-49. Kumar *et al.* (2017) <sup>[6]</sup> stated that improved TSS (10.09 Brix) were found in fruits harvested from the plants sprayed with potassium sulphate @ 3.0 percent followed by 9.78 Brix in plants sprayed potassium sulphate @ 2.0 percent on guava cv. Taiwan Pink. Mohamed *et al.* (2016) carried out research on mature-green fruits of guava and treated them with ethrel. It was concluded that ethrel treatment were significantly accelerated total soluble solids in the fruits. Similar results were proved at Jorhat, in guava cv. Allahabad Safeda that ethrel treatment @ 50 and 100 ppm resulted in increase of TSS and was concluded that ethrel @ 50 ppm was much effective than 100ppm (Lal and Das 2017) <sup>[9]</sup>.

### Acidity

It has been observed that spray of different nutrients and growth regulators significantly influences the acidity content. Manivannan *et al.* (2015) <sup>[11]</sup> recorded minimum acidity (0.25%) with spray of K<sub>2</sub>SO<sub>4</sub> (1%) in cv. Lucknow-49. Rajput *et al.* (2015) <sup>[12]</sup> observed lowest acidity (0.64%) with application of ethephon (500 ppm) along with other nutrients in cv. L-49. Kumar *et al.* (2017) <sup>[6]</sup> described that lowest acidity 0.35 per cent followed by 0.36 per cent were found in fruits harvested from trees treated with K<sub>2</sub>SO<sub>4</sub> @ 3.0 percent and @ 2.0 percent, respectively in cv. Taiwan Pink guava. The reduction in titratable acidity with ethrel may be due to its action by fast conversion of organic acids and their derivatives through higher respiration and carbon assimilation activity during rapid ripening process in guava

### Ascorbic acid

It has been observed that spray of different nutrients and growth regulators significantly influences the ascorbic acid content. Manivannan *et al.* (2015) <sup>[11]</sup> recorded highest ascorbic acid (130 mg/100 g) with the foliar application of potassium sulphate (1%) on guava cv. Lucknow-49. Kumar *et al.* (2016) <sup>[8]</sup> discovered that treatment with K<sub>2</sub>SO<sub>4</sub> (0.5%) in guava plants significantly enhanced ascorbic acid content over the control. Kumar *et al.* (2017) <sup>[6]</sup> described that maximum ascorbic acid (235.38 mg/100 g) was found in plants treated with K<sub>2</sub>SO<sub>4</sub> @ 3.0 per cent which was on par with plants treated with K<sub>2</sub>SO<sub>4</sub>@ 2.0 percent in cv. Taiwan Pink guava. Lal and Das (2017) <sup>[9]</sup> carried out research in guava cv. Allahabad Safeda at Jorhat and revealed that ethrel treatment @ 50 and 100 ppm increased ascorbic acid (mg/100g) of the guava fruit. They explained that ethrel (50 ppm and 100 ppm) were effective in increasing ascorbic acid of guava.

### Total Sugars

It has been observed that spray of different plant nutrients and growth regulators significantly influences the total sugar content. Rajput *et al.* (2015) <sup>[12]</sup> reevaluated that the maximum total sugar content (7.40%) with a spray of ethephon 1000 ppm in combination with nutrients on guava plants. Manivannan *et al.* (2015) <sup>[11]</sup> noticed that the maximum total sugar (9.25%) with the spray of potassium sulphate (1%) on guava cv. Lucknow-49. Kumar *et al.* (2017) <sup>[6]</sup> obtained improved total sugar (7.35%) in cv. Taiwan Pink guavas treated with potassium sulphate @ 3.0 percent followed by 7.28 percent sprayed with potassium sulphate @ 2.0 per cent. Lal and Das (2017) <sup>[9]</sup> at Jorhat revealed that ethrel treatment @ 50 and 100 ppm increased total sugar (%) of the guava fruit cv. Allahabad Safeda. In general, total sugars in guava fruits increased during storage period and recorded highest in NAA 200 ppm (Singh, 2018) <sup>[13,14]</sup>.

### Reducing sugars

It has been observed that spray of different plant nutrients and growth regulators significantly influences the reducing sugar content. Kumar *et al.* (2015) <sup>[7]</sup> described that treatment with potassium sulphate (0.5%) two weeks after fruit set significantly enhanced reducing sugars in guava plants. Manivannan *et al.* (2015) <sup>[11]</sup> recorded maximum reducing sugars (4.76%) with the spray of potassium sulphate (1%) on guava cv. Lucknow-49. Kumar *et al.* (2017) <sup>[6]</sup> described that maximum reducing sugars (4.63%) were found in plants treated with potassium sulphate @ 3.0 percent trailed by 4.59

percent in cv. Taiwan Pink guavas treated with potassium sulphate @ 2.0 percent.

### Non-reducing sugar

It has been observed that spray of different nutrients and growth regulators significantly influences the non-reducing sugar content. Kumar *et al.* (2015) <sup>[7]</sup> observed that spray application of potassium (0.5%) two weeks after fruit set significantly enhanced non-reducing sugar in guava plants. Kumar *et al.* (2017) <sup>[6]</sup> noticed that the highest non-reducing sugar 2.72 per cent followed by 2.69 percent was obtained in plants applied with potassium sulphate @ 3.0 percent and @ 2 percent respectively on guava cv. Taiwan Pink.

### Pectin content

It has been observed that spray of different nutrients and growth regulators significantly influences the pectin content. Kumar *et al.* (2015) <sup>[7]</sup> reported that spray of potassium (0.2%) two weeks after fruit set significantly enhanced pectin content (0.47%) in guava plants. Kumar *et al.* (2017) <sup>[6]</sup> reported that highest pectin content 0.86 percent followed by 0.83 percent was obtained in plants applied with potassium sulphate @ 3.0 percent followed by 0.83 percent in plants sprayed with potassium sulphate @ 2.0 percent on guava cv. Taiwan Pink.

### Conclusion

It has been concluded that ethephon is highly effective 400-500 ppm with respect to accelerated ripening. Application of ethephon expressively declined acidity of the guava but improved the amount of TSS. It also effected reducing sugars, non-reducing sugars and total sugars of the guavas as compared to untreated ones. Organoleptic qualities as effected to great extent. K inclined the pectin content of the guava fruits as it assists the translocation of photosynthates to young parts, which is used in the production of pectin materials. Highest organoleptic rating, pulp weight, acidity, TSS, ascorbic acid, reducing sugars, total sugars and improved pectin content was acknowledged with the treatment of potassium sulphate @ 2.5 per cent.

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