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Effect of pruning levels and spraying some chemical substances on quality characteristics of guava (*Psidium guajava* L.)

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Abstract: The experiment was laid out in randomized block design with three replications and thirteen treatments. Pre-harvest application of Ethephon (250 ppm, 500 ppm and 750ppm), Calcium nitrate (1.0, 1.5% and 2.0%), Potassium nitrate (1.0%, 3.0% and 4.5%) and Pruned at 25%, 50% and 75 % of shoot growth. It was recorded that maximum TSS (10.60 ^{0}Brix), Total sugars (9.53%), Reducing sugar (4.65%), Non-reducing sugar (4.53%) and Vit-C (236.96mg/100g of fresh fruit wt.) were found with 4.5% KNO_3 treated plants.

Key words: Guava, Potassium nitrate, Calcium nitrate, Ethephon, Pruning, Fruit quality

Introduction

Guava (*Psidium guajava* L.) belongs to family Myrtaceae. It is one of the highest fruit in area and production after citrus, mango grapes and banana. Guava fruit is often referred to as apple of tropics probably as it is the only fruit that matches the high nutritive value of more commercially important temperate fruit apple (Khan *et al.,* 2013). Guava fruit is the cheapest and richest source of vitamin 'C' as well as it contains small amounts of vitamin A, B, carbohydrates, oils and proteins. The fruits are eaten fresh or made into guava jelly. Juice is also extracted from the fruit and used as the basis for a beverage, while guava paste or guava cheese are popular dishes in some parts of the world (Singh and Singh, 1998). Guava is rich in vitamin C (75–260 mg/100 g pulp), pectin (0.5–1.8%), good source of thiamine (0.03–0.07 mg/100 g pulp) and riboflavin (0.02–0.04 mg/ 100 g pulp). Besides, guava fruit is also a good source of minerals, like phosphorus 22.5–40.0 mg/100 g, calcium 10.0–30.0 mg/100 g and iron 0.60–1.39 mg/ 100 g (Singh *et al*. 2003). It normally bears two crops in a year: the first bearing in rainy season from spring flush (*Ambe bahar*) and the second in winter from monsoon flush (*Mrig bahar*). The crop of spring flush gives maximum production. However the fruits are of poor quality and severely infected by fruit fly. On the other hand, fruits produced from monsoon flush are more nutritious and superior in quality but the yield is low.

Pruning of guava is one of the most important practices that influence vigour, productivity and quality of the fruits (Gadgil and Gadgil, 1933). Pruning is one of the oldest cultural practices which are practiced in temperate and sub-tropical fruit crops to bring a balance between vegetative and reproductive growth of the plant. Lal (1983) indicated that the yield of guava cv. Sardar was improved by pruning. Also, Salah, 2005 produced the highest bud emergence of guava by using severe and moderate pruning. Haropinder and Bal (2006) reported that pruning may be helpful in reducing the tree size and improving the fruit quality as well. Pre-harvest spray of minerals and plant growth regulators are one of the most important strategies applied for modern integrated fruit production systems helpful in improving fruit quality (El-hilali *et al.,* 2003, Dutta and Banik, 2007).

Calcium compounds extend the shelf life of several fruit by maintaining firmness, minimizing the rate of respiration, protein breakdown and disease incidence (Gupta *et al*., 1980). Calcium compounds have shown promise in the quality retention of fruit also (Huber, 1983). To improve the quality of fruit at harvest and to enhance the storage life by influencing the after harvest changes, several research workers have used certain pre-harvest treatments. The application of mineral nutrients calcium nitrate are known to play a crucial role in growth, development, quality and storage of fruits (Dixit *et al.,* 2004; Jayachandra *et al.,* 2005 and Singh *et al.,* 2004). Potassium has an important role in major plant processes, such as photosynthesis, respiration, protein synthesis, enzyme activation, water uptake, transpiration, growth, development and yield. It also imparts quality characters like attractive colour to skin and pulp, improve flavour, sugar, acidity, texture, weight and keeping quality of fruit. The effect of different doses and sources of potassium were studied on yield and quality of Alphonso mango as carried out by Jadhav *et al.* (2004). Among various nutrients, foliar application of potassium is also considered for profound effect on fruit quality that is total soluble solids, acidity, and vitamins contents (Bhargava *et al.,* 1993).

The present study will contribute in understanding the biochemical status of guava fruits at harvest as influenced by pruning and pre-harvest spray of ethephon, calcium nitrate and potassium nitrate which may help in increasing the physico-chemical quality of guava fruits under Lucknow conditions.

Materials and Methods

The present investigation was carried out on thirteen year old plants of uniform, healthy and young bearing tree of guava at Horticulture Research Farm, Babasaheb Bhimrao Ambedkar University, Lucknow during 2014-15. The selected plants were pruned at 25 %, 50 % and 75 % of current seasons shoot growth and plant selected for spray sprayed with Ethephon (250 ppm, 500

ppm and 750ppm), Calcium nitrate (1.0 %, 1.5 % and 2.0 %) and Potassium nitrate (1.0 %, 3.0 % and 4.5%) solutions in first week of May and control (without any treatment). The sprays were conducted until total saturation of foliage. Which were replicated thrice in a randomized block design along with the thirteen treatments. T_1 Control (unpruned and untreated trees), T_2(Ethephon 250ppm), T_3 (Ethephon 500ppm), T_4 (Ethephon 750ppm), T_5 (Calcium nitrate 1.0%), T_6 (Calcium nitrate 1.5%) , T_7 (Calcium nitrate 2.0%), T_8 (Potassium nitrate 1.5%), T_9 (Potassium nitrate 3.0%), T_{10} (Potassium nitrate 4.5%), T_{11} (Removal of 25% of current seasons shoots growth), T_{12} (Removal of 50% of current seasons shoots growth) and T_{13} (Removal of 75% of current seasons shoots growth).

The total soluble solid (TSS) content of fruits were determined with the help of an Erma Hand Refractometer (Tokyo, Japan), and expressed in per cent after making the temperature correction at 20°C. A little amount of fruit pulp was taken in muslin cloth and crushed to obtain the juice of crushed pulp which was taken on the refractometer and their value was read against light. The ascorbic acid and acidity was estimated by the method described by AOAC (2000). Total sugar content was determined by 'Fehling solution method' and expressed in percentage. The data was analysed as per the method given by Panse and Sukhatme (1985). Least significant difference at 5% level was used for finding the significant differences among the treatment means.

The objective of present study was to determine the best treatment combination for quality enhancement in guava.

Results and Discussion

The results presented in Fig.1 show that the response of KNO_3, pruning and $Ca(NO_3)_2$ was better than that of ethephon in increasing the TSS however, all the treatments recorded higher TSS than control. The maximum TSS (10.60 ^{0}Brix) and (10.30 ^{0}Brix) were recorded with KNO_3 4.5% and 3.0 % followed (9.86 ^{0}Brix) and (9.74 ^{0}Brix) with pruning 75% and $Ca(NO_3)_2$ 1.5% and minimum (9.28 ^{0}Brix) with ethephon 250 ppm treatments. In the present studies, it seems that K play a significant role in accumulation of sugar from leaves and other soluble solids in the fruit which results better quality of fruits in terms of total soluble solids. This is well and conventional fact that potassium plays an important role in sugars translocation. These findings are also supported by the work of Singh and Chhonkar (1983) and Tossar *et al.* (1989) who reported an increase in TSS with K and micro-nutrients in guava, Shirzadeh and Kazemi (2011) in Apple, Dhatt and Mahajan (2005) in Pear cv. Pathernakh, and Mahajan *et al.* (2008) in plum cv. Satluj Purple. Highest acidity (0.44 %) were recorded T_1 (control) and 0.43 % with treatment calcium nitrate 2.0 %, whereas lowest (0.20 %) was recorded in treatment with 0.3 % KNO_3. Highest Vitamin C (236.96mg/100g) was recorded with treatment 4.5% KNO_3, whereas lowest (154.86 mg/100 g) was recorded in treatment T_1 (control). Increased ascorbic acid content in the fruits may be because potassium could have helped to slow down the enzyme system that encouraged the oxidation of ascorbic acid, thus helping the plants to accumulate more ascorbic acid content in the fruits (Ananthi *et al.*, 2004). The high energy status in crops well supplied with K also promotes synthesis of secondary metabolites, like Vitamin C (Mengel, 1997). The application of mineral nutrients has positively influenced the metabolic activities probably due to their improved endogenous level following external application. These may have enhanced the process of synthesis, translocation and accumulation of quality constituents like TSS, sugars and ascorbic acid following strong source sink relationship (Goswami *et al.,* 2014).

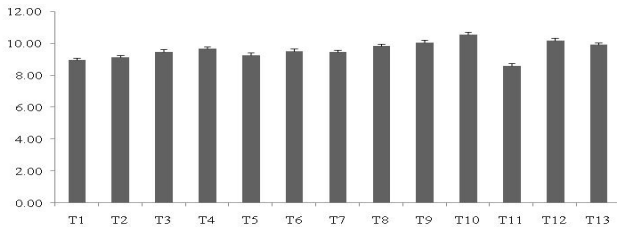

Fig.1: Effect of chemical spray and pruning levels on TSS (^{0}Brix)

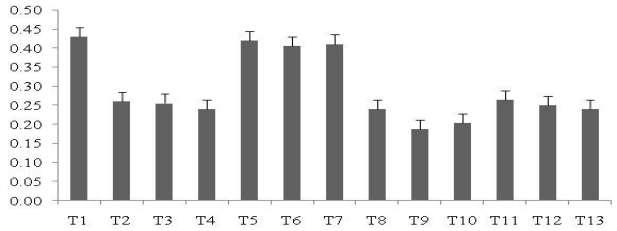

Fig. 2: Effect of chemical spray and pruning levels on Acidity (%)

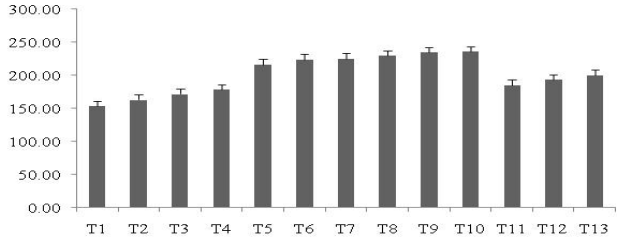

Fig. 3: Effect of chemical spray and pruning levels on Vitamin C (mg/100 g FW)

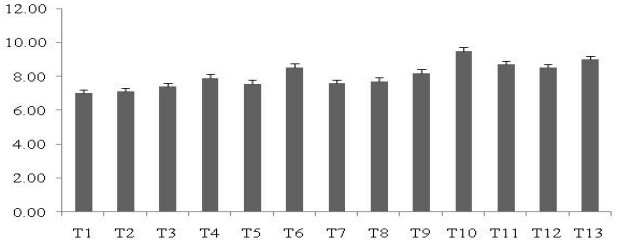

Fig. 4: Effect of chemical spray and pruning levels on Total sugars (%)

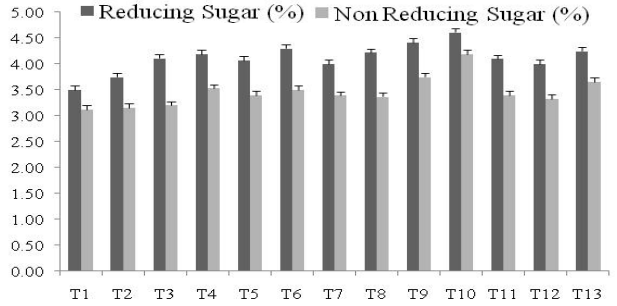

Fig. 5: Effect of chemical spray and pruning levels on Reducing and Non-reducing sugar (%)

The maximum total sugars (9.53 %) recorded in 4.5% KNO_3 followed by (9.03 %) in pruning with 75%. The minimum value for total sugars 7.08 % in T_1 control. Higher fruit quality especially higher sugar content can be explained as potassium plays a major role in carbohydrate synthesis, breakdown and translocation and synthesis of protein and neutralization of physiologically important organic acids (Tisdale and Nelson, 1966). Data indicate the maximum reducing

sugar content (4.65% and 4.46%) in treatment with 4.5% KNO_3 and 3.0 % KNO_3 respectively. In terms of maximum non-reducing sugar (4.53 %) was found in plant treated with 4.5% KNO_3 treatment which was significantly higher than the control. Regarding reducing, non reducing and total sugars data obtained, indicated that reducing, non-reducing and total sugars contents in guava fruits increased significantly as affected by all foliar spray treatments over than that the control. An increase in reducing sugar content with these nutrients may be due to the improvement of photophosphorylation and dark reaction of photosynthesis by potassium and hence resulted in addition of more carbohydrates to the fruits, which results the enhanced accessibility of nutrition for development of fruits and at long last increases the reducing sugar level of fruits. Similar findings have been reported by Bhat *et al.* (2012) in pear fruit cv. Bartlett and Singh *et al*. (2002) in peach cv. Flordasun. These results are also supported with the findings of Akhuat and Yamdagni (1981); Mitra (1987); Ghosh (1994) and Al-Taweel (2001) they reported that total sugars were increased as nitrogen and potassium increased. The probable reason for increase in content of non reducing sugar in fruits with the application of nutrients may be attributed to the hydrolysis of polysaccharides into simpler form, that is, mono and disaccharides and better transportation of nutrients to plant through potassium due to their major role in the transportation of assimilates and other nutrients to the plant from leaves to their place of consumption, which helps to increase accessibility of nutrition and conclusively better quality advancement in term of non reducing sugar content of fruits. These results agree with the earlier records of Kumar *et al.* (1990) in grape cv. Delight, Bhat *et al*. (2009) in pear cv. Bartlett, Kaur and Dhillon (2006) in guava cv. Allahabad Safeda and Elham *et al.* (2007) in apricot cv. Canino.

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