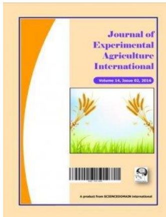

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Role of Pre-harvest Application of Paclobutrazol and Ethephon on Fruit Quality of Winter Guava cv. Sardar

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Authors' contributions

This work was carried out in collaboration between both the authors. Author PS designed the study, wrote the protocol, wrote the first draft of manuscript, managed the analyses of the study and managed the literature searches. Author GK performed the statistical analysis. Both the authors read and approved the final manuscript.

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ABSTRACT

The investigation on the role of pre-harvest application of paclobutrazol and ethephon on fruit quality of winter guava cv. Sardar was conducted in the well-maintained guava orchard of Department of Agriculture, Khalsa College, Amritsar during 2016-2017. The experiment comprised of seven pre-harvest treatments viz. Paclobutrazol @ 250 ppm, 500 ppm, 750 ppm, Ethephon @ 250 ppm, 500 ppm, 750 ppm and control. The experiment was laid out in Randomized Block Design (RBD) with three replications. Results of the study revealed that marked variations were recorded among the pre-harvest treatments on physicochemical characters of guava. Among all treatments, paclobutrazol 750 ppm treated fruits showed maximum fruit size (6.62 cm × 6.40 cm), fruit weight (155.43 g), pulp content (87.4 %) and fruit yield (37.85 kg/plant). Whereas, the fruit bio-chemical characters were improved significantly with the use of ethephon 750 ppm (T_6). Maximum TSS (10.75%), total sugars (7.89%), reducing sugars (5.86%) and ascorbic acid content (194.27

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mg/100 g pulp) was observed under treatment T_6 (Ethephon 750 ppm). Also, the fruits harvested from trees under treatment T_6 (Ethephon 750 ppm) attained excellent fruit colour with minimum seed count.

Keywords: Guava; sardar; physico-chemical characteristics; paclobutrazol; ethephon.

1. INTRODUCTION

Guava (*Psidium guajava* L.) is native to central America and belongs to family Myrtaceae and order Myrtales [1]. It is a tropical fruit but also grows well under sub-tropical conditions. Guava is cultivated on the commercial scale in Mexico, Peru, Egypt, India, South Africa, USA, Brazil and West Indies [2]. Guava fruit is very nutritious being rich in vitamin C (200-300 mg/100 g of pulp). It is also a good source of vitamin A, riboflavin, thiamine and minerals like Calcium, Phosphorus and Iron. The vitamin C content of guava fruit is four-five times higher than the citrus fruit. It is used for making juice, jam, jellies and various culinary purposes [3]. It is a rich source of potassium which is an important component of cell and body fluids that helps in controlling heart rate and blood pressure [2]. Guava trees respond well to canopy modification with respect to vegetative and reproductive growth, modification of canopy through pruning and use of certain plant growth regulators may be required to enhance production efficiency [4]. Plant growth regulators like paclobutrazol and ethephon may be used for this purpose. Paclobutrazol blocks gibberellin biosynthesis and helps in reducing abscisic acid, ethylene and Indole-3 acetic acid, however, it increases the cytokinin levels. Due to blockage of gibberellins, internodal growth reduces to give stout stems, increases root growth, improves the fruit quality and also helps in early fruit setting [5]. Whereas, ethephon acts as a ripening hormone and its mode of action on plants is similar to the influence of hormonal antiauxins and it also releases ethylene. Foliar application of ethephon has proved to be effective in retarding the vegetative growth, improves fruit yield as well as quality [6]. Ethephon advances the fruit ripening by one week and it also enhances the fruit quality in terms of TSS, total sugars and reducing sugars.

2. MATERIALS AND METHODS

The investigation on the role of pre-harvest application of paclobutrazol and ethephon on fruit quality of winter guava cv. Sardar was conducted in a well-maintained guava orchard of Department of Agriculture, Khalsa College, Amritsar during 2016-2017. The trial was conducted on 6 years old uniform vigorous guava trees. The physicochemical analysis was carried out in the laboratory of Department of Agriculture. The experiment was conducted in Randomized Block Design with three replications and seven treatments viz., T_1: Paclobutrazol (PBZ) 250 ppm, T_2: Paclobutrazol 500 ppm, T_3: Paclobutrazol 750 ppm, T_4: Ethephon 250 ppm, T_5: Ethephon 500 ppm, T_6: Ethephon 750 ppm and T_7: Control. Treatments were applied on the trees by spraying the pre-determined concentration of chemicals on flowering stage in the month of August. The whole dose of paclobutrazol was applied during flowering. However, ethephon was supplied in two splits, half of ethephon was sprayed, during august and the rest of the dose was applied one month before harvesting. Knapsack sprayer was used for spraying the chemicals. Fruits were harvested at proper ripened stage (when skin colour of fruits turned dull green to light yellow). Four fruits per replication were used for physicochemical analysis. The fruit length and breadth was measured with the help of Vernier's Caliper, fruit weight with electronic balance, pulp content by calculating pulp and peel weight separately, seeds were calculated by manually counting the seeds with fermentation method, yield per tree was calculated by multiplying the average fruit weight by total number of fruits obtained per tree and fruit colour was obtained with the help of scoring technique by panel of five judges. The total soluble solids (TSS) of fruits was determined with the help of hand refractometer. Sugars and acidity in fruits was calculated by the methods given by [7]. Ascorbic acid was estimated by indophenol dye method.

3. RESULTS AND DISCUSSION

The physicochemical characters of guava fruits were significantly influenced by the pre-harvest application of paclobutrazol and ethephon. It can be seen from the Table (1) that maximum fruit size (6.62 cm × 6.40 cm) was obtained from the fruits treated with paclobutrazol 750 ppm and the minimum was observed in control fruits (6.12 cm ×5.97 cm). The present results are in accordance with [3] in guava and [8] in grapes. Data from Table (1) reveals that maximum fruit weight (155.43 g) was registered in fruits harvested from the trees treated with paclobutrazol 750 ppm, while the trees under control yielded fruits with minimum fruit weight (132.69 g). The results obtained from the study also get support from the findings of [9] in peach, [10] in guava, [11] in mango and [8] in grapes. The plants treated with paclobutrazol 750 ppm recorded the maximum fruit yield (37.85 kg) which was followed by treatment Ethephon 750 ppm with fruit yield of 36.75 kg. Minimum fruit yield (25.86 kg) was noticed under the control treatment. Yield depends upon reserve food materials maintained by the plants. The trees treated with paclobutrazol and ethephon might have less gibberellins and higher photosynthates, while less energy was utilized for vegetative growth and having more energy for flower bud initiation, fruit setting, fruit size and weight which ultimately lead to increase in yield [6]. The present results are in line with the findings of [1,4] in guava, [12] in pomegranate, [13] in litchi and [8] in grapes, [14,15] in guava and [16] in peaches.

Data presented in Table (1) advocates that, the fruits obtained from the trees treated with ethephon 750 ppm attained excellent colour with scoring of 8.67 (pale yellow). The former treatment was found to be at par with treatment of ethephon 500 ppm with similar coloured fruits (8.33). Fruit colour improvement in ethephon may be due to ripening enhancing properties of ethephon [10]. However, the guava trees under control treatment gave light green coloured fruits with the minimum scoring of 6.33. The [17] in peach obtained similar results. The trees under treatment T_3 (paclobutrazol 750 ppm) produced fruits with maximum pulp content (87.40%). Ethephon 750 ppm yielded fruits with 86.80 per cent pulp content and found to be at par with treatment paclobutrazol 500 ppm (86.30%) and the above treatments were found to be significantly superior to rest of the treatments. The increase in pulp content could be attributed to the fact that the plant growth regulators increased the fruit size as well as fruit weight which resulted in high proportion of pulp content. Present findings are in line with the results obtained by [10] in guava and [17] in peach. The least number of seeds (219.33) were extracted from the fruits picked from trees sprayed with the ethephon 750 ppm whereas, maximum number of seeds (312) were extracted from fruits picked from trees under control (T_7). The present results of the investigation are in conformity with the findings of [3,10] in guava.

From the data presented in Table (2) it has been observed that total soluble solids (TSS) in fruits increased significantly with the use of paclobutrazol and ethephon. Maximum TSS (10.75%) was observed in fruits obtained from the trees treated with ethephon 750 ppm (T_6) which was followed by the treatments T_3 (Paclobutrazol 750 ppm) and T_5 (Ethephon 500 ppm) with TSS content of 10.58 and 10.50 per cent respectively. Increase in TSS by ethephon might be due to increase in sugar content by the activation of hydrolytic enzymes which are responsible for the conversion of starch into sugars [6]. Minimum TSS content (9.12%) was noticed under the control (T_7) and found to be at par with treatments T_1 (Paclobutrazol 250 ppm) and T_4 (Ethephon 250 ppm) with TSS content of 9.31 per cent each. The results obtained from the present study are in conformation with findings of [6] in gooseberry, [8] in grapes, [18,10] in guava.

Acid content in fruits was greatly influenced by the application of various concentrations of plant growth regulators as shown in the Table (2). The fruits harvested from trees treated with ethephon 750 ppm contained minimum acidity i.e. 0.46%. The former treatment was found to be statistically at par with the treatments T_3 (Paclobutrazol 750 ppm) and T_5 (Ethephon 500 ppm) with acid contents of 0.50 and 0.49 per cent respectively. A decrease in acid content of fruits by the use of plant growth regulators might be due to the increasing rate of respiration which leads to the conversion of complex substances or acids into simple sugars [19]. While the trees under control (T_7) produced fruits with maximum acidity (0.59%). These observations are also in agreement with the findings of [20] in papaya, [21] in strawberry, [10] in guava.

It is clear from the data presented in Table (2) that all the treatments significantly improved TSS: titratable acidity (TA) ratio over control. Significantly higher TSS: titratable acidity ratio (23.39) was found in fruits harvested from the trees treated with ethephon 750 ppm and it was followed by T_5 (Ethephon 500 ppm) and T_3 (Paclobutrazol 500 ppm) with TSS: titratable acidity ratio of 21.48 and 21.22 respectively. Ethephon 250 ppm recorded the TSS: TA ratio of (17.90) which was at par with paclobutrazol 250 ppm (17.59) and the lowest TSS: TA ratio was observed under the control treatment (15.46).

Results of these findings are also confirmed by [22] in papaya, [8,23] in grapes.

Data shown in the Table (3) reveals that sugars in fruits significantly improved with the use of plant growth regulators than control. Significantly higher total sugars (7.89%) were found in fruits harvested from the trees treated with T_6 (Ethephon 750 ppm). Minimum total sugars (7.07%) were found under the control, which was found to be closely followed by the treatment T_1 (Paclobutrazol 250 ppm) with 7.12 per cent total sugar. Highest percentage (5.86) of reducing sugars were recorded in the fruits treated with ethephon 750 ppm (T_6) while it was closely followed by treatments T_5 (Ethephon 500 ppm) and T_3 (Paclobutrazol 750 ppm) with reducing sugars of 5.81 and 5.61 per cent respectively. Minimum reducing sugars (4.90%) were observed in treatment T_1 (Paclobutrazol 250 ppm) and was found to be statistically at par with the treatments T_7 (5.14%) and T_4 (5.18%). It can be seen from the data that treatments had non-significant effect on non-reducing sugars in fruits. Maximum non reducing sugars (2.26%) were observed in the fruits obtained from trees treated with treatment T_4 (Ethephon 250 ppm). However, minimum non reducing sugars (1.81%) were noticed under treatment T_5. From the given data, it is evident that sugar content of guava fruits was significantly improved with the use of plant growth regulators than control. It seems that paclobutrazol and ethephon might have caused an increase in hydrolytic activities in fruits which may have resulted in increased sugars content in the fruits treated with these treatments. The observations are also in agreement with the findings of [18] in guava, [6] in gooseberry, [24] in phalsa, [20] in papaya.

Ascorbic acid content was greatly influenced by the application of plant growth regulators as shown in the data presented in Table 3. Highest ascorbic acid content (194.27 mg/100 g pulp) was recorded in the fruits obtained from trees treated with treatment T_6 (Ethephon 750 ppm).

Table 1. Role of pre-harvest application of paclobutrazol and ethephon on guava fruit cv. Sardar in the physical characteristics

Treatments	Fruit length (cm)	Fruit breadth (cm)	Fruit weight (g)	Fruit colour	Pulp content (%)	Seed count per fruit	Yield per tree (kg)
T_1 - Paclobutrazol 250 ppm	6.37	6.21	148.25	6.67	85.00	278.33	30.17
T_2 - Paclobutrazol 500 ppm	6.53	6.32	150.64	7.33	86.30	247.67	34.06
T_3 - Paclobutrazol 750 ppm	6.62	6.40	155.43	7.67	87.40	238.97	37.85
T_4 - Ethephon 250 ppm	6.26	6.07	138.73	8.00	84.89	230.67	32.75
T_5 - Ethephon 500 ppm	6.42	6.13	142.21	8.33	85.31	234.00	34.80
T_6 - Ethephon 750 ppm	6.39	6.22	145.32	8.67	86.80	219.33	36.75
T_7 - Control	6.12	5.97	132.69	6.33	84.60	312.00	25.86
Mean	6.39	6.19	144.75	7.57	85.76	251.57	33.18
CD (P=0.05%)	0.11	0.17	6.05	0.61	0.73	NS	1.52

Table 2. Role of various concentrations of paclobutrazol and ethephon on total soluble solids (TSS), titratable acidity (TA) and TSS: TA ratio in fruits of guava cv. Sardar

Treatments	Total soluble solids (%)	Titratable acidity (%)	TSS: TA ratio
T_1 – Paclobutrazol 250 ppm	9.31	0.53	17.59
T_2 – Paclobutrazol 500 ppm	10.22	0.51	20.07
T_3 – Paclobutrazol 750 ppm	10.58	0.50	21.22
T_4 – Ethephon 250 ppm	9.31	0.52	17.90
T_5 – Ethephon 500 ppm	10.50	0.49	21.48
T_6 – Ethephon 750 ppm	10.75	0.46	23.39
T_7 – Control	9.12	0.59	15.46
Mean	9.97	0.51	19.59
CD (P = 0.05%)	0.39	0.04	1.27

Table 3. Role of various concentrations of paclobutrazol and ethephon on sugars and ascorbic acid content of guava cv. Sardar

Treatments	Total sugars (%)	Reducing sugars (%)	Non reducing sugars (%)	Ascorbic acid (mg/100 g pulp)
T_1- Paclobutrazol 250 ppm	7.12	4.90	2.22	181.24
T_2 – Paclobutrazol 500 ppm	7.50	5.53	1.98	184.65
T_3- Paclobutrazol 750 ppm	7.51	5.61	1.90	187.42
T_4- Ethephon 250 ppm	7.44	5.18	2.26	187.14
T_5-Ethephon 500 ppm	7.62	5.81	1.81	191.49
T_6-Ethephon 750 ppm	7.89	5.86	2.03	194.27
T_7- Control	7.07	5.14	1.93	178.99
Mean	7.45	5.53	2.02	186.46
CD (P=0.05%)	0.14	0.42	NS	2.17

The inhibited activity of oxidative enzymes and enhanced photo-phosphorylation may have prolonged the photosynthesizing ability of chlorophyllous leaves and fruits, probably caused by paclobutrazol and ethephon which might have helped in increasing the ascorbic acid content [6]. However, minimum ascorbic acid content (178.99 mg/100 g pulp) was recorded under the control. The present observations are also in agreement with the findings of [10,18] in guava.

4. CONCLUSION

It is concluded from the study that paclobutrazol 750 ppm proved to be the most effective treatment in enhancing fruit physical characters, however, it was closely followed by ethephon 750 ppm. Fruit bio-chemical characters were found to be significantly improved by the use of ethephon 750 ppm. Hence, it has been suggested that ethephon 750 ppm could be used for enhancing the quality characters of guava fruits cv. Sardar.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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