

Original Research Article

Effect of Pre-harvest Application of Paclobutrazol and Ethephon on Physico-chemical Characteristics of Winter Guava cv. Sardar

ABSTRACT

The investigation on effect of pre-harvest application of paclobutrazol and ethephon on physico-chemical characteristics 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 physico- chemical 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 (T₆). Maximum TSS (10.75 %), total sugars (7.89 %), reducing sugars (5.86 %) and ascorbic acid content (194.27 mg/100 g pulp) was observed under treatment T₆. Also the fruits harvested from trees under treatment T₆ 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 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 do well to canopy modification with respect to vegetative and reproductive growth, modification of

canopy through pruning and use of certain growth regulators may be required to enhance production efficiency [4]. 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 while increasing cytokinin levels. Due to blockage of gibberellins, internodal growth is reduced to give stouter stems, increasing root growth and causing early fruit set and also improve fruit quality [5]. Whereas, ethephon acts as a ripening hormone and its mode of action on plants is similar to the influence of hormonal antiauxins and releases ethylene. Foliar application of ethephon has proved to be effective in retarding the vegetative growth and increases the fruit yield as well as quality also improved [6]. Ethephon enhances fruit ripening one week earlier than normal harvesting time. It also improves fruit quality in terms of TSS, total sugars and reducing sugars.

2. MATERIALS AND METHODS

The study was conducted in the 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 fruits were harvested at proper stage of maturity and the 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., T₁: Paclobutrazol 250 ppm, T₂: Paclobutrazol 500 ppm, T₃: 750 ppm, T₄: Ethephon 250 ppm, T₅: Ethephon 500 ppm, T₆: Ethephon 750 ppm and T₇: Control. 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 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 physical characters of guava fruits were significantly influenced by the pre-harvest application of paclobutrazol and ethephon. Maximum fruit size (6.62 cm × 6.40 cm) was obtained from the fruits treated with paclobutrazol 750 ppm and minimum was observed in control fruits (6.12 cm × 5.97 cm). Increase in fruit size and fruit weight with the application of paclobutrazol might be attributed to increased supply of nutrients and photosynthates to

63 developing fruits at the expense of restricted vegetative growth. [8]. The present results are in
64 accordance, [3] in guava and [9] in grapes.

65 Maximum fruit weight (155.43 g) was registered in fruits harvested from the trees treated
66 with paclobutrazol 750 ppm while the trees under control yielded fruits with minimum fruit
67 weight (132.69 g). With the application of paclobutrazol, the vegetative growth was
68 suppressed and the supply of nutrients and photosynthates to the fruits increased surprisingly,
69 by which the fruit weight increased significantly [8]. The results obtained from the study also
70 get support from the findings of [10] in peach, [8] in guava, [11] in mango and [9] in grapes.

71 The fruits obtained from the trees treated with ethephon 750 ppm attained excellent colour
72 with scoring of 8.67 (pale yellow). The former treatment was found to be at par with
73 treatment ethephon 500 ppm with similar coloured fruits (8.33). Fruit colour improvement in
74 ethephon may be due to ripening enhancing properties of ethephon [8]. However the guava
75 trees under control (6.33) gave light green coloured fruits. Similar results were obtained by
76 the [12] in peach.

77 The trees under treatment of paclobutrazol 750 ppm produced fruits with significant pulp
78 content (87.40 %). Ethephon 750 ppm yielded fruits with 86.80 per cent pulp content and
79 found to be at par with treatment paclobutrazol 500 ppm (86.30 %). However the above
80 treatments were found to be significantly superior to rest of the treatments. The increase in
81 pulp content could be attributed to the fact that the growth regulators increased the fruit size
82 as well as fruit weight which resulted in high proportion of pulp content. Present findings are
83 in line with the results obtained by [8] in guava and [12] in peach.

84 The least number of seeds (219.33) were extracted from the fruits picked from trees sprayed
85 with the ethephon 750 ppm whereas maximum number of seeds (312) were extracted from
86 fruits picked from trees under control. The present results of the investigation are in
87 conformity with the findings of [3] and [8] in guava.

88 The plants treated with paclobutrazol 750 ppm recorded the maximum fruit yield (37.85 Kg)
89 which was followed by treatment Ethephon 750 ppm with fruit yield of 36.75 Kg. Minimum
90 fruit yield (25.86 Kg) was noticed under the control treatment. Yield depends upon reserve
91 food materials maintained by the plants. The trees treated with paclobutrazol and ethephon
92 might have less gibberellins and higher photosynthates, while less energy was utilized for
93 vegetative growth and having more energy for flower bud initiation, fruit setting, fruit size
94 and weight which ultimately lead to increase in yield [6]. The present results are in line with

the findings of [1], [4] in guava, [13] in pomegranate, [14] in litchi and [9] in grapes, [15], [16] in guava and [17] in peaches.

From the data it has been observed that total soluble solids 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, [9] in grapes, [18] and [8] in guava.

Acidic content in fruits was greatly influenced by the application of various concentrations of growth regulators. The fruits harvested from trees treated with ethephon 750 ppm contained minimum acidity i.e. 0.46 per cent. 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 acidic contents of 0.50 and 0.49 per cent respectively. Decrease in acidic content of fruits by the use of 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 produced significantly acidic fruits (0.59 %). These observations are also in agreement with the findings of [20] in papaya, [21] in strawberry, [8] in guava.

All the treatments significantly improved TSS: acid ratio over control. Significantly higher TSS: acid 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: acid ratio of 21.48 and 21.22 respectively. Ethephon 250 ppm recorded the TSS: acid ratio of (17.90) which was at par with paclobutrazol 250 ppm (17.59) and the lowest TSS: acid ratio was observed under the control treatment (15.46). Results of these findings are also confirmed by [22] in papaya, [9] and [23] in grapes.

Total sugars in fruits significantly improved with the use of 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 T₁ (Paclobutrazol 250 ppm) with 7.12 per cent total sugar.

Paclobutrazol and ethephon exerted a significant influence on reducing sugars in guava fruits. Highest percentage (5.86 %) of reducing sugars were recorded in the fruits treated with ethephon 750 ppm (T₆) while it was closely followed by treatments T₅ (Ethephon 500 ppm) and T₃ (Paclobutrazol 750 ppm) with reducing sugars of 5.81 and 5.61 per cent respectively. Minimum reducing sugars (4.90 %) were observed in treatment T₁ (Paclobutrazol 250 ppm) and was found to be statistically at par with the treatments T₇ (5.14 %) and T₄ (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 T₄ (Ethephon 250 ppm). However minimum non reducing sugars (1.81 %) were noticed under treatment T₅. From the given data, it is evident that sugar content of guava fruits was significantly improved with the use of growth regulators than control. It seems that paclobutrazol and ethephon might have caused an increase in hydrolytic activities in fruits which 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 [15].

Ascorbic acid content was significantly influenced by the application of growth regulators. Significant ascorbic acid content (194.27 mg/100 g pulp) was recorded in fruits obtained from trees treated with treatment T₆ (Ethephon 750 ppm). The increase in ascorbic acid content might be due to the catalytic influence of the growth substances on the biosynthesis of ascorbic acid from sugars. Inhibited activity of oxidative enzyme and enhanced photo-phosphorylation prolonged the photo synthesizing 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 [8] and [18] in guava.

Table 1 : Effect of pre-harvest application of paclobutrazol and ethephon on fruit physical characteristics of winter guava cv. Sardar

Treatments	Fruit length (cm)	Fruit breadth (cm)	Fruit weight (g)	Fruit colour	Pulp content (%)	Seed count per	Yield per tree
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						fruit	(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

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157 **Table 2 : Effect of various concentrations of paclobutrazol and ethephon on total**
158 **soluble solids , titratable acidity and TSS: acid ratio in fruits of guava cv. Sardar.**

Treatments	Total soluble solids (%)	Titratable acidity (%)	TSS: acid 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

159 **Table 3 : Effect of various concentrations of paclobutrazol and ethephon on sugars and**
160 **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

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 significant by the use of ethephon 750 ppm. Hence it has been suggested that ethephon 750 ppm could be used for improving the quality characters of guava fruits cv. Sardar.

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