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# Studies on Effect of Crop Regulation Practices on Physico-Chemical Attributes and Organoleptic Evaluation of Guava Variety Sardar

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**A B S T R A C T**

Crop regulation treatments in guava like No Pruning ($P_1$- Control), Pruning ($P_2$) and four bio regulators namely NAA 250ppm ($T_2$), Urea 15% ($T_3$), Ethrel 500ppm ($T_4$) and CCC 50ppm ($T_5$) were used to regulate rainy season crop on 10year old L-49 guava plants during the year 2014-2015 at KRC college of Horticulture, Arabhavi (Karnataka). Pruning at 10-20 cm of shoot length proved to be most effective in getting very good quality fruits whereas pruning combined with bio regulators like NAA, Ethrel and Urea found significantly effective on quality parameter as compared to control combination of pruning and ethrel treated ($P_2T_4$). Plants recorded maximum TSS, TSS: acid ratio and minimum titratable acidity. Combination of pruning and urea treated ($P_2T_3$) plants recorded highest percentage of reducing non reducing and total sugars, highest ascorbic acid and pectin content was recorded in pruned plants with 250 ppm NAA treatment ($P_2T_2$) and highest total phenol was recorded in combination of pruning and ethrel treatment ($P_2T_4$). Skin color, color and appearance was not significantly affected by pruning and bio regulators but texture, taste and flavour, overall acceptability was significantly higher than control.

## Introduction

Guava (*Psidium guajava* L.) is one of the most important tropical as well as subtropical fruit crops of the world and is a potential crop of India belongs to the family Myrateace; it was originated in tropical America and then distributed throughout the world. In India, it is ranked as fifth major fruit after Mango, Banana, Citrus and Apple (Anonymous, 2004). It is usually known as the poor man's fruit or apple of the tropics. Guava is one of the attractive fruit in appearance, shape, fragrance and nutrition. Depending on cultivars, it contains four times more ascorbic acid than orange (over 200 mg 100-1g) and generally a broad low-calorie profile of essential nutrients (Adrees *et al.*, 2010; Hassimotto *et al.*, 2005; Swain and Padhi, 2012). Its seeds provide omega-3 and omega-6 polyunsaturated fatty acids and especially high levels of dietary fiber (Anon., 2009). It contains carotenoids and polyphenols which are the major classes of dietary antioxidant pigments among plant foods (Hassimotto *et al.*, 2005; Jimenez-Escrig *et al.*, 2001). Due to their astringent properties, mature guava fruits, leaves, roots and bark are used in local medicines to treat gastroenteritis, asthma, high blood pressure, obesity and diarrhea (Joseph and Priya, 2011). Its cultivation in India isas early as 17th century (Mitra and Bose, 1990). In subtropical climate, three distinct periods of flowering and fruiting are found in the guava. These three distinct periods are Ambebahar (February to March flowering and fruit ripens in July- August), Mrigbahar (June to July flowering and fruit ripens in October to December) and Hasta bahar (October to November flowering and fruit ripens in February to April) (Shukla *et al.,* 2008). The heaviest flowering has always been obtained in summer season. Because the food reserved is already exhausted in flowering and vegetative growth during summer, the rainy season flowering for the winter crop is always less but winter season crop is preferred because of its superior quality as compared to monsoon crop (Pandey *et al.,* 1980). Moreover, rainy season fruits are small in size, inferior in quality due to temperature and humidity leads to highly susceptible to pest and disease infestation. The best remedy to this problem would be to eliminate the rainy season crop and thereby to induce a good winter crop. There were earlier works in this line by avoiding monsoon crop through shoot pruning, hand deblossoming, foliar sprays of urea and growth regulators at full bloom and pre bloom stages which correspondingly induce a reasonably good winter season crop (Singh *et al.,* 1992; Lal *et al.,* 2000; Tiwari and Lal, 2007). The present investigation is an attempt to standardize a crop regulation technique with 10-20cm shoot pruning and sprays of different bio regulators at 50% flowering stage during rainy season crop.

## Materials and Methods

The present investigation was conducted during the year 2014-2015 at Kittur Rani Channamma College of Horticulture, Arabhavi (University of Horticultural Sciences, Bagalkot), Gokak taluk of Belgaum district, Karnataka. The experimental material consisted of ten- year-old uniform trees of guava variety Sardar. The treatment consisted of two pruning levels, i.e. no pruning (P1), pruning (P2) and four bio regulators treatment, i.e. control = T1, NAA 250 ppm = T2, Urea 15% = T3, Ethrel 500 ppm = T4 and Cycocel 50 ppm = T5 all treatments were applied as foliar spray at 50% flowering stage. There were ten treatment combinations each replicated four times in factorial randomized block design. Shoot pruning of current season's growth was done at 10-20 cm of shoot length. It was performed in the first week of May. The data on physico-chemical parameters of fruits were recorded. Physical and chemical parameters of fruits were determined using to average size fruits collected randomly from each replication. The TSS (0 Brix) was determined with the help of a hand refractometer. Ascorbic acid and acidity were analyzed by using the standard method recommended by A.O.A.C. (1990). The TSS: Acid ratio was calculated by dividing TSS by the corresponding Titratable acidity value. Total sugars and reducing sugars content were determined by using DNSA method (Miller, 1972), non-reducing sugar was obtained by subtracting reducing sugar from the amount of total sugar and multiplying the resultant by factor 0.95 as given below (Somogyi, 1952). Pectin content was determined in fruit tissue calcium pectate method (Ranganna, 1977). Phenols were estimated as per the Folin Ciocatteau Reagent (FCR) method (Bray and Thorpe, 1954) and expressed as mg per 100 g. Organoleptic evaluation by 10 panelists was carried out using the nine-point hedonic scale described by Peryam and Pilgrim (1957), Statistical analysis was performed using web agri stat package (WASP) Version 2.0 (Jangam and Thali, 2010).

## Results and Discussion

The results obtained from the present investigation are summarized below:

**Effect of pruning and bio regulator treatment on quality parameters in guava**

Even though significant differences were noted for fruit quality parameters, the variations among the treatments were very narrow. The total soluble solids (TSS) of fruits influenced non-significantly and TSS to Acid ratio influenced significantly by pruning and maximum value was recorded in $P_2$ (10.34 and 30.41) respectively. These are in the same line with the results recorded by Singh and Singh (2001). Singh and Bal (2006) reported higher TSS in plants pruned at 10- 20cm. Bio regulator treatment had a significant effect on both TSS and TSS to acid ratio values of fruits; the highest value was recorded in $T_4$. The increase in TSS, due to application of ethrel in the present investigation might be because of its action on converting complex substances (starch) into simpler ones (sugars) through higher respiration and carbon assimilation activity (Yadav *et al.*, 2001). The results are in line with the findings of Jain and Dashora (2010), Brar *et al.*, (2012) in guava. Their interaction showed non-significant difference for TSS but significant differences for TSS to acid ratio whereas highest value for both the parameter in $P_2T_4$ (13.00 and 44.10) respectively (Table 1 and Fig. 1).

The trend of results of present investigations with respect to titratable acidity as influenced by pruning showed significant differences. The interpretation of results indicated that the titratable acidity was considerably high (0.40%) in unpruned plants compared to pruned plants. These findings are agreement with Singh and Bal (2006) who reported lowest acidity in pruned plants at 6 x5m spacing. With respect to bio regulator treatment, there was a significant effect observed. Maximum titratable acidity of 0.45 % was recorded in $T_1$. The interaction effect revealed significant differences for titratable acidity, High values for titratable acidity (0.48) was recorded in $P_1T_1$ treatment combination. Similarly, Mohammod *et al.*, (2006), Brar *et al.*, (2012), Jain and Dashora (2010) also reported maximum acidity in control.

The data pertaining to the reducing, non-reducing and total sugar as influenced by pruning revealed significant differences. Plants under gone pruning have recorded maximum values for reducing, non-reducing and total sugar (4.36 %, 3.28% and 7.63% respectively). These results are in close conformity with the findings of Ali *et al.*, (2014) and Lakpathi *et al.*, (2013). The interpretation of data related to bio regulator treatment on reducing, non-reducing and total sugar was found to be significantly higher in plants that were treated with urea. This might be due to the fact that nitrogen promotes hydrolysis of starch into sugars and application of foliar urea might increase the concentration of polyamines in the plant leaf tissues, which help in attracting more minerals and assimilates into the fruit tissues, there by increases the TSS. Kundu and Mitra (1997) and Singh *et al.*, (2002) also observed the similar results. These results are in close conformity with the findings of Jat and Kacha (2014), Mohammed *et al.*, (2006) and Dwivedi *et al.*, (1990). Improvement in the quality of fruit by urea spray was observed by Rajput *et al.*, (1986). Interactions revealed non-significant differences, although the plants pruned and sprayed with urea recorded maximum (5.34, 4.43 and 9.77) reducing, non-reducing and total sugars respectively (Table 2).

The ascorbic acid content also recorded significant difference with respect to time of pruning. Maximum ascorbic acid (191.84 mg/100 g) was recorded in $P_2$. These results are supported by Singh and Reddy (1997), Singh and Dhaliwal (2004), Dhaliwal and Kaur (2003), Singh and Singh (2001).

**Plate.1** Organoleptic evaluation of guava fruits

**Fig.1** Effect of pruning and bio regulators on quality parameters of guava

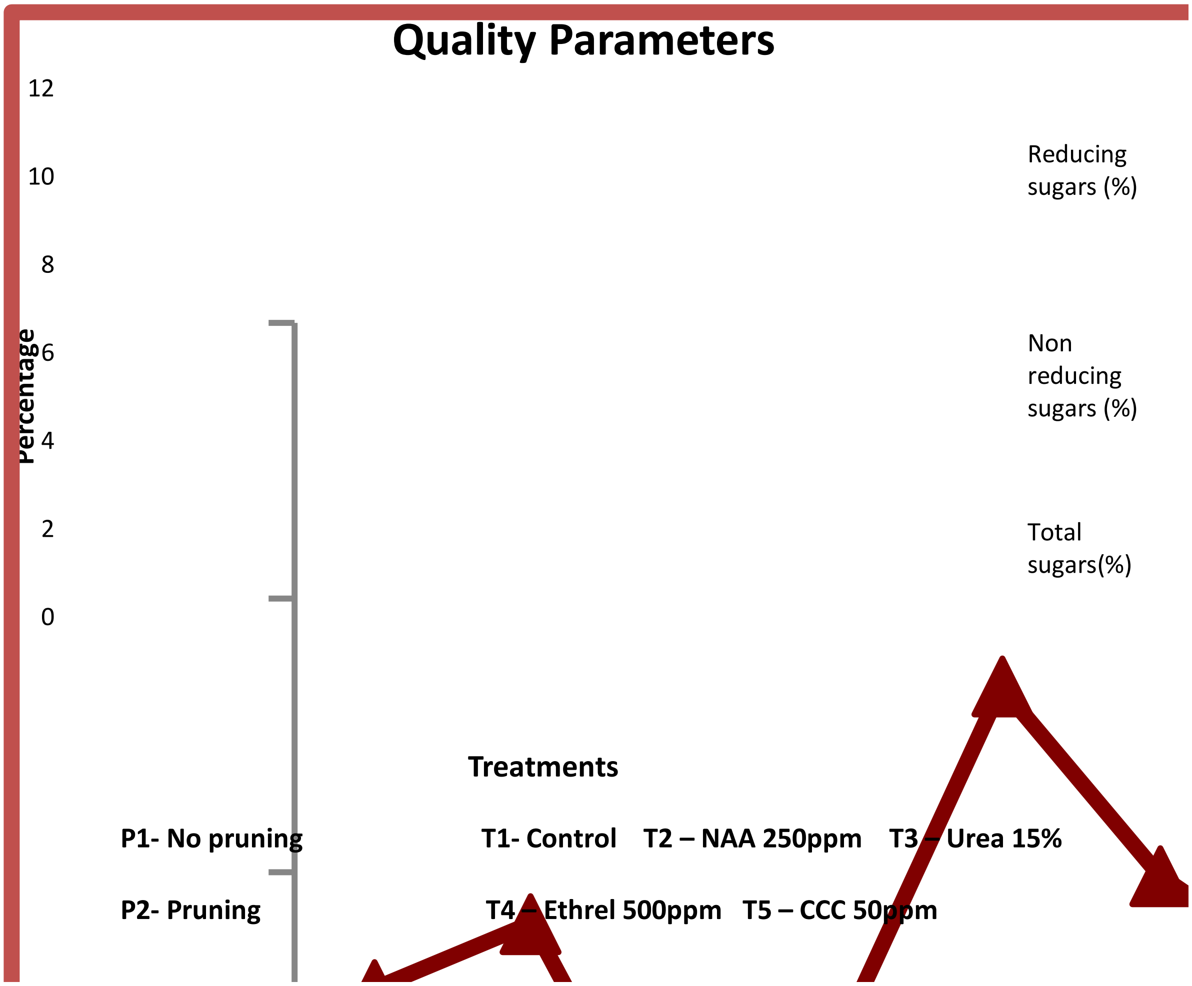

**Table.1** Effect of pruning and bio regulators on TSS and titratable acidity of guava fruits

| Treatments | TSS ˚B | Titratable acidity (%) | TSS: Acid Ratio |
|---|---|---|---|
| **Pruning** | | | |
| **$P_1$ (No pruning)** | 10.22 | 0.40 | 26.00 |
| **$P_2$ (Pruning)** | 10.34 | 0.36 | 30.41 |
| **S.Em±** | 0.19 | 0.01 | 1.21 |
| **CD at 5%** | NS | 0.03 | 3.5 |
| **Bio regulator treatments** | | | |
| **$T_1$ (Control)** | 09.45 | 0.45 | 21.31 |
| **$T_2$ (NAA 250 ppm)** | 10.59 | 0.38 | 27.63 |
| **$T_3$ (Urea 15%)** | 10.00 | 0.33 | 30.68 |
| **$T_4$ (Ethrel 500 ppm)** | 11.10 | 0.34 | 35.61 |
| **$T_5$ (Cycocel 50 ppm)** | 10.26 | 0.40 | 25.81 |
| **S.Em±** | 0.30 | 0.02 | 1.91 |
| **CD at 5%** | 0.85 | 0.05 | 5.55 |
| **Interactions** | | | |
| **$P_1T_1$** | 09.13 | 0.48 | 19.18 |
| **$P_1T_2$** | 10.63 | 0.40 | 26.87 |
| **$P_1T_3$** | 10.00 | 0.32 | 31.00 |
| **$P_1T_4$** | 10.95 | 0.41 | 27.11 |
| **$P_1T_5$** | 10.40 | 0.40 | 25.85 |
| **$P_2T_1$** | 10.08 | 0.41 | 23.45 |
| **$P_2T_2$** | 12.05 | 0.38 | 28.39 |
| **$P_2T_3$** | 10.63 | 0.34 | 30.33 |
| **$P_2T_4$** | 13.00 | 0.28 | 44.10 |
| **$P_2T_5$** | 11.58 | 0.40 | 25.78 |
| **S.Em±** | 0.41 | 0.02 | 2.70 |
| **CD at 5%** | NS | 0.07 | 7.85 |
| **CV (%)** | 8.05 | 12.37 | 19.20 |

Pruning followed at 10-20 cm of shoot length
NS – Non-significant

**Table.2** Effect of pruning and bio regulators on biochemical parameters of guava

| Treatments | Total sugars (%) | Reducing sugars (%) | Non-reducing sugars (%) |
|---|---|---|---|
| **Pruning** | | | |
| **$P_1$ (No pruning)** | 7.15 | 4.09 | 3.06 |
| **$P_2$ (Pruning)** | 7.63 | 4.36 | 3.28 |
| **S.Em±** | 0.11 | 0.08 | 0.08 |
| **CD at 5%** | 0.31 | 0.23 | 0.22 |
| **Bio regulator treatments** | | | |
| **$T_1$ (Control)** | 5.51 | 3.14 | 2.37 |
| **$T_2$ (NAA 250 ppm)** | 6.90 | 4.23 | 2.66 |
| **$T_3$ (Urea 15%)** | 9.35 | 4.99 | 4.36 |
| **$T_4$ (Ethrel 500 ppm)** | 7.98 | 4.51 | 3.47 |
| **$T_5$ (Cycocel 50 ppm)** | 7.20 | 4.22 | 2.99 |
| **S.Em±** | 0.17 | 0.13 | 0.12 |
| **CD at 5%** | 0.49 | 0.37 | 0.35 |
| **Interactions** | | | |
| **$P_1T_1$** | 5.30 | 3.03 | 2.27 |
| **$P_1T_2$** | 6.68 | 4.16 | 2.52 |
| **$P_1T_3$** | 8.94 | 4.65 | 4.30 |
| **$P_1T_4$** | 7.77 | 4.46 | 3.31 |
| **$P_1T_5$** | 7.06 | 4.15 | 2.91 |
| **$P_2T_1$** | 5.73 | 3.26 | 2.47 |
| **$P_2T_2$** | 7.13 | 4.32 | 2.81 |
| **$P_2T_3$** | 9.77 | 5.34 | 4.43 |
| **$P_2T_4$** | 8.20 | 4.57 | 3.63 |
| **$P_2T_5$** | 7.35 | 4.29 | 3.06 |
| **S.Em±** | 0.24 | 0.18 | 0.17 |
| **CD at 5%** | NS | NS | NS |
| **CV (%)** | 6.41 | 8.54 | 10.62 |

Pruning followed at 10-20 cm of shoot length
NS- Non-significant

**Table.3** Effect of pruning and bio regulators on ascorbic acid, total phenol and Pectin content of guava

| Treatments | Ascorbic acid (mg/100g) | Total phenol mg/100g | Pectin content (%) |
|---|---|---|---|
| **Pruning** | | | |
| **$P_1$ (No pruning)** | 152.76 | 154.25 | 0.67 |
| **$P_2$ (Pruning)** | 191.84 | 130.20 | 0.70 |
| **S.Em±** | 5.34 | 2.61 | 0.01 |
| **CD at 5%** | 15.50 | 7.58 | 0.02 |
| **Bio regulator treatments** | | | |
| **$T_1$ (Control)** | 136.67 | 137.75 | 0.56 |
| **$T_2$ (NAA 250 ppm)** | 205.33 | 132.87 | 0.81 |
| **$T_3$ (Urea 15%)** | 181.32 | 139.63 | 0.65 |
| **$T_4$ (Ethrel 500 ppm)** | 170.62 | 152.62 | 0.67 |
| **$T_5$ (Cycocel 50 ppm)** | 167.58 | 148.25 | 0.74 |
| **S.Em±** | 8.45 | 4.13 | 0.01 |
| **CD at 5%** | 24.51 | 11.99 | 0.04 |
| **Interactions** | | | |
| **$P_1T_1$** | 136.25 | 143.75 | 0.57 |
| **$P_1T_2$** | 195.67 | 136.00 | 0.78 |
| **$P_1T_3$** | 148.50 | 159.00 | 0.60 |
| **$P_1T_4$** | 146.25 | 170.00 | 0.65 |
| **$P_1T_5$** | 137.16 | 162.50 | 0.75 |
| **$P_2T_1$** | 137.05 | 131.75 | 0.55 |
| **$P_2T_2$** | 215.00 | 129.75 | 0.84 |
| **$4P_2T_3$** | 214.14 | 120.25 | 0.70 |
| **$P_2T_4$** | 195.00 | 135.25 | 0.70 |
| **$P_2T_5$** | 198.00 | 134.00 | 0.73 |
| **S.Em±** | 11.95 | 5.84 | 0.02 |
| **CD at 5%** | 34.66 | 16.96 | 0.06 |
| **CV (%)** | 13.87 | 8.22 | 5.53 |

Pruning followed at 10-20 cm of shoot length

**Table.4** Effect of pruning and bio regulators on organoleptic evaluation of guava fruits

| Treatments | Skin colour | Colour& appearance | Texture | Taste &flavour | Overall acceptability |
|---|---|---|---|---|---|
| **Pruning** | | | | | |
| **$P_1$ (No pruning)** | 6.67 | 7.03 | 7.02 | 6.73 | 6.78 |
| **$P_2$ (Pruning)** | 7.54 | 7.98 | 7.83 | 7.46 | 7.53 |
| **S.Em±** | 0.41 | 0.30 | 0.20 | 0.20 | 0.17 |
| **CD at 5%** | NS | 0.93 | 0.62 | 0.62 | 0.53 |
| **Bio regulator treatments** | | | | | |
| **$T_1$ (Control)** | 7.06 | 7.48 | 6.91 | 6.55 | 6.50 |
| **$T_2$ (NAA 250 ppm)** | 7.05 | 8.03 | 7.11 | 7.30 | 7.74 |
| **$T_3$ (Urea 15%)** | 7.08 | 7.13 | 6.19 | 6.30 | 6.70 |
| **$T_4$ (Ethrel 500 ppm)** | 7.00 | 7.30 | 8.63 | 7.39 | 6.75 |
| **$T_5$ (Cycocel 50 ppm)** | 7.33 | 7.58 | 8.28 | 7.93 | 8.08 |
| **S.Em±** | 0.64 | 0.48 | 0.32 | 0.32 | 0.27 |
| **CD at 5%** | NS | NS | 0.98 | 0.98 | 0.84 |
| **Interactions** | | | | | |
| **$P_1T_1$** | 6.25 | 7.00 | 6.25 | 6.58 | 6.00 |
| **$P_1T_2$** | 6.00 | 7.25 | 6.00 | 6.10 | 6.58 |
| **$P_1T_3$** | 7.15 | 6.50 | 5.55 | 6.58 | 6.83 |
| **$P_1T_4$** | 6.00 | 6.80 | 8.75 | 6.53 | 6.50 |
| **$P_1T_5$** | 7.65 | 7.58 | 8.55 | 7.85 | 8.00 |
| **$P_2T_1$** | 7.60 | 7.95 | 7.58 | 6.53 | 7.00 |
| **$P_2T_2$** | 8.10 | 8.80 | 8.23 | 8.50 | 8.90 |
| **$P_2T_3$** | 7.00 | 7.75 | 6.83 | 6.03 | 6.58 |
| **$P_2T_4$** | 8.00 | 7.80 | 8.50 | 8.25 | 7.00 |
| **$P_2T_5$** | 7.00 | 7.58 | 8.00 | 8.00 | 8.15 |
| **S.Em±** | 0.91 | 0.68 | 0.45 | 0.45 | 0.39 |
| **CD at 5%** | NS | NS | 1.38 | 1.39 | 1.19 |
| **CV (%)** | 27.20 | 19.27 | 12.77 | 12.06 | 11.43 |

Pruning followed at 10-20 cm of shoot length
NS – Non-significant

Significant variation was found in ascorbic acid content among the bio regulators and interaction (Table 3). Ascorbic acid content recorded higher (205 mg/100g) in fruits collected from NAA treated plants. Interaction revealed significantly high values for ascorbic acid content in fruits collected from plants under $P_2T_2$ treatment. The results are in line with the findings of Jain and Dashora (2010) in guava and results are contrary with findings of Mohammed *et al.*, (2006) who reported higher ascorbic acid in urea 15%.

The maximum total phenol as influenced by pruning was observed in $P_1$ (154.25). Significantly maximum values for total phenol (152.62) as influenced by bio regulator recorded in ethrel treatment. Among the interaction, the maximum value for total phenol (170) was observed with $P_1T_4$ treatment combination.

The data related to pectin content by pruning highlighted significant effect. Maximum pectin content was recorded in $P_2$ (0.70). The pectin content as influenced by bio regulator treatment recorded higher values in plants sprayed with NAA (Table 3). The data on interaction highlighted higher values for pectin content in the treatment combination of $P_2T_2$ (0.84). The results are in line with the findings of Jain and Dashora (2010), Dubey *et al.,* (2002) in guava. On the contrary Mohammed *et al.,* (2006) and Agnihotri *et al.,* (2013) reported high pectin in urea 15% treatment.

## Effect of pruning and bio regulator treatment on organoleptic evaluation in guava (Table 4 and Plate 1)

The trend of results of present investigation with respect to organoleptic properties as influenced by pruning showed significant differences with respect to colour and appearance of pulp, taste and flavor, texture, and overall acceptability. While for skin colour, non- significant difference was observed (Plate 5). The interpretation of results indicated that all the above mentioned organoleptic properties were considerably high in pruned plants compared to unpruned plants. These findings are agreement with Singh and Bal (2006) who reported more palatability rating in 10-20 cm pruned trees compared to un pruned trees.

With respect to bio regulator treatment, significant difference was observed in case of taste and flavour, texture and overall acceptability. Maximum texture score of 8.63 was recorded in $T_4$, the results obtained are in line with those findings of Jain and Dashora (2010), Singh and Bal (2006) and Brar *et al.,* (2012) in guava who obtained maximum palatability rating of guava fruits with ethrel 1000 ppm (8.01) followed by ethrel 500 ppm (8.09). Whereas highest score for taste and flavor (7.93) was observed in $T_5$ then overall acceptability score was also high (8.08) in $T_5$. Non-significant difference was observed in bio regulator treatment with respect to skin colour and pulp colour and appearance.

The interaction effect revealed non-significant differences for skin colour and pulp colour and appearance, while significant difference was observed for taste and flavor, texture and overall acceptability. A high value for texture (8.75) was recorded in $P_1T_4$ treatment combination. These results are in close conformity with the findings of Singh and Bal (2006), Jain and Dashora (2010). Similarly, maximum score for taste and flavor and overall acceptability was noticed in the $P_2T_2$ combination.

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