International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2020; 8(1): 1839-1844
© 2020 IJCS
Received: 10-11-2019
Accepted: 12-12-2019

**Ravindra Kumar**
Department of Horticulture (Fruit and Fruit Technology), Bihar Agricultural University, Sabour, Bhagalpur, Bihar, India

**Amit Raj**
Department of Horticulture (Fruit and Fruit Technology), Bihar Agricultural University, Sabour, Bhagalpur, Bihar, India

**SN Roy**
Department of Entomology, Bihar Agricultural University, Sabour, Bhagalpur, Bihar, India

**Sanjay Sahay**
Department of Horticulture (Fruit and Fruit Technology), Bihar Agricultural University, Sabour, Bhagalpur, Bihar, India

**Samik Sengupta**
Department of Horticulture (Fruit and Fruit Technology), Bihar Agricultural University, Sabour, Bhagalpur, Bihar, India

**KP Singh**
KVK, Katihar, Bihar Agricultural University, Sabour, Bhagalpur, Bihar, India

**Chanda Kushwaha**
Department of Plant Pathology, Bihar Agricultural University, Sabour, Bhagalpur, Bihar, India

**Corresponding Author:**
Department of Horticulture (Fruit and Fruit Technology), Bihar Agricultural University, Sabour, Bhagalpur, Bihar, India

# Effect of paclobutrazol and pruning on plant growth and yield of mango (*Mangifera indica* L.) cv. Langra

**Ravindra Kumar, Amit Raj, SN Roy, Sanjay Sahay, Samik Sengupta, KP Singh and Chanda Kushwaha**

**DOI:** https://doi.org/10.22271/chemi.2020.v8.i1aa.8531

**Abstract**
The optimum use of paclobutrazol is a tool to enable the trees to produce shorter canopy with increased fruit yield during off-season. So, keeping this view the experiment was conducted to study the effect of paclobutrazol and pruning on plant growth and yield of mango (*Mangifera indica* L.) cv. Langra at experimental area of BAU, Sabour, Bhagalpur, Bihar, India during the two successive seasons 2015 and 2016. The experiment included seven treatments combinations in three replications. The paclobutrazol @ of 1.5 g a.i. per tree was applied in soil drench of mango cv. Langra in March for first year and October for second. The minimum vegetative growth and maximum fruit yield was observed in the pruning method which was soil drenched with paclobutrazol. Thus, light pruning with application of paclobutrazol is able to restrict the canopy growth with enhanced fruit production during the off-season of mango.

**Keywords:** Paclobutrazol, pruning, plant growth, yield, mango

## Introduction
Mango (*Mangifera indica* L.) cv. Langra is the most popular and widely growing fruit crop in Northern India. Old orchards and biennial bearing habit are the major cause of low productivity and poor income of the mango growers of cv. Langra. Most of orchards in mango growing areas are very old and they are not scientifically managed. As a result of overcrowded branchlets and dense canopy restrict the entrance of sun ray and air in the inner side of canopy. This unproductive canopy growth can be managed by pruning and thinning and use of growth regulators like paclobutrazol. So, rejuvenation with application of paclobutrazol in old and senile orchards has become the need of the day to solve the problem of lower production and biennial bearing through pruning technology.

Paclobutrazol, the growth retardants act as inhibitors of mono-oxygenases catalyzing the oxidative steps from ent-kaurene to ent-kaurenoic acid of biosynthesis path way of Gibberellic Acid (Rademacher, 2000) [1]. The optimum use of paclobutrazol boost up early flowering and also enable the trees to produce shorter canopy with more number of hermaphrodite flowers which results in higher fruit set during off-season.

Paclobutrazol is eco-friendly and nontoxic, can safely be used in crop fields having various influential roles in physiological system of mango plants is well known, but is unknown or little known about its effects on different seasonal fractions (Pal *et al*, 2017) [2].

Hence, the present investigation was conducted to study the effect of paclobutrazol and pruning on plant growth and yield of mango (*Mangifera indica* L.) cv. Langra.

## Materials and Methods
The present investigation was carried out under the Experimental Area of Bihar Agricultural University, Sabour, Bhagalpur, Bihar, India on mango cv. Langra during two successive seasons (2015-2016). The 45 years old mango tree with spacing 10 m × 12 m was selected to conduct the experiment. The experimental plot had well drained sandy loam soil of good fertility with leveled surface. The experiment included seven (including one control) treatment combinations in three replications.

The treatment combination were $T_1$($M_1P_0$: heading back up to secondary branch let without paclobutrazol), $T_2$ ($M_1P_1$: heading back up to secondary branch let with application of paclobutrazol), $T_3$($M_2P_0$ : heading back up to tertiary branch let without paclobutrazol), $T_4$($M_2P_1$:heading back up to tertiary branch let with application of paclobutrazol), $T_5$($M_3P_0$ :heading back up to the crowded branch let and centre opening without paclobutrazol), $T_6$($M_3P_1$:heading back up to the crowded branch let and centre opening with application of paclobutrazol), $T_7$($M_0P_0$: No pruning and without use of paclobutrazol, Control) in Randomized Block Design. When trees were in dormant stage during the December-January, it was pruned for central opening. Heading back up to secondary branch let was practiced at the height of 4 m and tertiary branch let at 6 m above the ground level in both set of pruning system. Heading back up to crowded branch let and centre opening included removal of the centre canopy and thinning of unproductive branches of the tree was also done to maintain same height of plant and similar canopy with or without application of paclobutrazol. Immediately after pruning, paste of copper oxychloride was applied on cut surface of the branched. Recommended dose of the fertilizers and irrigation was given after the pruning. Soil drenching of paclobutrazol was done in March for first year and October for second year by dissolving required quantity of paclobutrazol @ of 1.5 g a.i. (gram active ingredient) per tree in 10-15 liters of water and this solution was poured in the root zone. Observations were recorded on growth, yield and quality characters.

**Method of observation**

**Plant height**

Plant height was measured with a measuring bamboo stick from ground level to terminal shoot of the plant.

**Plant spread**

Plant spread was measured as its widest part from leaf tip to leaf tip in cross wise East-West and North- South of the canopy by a measuring tape.

**Internodal Length**

Terminal shoot at the time of bud break was selected for measuring of internodal length and second or third node from apex of the shoot was measured by the help of slide calipers.

**Annual shoot growth**

Terminal shoot just before bud break was selected for annual shoot growth and measured by measuring scale.

**Number of fruits per plant**

Number of fruits per plant was counted at full maturity of fruits at the time of harvesting.

**Fruit weight**

Immediately after the harvest of the matured fruit, stalk was removed and randomly 10 fruits were weighed and average fruit was calculated in grams.

**Fruit yield per tree**

Total numbers of fruit per plant was multiplied by average fruit weight and calculated it kg per tree.

**Fruit Length**

The length of fruit from stalk end to apex of the fruit was determined at harvest stage with the help of vernier caliper and expressed in centimeters.

**Fruit Breadth**

The breadth of fruit was determined as the maximum linear distance between two shoulders of the fruit with the help of vernier caliper and expressed in centimeters.

**Peel weight**

The ripened fruits were peeled off using a knife and weight of the peel was recorded in grams. The percentage peel weight to that of total weight of fruit was also computed.

**Stone weight**

The stones of ripe mango fruits were separated from the pulp and their weight was recorded in grams. The percentage weight of stone to that of total weight of fruit was also calculated.

**Pulp weight**

The mango pulp from the ripe fruits was separated from the peel and the stone and the weight was expressed in grams. The percentage weight of pulp to that of total weight of fruit was also computed.

**Results and Discussion**

The results obtained from the present investigation have been discussed under the following heads:

**(a) Plant height (m), Plant spread (m), Internodal length (cm), Annual shoot growth (cm)**

The data presented in Table-1, clearly indicates that the application of paclobutrazol @ 1.5 g a.i. (gram active ingredient) per tree in 10-15 liters of water significantly minimized the plant height (m), plant spread (m), internodal length (cm), annual shoot growth (cm) in both years (2015 and 2016) as compared to without use of paclobutrazol including control in all methods of pruning. The plant height of 4.40 m and 4.93 m in $T_2$ ($M_2P_1$-heading back up to secondary branchlet), $T_4$ ($M_4P_1$-heading back up to tertiary branchlet) of 4.60m and 5.27 m and in $T_6$ ($M_6P_1$-heading back up to the crowded branchlet and centre opening) of 7.86 m and 8.27m with addition of paclobutrazol during both the years (2015 and 2016 respectively) was found significantly minimum in comparison to different methods of pruning without application of paclobutrazol and control. The pooled data of both years (2015 and 2016) also showed the minimum plant height of 4.67 m in $T_2$ ($M_2P_1$-heading back up to secondary branch let), 4.93 m in $T_4$ ($M_4P_1$-heading back up to tertiary branch let) and 8.06 m in $T_6$ ($M_6$ $P_1$-heading back up to the crowded branchlet and centre opening) with use of paclobutrazol than the other set of treatments including control.

Plant spread in both direction East-West and North- South was observed minimum in all methods of pruning with application of paclobutrazol. The canopy spread in East-West direction for the year 2015, 2016 and pooled over both the years was noticed minimum of 2.38m, 4,10 m and 3.24 m was registered by the use of paclobutrazol in the treatment $T_2$ ($M_2P_1$- heading back up to secondary branch let), 4.30 m, 4.83 m and 4.57 m in $T_4$ ($M_4P_1$-heading back up to tertiary branch let) and 8.26, 9.37 and 8.81m in $T_6$ ($M_6P_1$-heading back up to the crowded branch let) and centre opening) respectively. Whereas; the canopy spread in North-South direction was also recorded minimum in the pruning methods, which was treated with the paclobutrazol. In this respect minimum canopy spared of 2.60m, 3.77m and 3.19 m in $T_2$ ($M_2P_1$-heading back up to secondary branch let, 3.40 m, 5.33 m and 4.37 m in $T_4$

($M_4P_1$-heading back up to tertiary branch let) and 8.81m, 8.96 m and 9.67 m in $T_6$ ($M_6P_1$-heading back up to the crowded branch let) and centre opening) was noted in the year 2015, 2016 and pooled over the both years respectively.

Internodal length of the terminal shoot was also noted minimum in the treatment which was treated with paclobutrazol. The internodal length of 1.57cm, 1.41cm and 1.49cm was observed in the treatment $T_2$ ($M_2P_1$- heading back up to secondary branchlet), 1.80 cm, 1.56 cm and 1.68 cm in $T_4$ ($M_4P_1$-heading back up to tertiary branchlet) and 1.46 cm, 1.37 cm and 1.42 cm in $T_6$($M_6P_1$- heading back up to the crowded branchlet and centre opening) was observed minimum in the pruning system which was treated with paclobutrazol for the both years and pooled data of the years 2015 and 2016 respectively in comparison to pruning system without use of paclobutrazol including control.

The annual shoot growth was restricted by the application of paclobutrazol. The treated tree of paclobutrazol showed the less shoot growth than the untreated tree including control during the years 2015 and 2016 and pooled data of both years in the treatment $T_2$ ($M_2P_1$-heading back up to secondary branchlet) with value of 9.26 cm, 8.52 cm and 8.89 cm, in the treatment $T_4$ ($M_4P_1$-heading back up to tertiary branchlet) with value of 8.89 cm, 7.47 cm and 8.81 cm and in $T_6$ ($M_6P_1$-heading back up to the crowded branch let and centre opening) with value of 9.36 cm, 6.74 cm and 8.05 cm respectively.

Thus, paclobutrazol minimize the plant height, canopy spread, internodal length and annual shoot growth. This might be due to gibberellic acid suppressing nature of paclobutrazol. It is known gibberellins promote cell elongation (Murti *et al.* 2001) [3]. Kurian and Iyer (1992) [4] reported paclobutrazol enhance the total phenolics content of terminal buds and take part in change of phloem to xylem ratio of the stem, which is restricting the vegetative growth and promoting flowering by altering assimilate partitioning and patterns of nutrient supply for new growth. According to Shinde *et al.* (2015) [5] vegetative growth of the plant was suppressed significantly by the application of paclobutrazol.

**(b) Number of fruits per plant, Fruit weight (g), Fruit yields (kg/tree)**

It is evident from Fig.-2 that the application of paclobutrazol significantly enhanced the numbers of fruits per plant, fruit weight and ultimately fruit yield per tree in both the years (2015 and 2016) in comparison to untreated pruning tree including control. The 8.00 and 28.67 fruits per tree in treatment $T_2$($M_2P_1$- heading back up to secondary branchlet), 67.67 and 147.67 fruits per tree in $T_4$ ($M_4P_1$- heading back up to tertiary branchlet) and 815.00 and 337.00 fruits per tree in $T_6$ ($M_6P_1$-heading back up to the crowded branchlet and centre opening) with application of paclobutrazol respectively was found significantly maximum in comparison to different pruning methods of without use of paclobutrazol. The pooled data of both years (2015 and 2016) also showed the maximum number of fruits i.e.18.33 fruits per tree in treatment $T_2$ ($M_2P_1$-heading back up to secondary branchlet), $T_4$ ($M_4P_1$-heading back up to tertiary branchlet) with having value of 107 fruits per tree and in $T_6$ ($M_6P_1$- heading back up to the crowded branchlet and centre opening) with yield of 576.00 fruits per tree than the rest treatments which was not treated with paclobutrazol including control. These findings agreed in the experiments of Subbaiah *et al.* (2017) [6] in mango cv. Banganpalli. They reported that paclobutrazol treated tree performed better in respect to increase the numbers of fruit per tree than the non treated trees. Increased in the number of fruits per plant by the use of paclobutrazol was also reported by Hoda *et al.* (2001) [7] in mango cv. Langra. The use of paclobutrazol increased the efficiency and functions of flowering and fruiting by suppressing the biosynthesis of gibberellin and induces the flower 50 to 100 per cent (Martinez *et al.* 2008) [8].

Fruit weight was found less in all pruning methods with application of paclobutrazol. The treated tree of paclobutrazol showed less fruit weight of 281.67 g and 294.67 g in pruning method $T_2$ ($M_2P_1$-heading back up to secondary branchlet), 255.67 g and 242.23 g in $T_4$($M_4P_1$- heading back up to tertiary branchlet) and 262.00 g and 244.40 g in $T_6$($M_6P_1$-heading back up to the crowded branchlet and centre opening) in comparison to the treatment of without use of paclobutrazol during both the years (2015 and 2016) respectively. The pooled data of both the years also exhibited the similar results. The minimum fruit weight of 288.17 g in$T_2$ ($M_2P_1$-heading back up to secondary branchlet), 249.30g in$T_4$($M_4P_1$-heading back up to tertiary branchlet) and 253.20g in $T_6$($M_6P_1$- heading back up to the crowded branchlet and centre opening system) with application of paclobutrazol. The fruit weight was decreased in the treatments of paclobutrazol application; probably it may be due to distribution of nutrients and other food materials among the more numbers of fruits in comparison to less number fruits in the treatments of without use of paclobutrazol. This finding was supported by the researcher (Husen *et al.* 2012) [9].

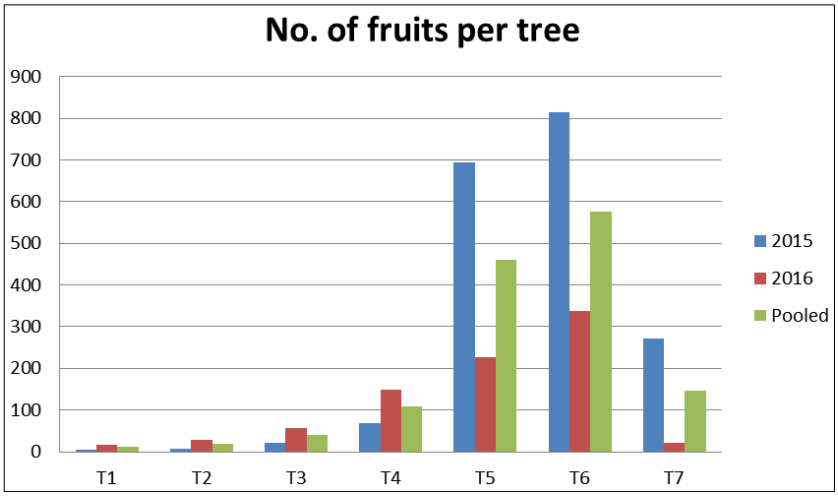


**Fig 1:** Effect of paclobutrazol and pruning on number of fruits per plant

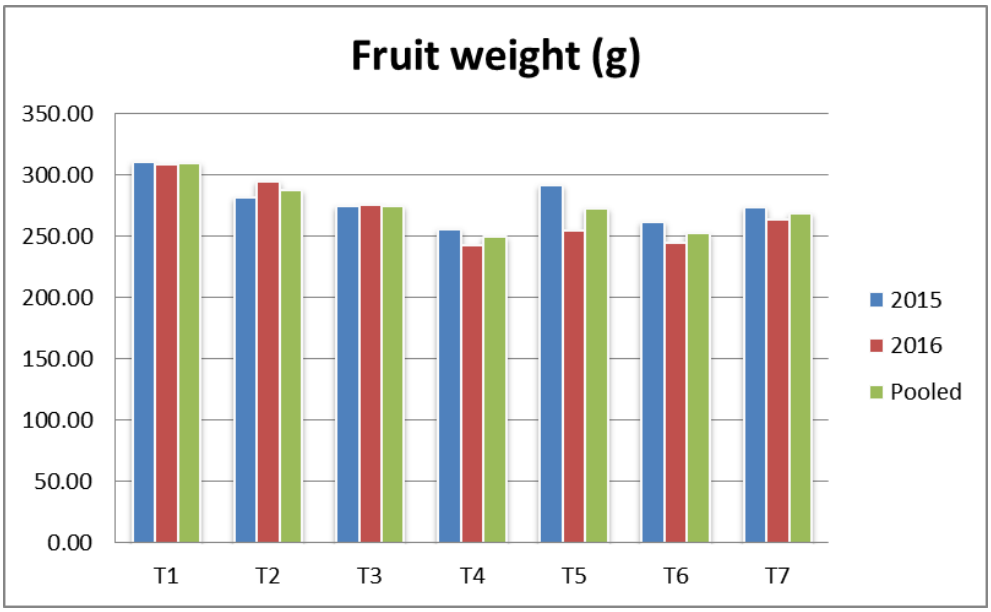


**Fig 2:** Effect of paclobutrazol and pruning on fruit weight of mango cv. Langra

In respect to fruit yield per tree on and off-season of fruiting, it was found more in the treatment of paclobutrazol application. The use of paclobutrazol gave more yield per tree i.e. 2.26 kg and 8.43kg per tree in$T_2$ ($M_2P_1$- heading back up to secondary branchlet), 17.27 kg and 35.58 kg per tree in $T_4$($M_4P_1$- heading back up to tertiary branchlet) and 213.32 kg and 82.35 kg per tree in $T_6$($M_6P_1$-heading back up to the crowded branchlet and centre opening) in comparison to without use of paclobutrazol in both years 2015 and 2016 respectively. The pooled result of both years also produced significantly more yield by the use of paclobutrazol. In the pruning method of $T_2$($M_2P_1$- heading back up to secondary branchlet) with having value of 5.35 kg/tree, in $T_4$ ($M_4P_1$-heading back up to tertiary branchlet) of fruit yield 26.42 kg/tree and treatment $T_6$($M_6P_1$-heading back up to the crowded branchlet and centre opening) with paclobutrazol soil drenching produced significantly higher yield of 147.84 kg/tree in comparison to the pruning methods which have no use of paclobutrazol. The tree treated with paclobutrazol produced higher yield than the treatments have no use of paclobutrazol has confirmed by the earlier researchers, Tandel and Patel (2011) [10] reported numbers of fruit and yield in mango was increased by use of paclobutrazol. Kulkarni *et al.* (1988) [11] and Martinez *et al.* (2008) [8] confirmed that treated tree with paclobutrazol enhanced the fruit yield and quality of mango.

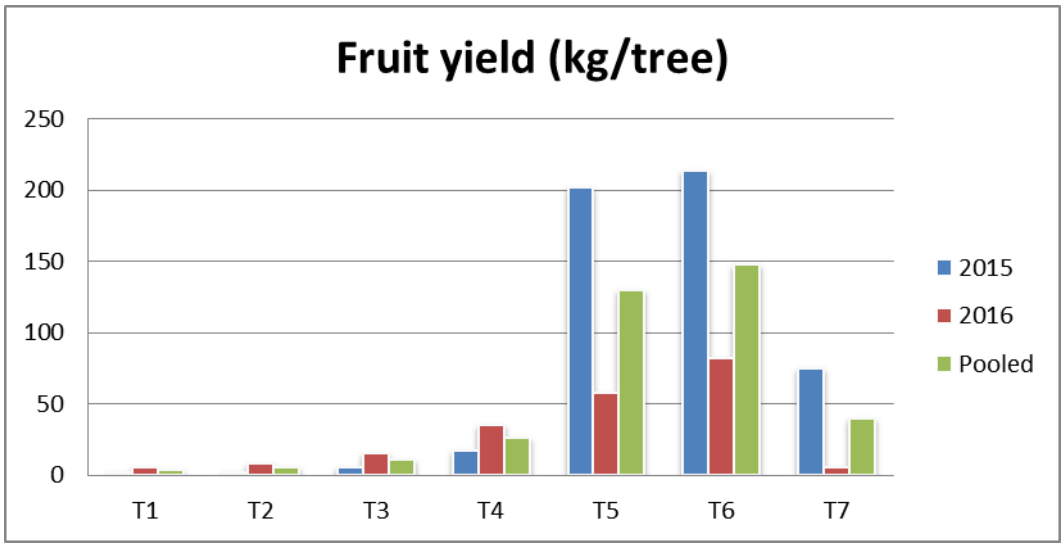


**Fig 3:** Effect of paclobutrazol and pruning on fruit yield of mango cv. Langra.

**(c) Fruit size (Length and breadth, cm), Pulp weight (g), Peel weight (g), Stone weight (g)**

The data presented in Table-2, clearly showed that different methods of pruning without application of paclobutrazol has significantly performed better in respect to fruit length, breadth and pulp weight than the pruning methods which have been used by the help of paclobutrazol, whereas; peel weight and stone weight was affected by the application of paclobutrazol. The maximum fruit length of 9.42 cm and 9.50 cm in treatment $T_1$ ($M_1P_0$-heading back up to secondary branchlet), 9.38 cm and 9.33 cm in $T_3$ ($M_3P_0$- heading back up to tertiary branchlet) and 9.59 cm 9.30 cm in $T_5$($M_5P_0$-heading back up to the crowded branchlet and centre opening) pruning methods were performed better in respect of without use of paclobutrazol in both years 2015 and 2016 respectively. The pooled data of both years showed similar trends of the result of previous both years. The pruning method $T_1$ ($M_1P_0$-heading back up to secondary branchlet), T3 ($M_3P_0$-heading back up to

tertiary branchlet) and $T_5$ ($M_5P_0$-heading back up to the crowded branch let and centre opening system) with having value of 9.46 cm, 9.36 cm and 9.45cm respectively without use of paclobutrazol including control significantly produced more fruit length than the different pruning methods treated with paclobutrazol.

The similar trend was observed during the observation of fruit breadth. The different pruning methods without use of paclobutrazol performed better than the pruning methods with application of paclobutrazol, the pruning method $T_1$ ($M_1P_0$-heading back up to secondary branchlet), $T_3$($M_3P_0$- heading back up to tertiary branchlet) and $T_5$ ($M_5P_0$- heading back up to the crowded branchlet and centre opening) produced maximum fruit breadth of 7.21 cm and 7.13 cm, 6.69cm and 6.83 cm and 7.11 cm and 6.84 cm without use of paclobutrazol in both years 2015 and 2016 respectively. More or less similar results were exhibited by the pooled data of both years. The pruning method $T_1$ ($M_1P_0$-heading back up to secondary branchlet), $T_3$($M_3P_0$-heading back up to tertiary branchlet) (6.76 cm) and $T_5$($M_5P_0$-heading back up to the crowded branchlet and centre opening system) with having value of 7.17 cm, 6.76cm and 6.98 cm respectively significantly produced maximum fruit breadth in comparison to those of pruning methods treated with paclobutrazol. These findings were confirmed by the observations of Yeshitela *et al.* (2004) [12]. He reported that the average fruit size was not affected by the application of paclobutrazol. Probably, it was happen due to distribution of nutrients and other food materials among the more numbers of fruits in the treatments treated with paclobutrazol, whereas; the fruit size was more in the treatment which was not treated with paclobutrazol due to more uptakes of nutrients and food materials in between the less numbers of fruits. This finding was also supported by the researcher Husen *et al.* (2012) [9]. Gollagi *et al*. (2019) [13] reported application of paclobutrazol induce morphological modifications of leaves, such as smaller and thicker leaves with smaller stomatal pores resulting of modification in photosynthesis rate and carbohydrates affects the size of fruits. Similar results were observed by Kumar *et al*., (2019) [14] in Dashehari and reported that paclobutrazol as soil drenched reduced fruit size in mango.

The application of paclobutrazol treatments markedly influenced the physical characters of fruits like pulp, peel and stone weight. It is clear from Table-2 that the application of paclobutrazol significantly influenced the pulp weight of the fruit but due to more fruit weight in less numbers of fruits per tree with pruning methods of without use of paclobutrazol produced more fruit weight. The highest pulp weight of the fruit was recorded in the treatment of pruning method of $T_1$($M_1P_0$-heading back up to secondary branchlet) with value of 239.67 g, 230.00g and 234.83g, in T3(M3P0-heading back up to tertiary branchlet) with pulp weight 206.44g, 207.67g and 207.06g and in $T_5$ ($M_5P_0$- heading back up to the crowded branch let and centre opening) with 221.67 g, 184.47 g and 203.07g pulp weight was observed in the treatments of without use of paclobutrazol in both the years and pooled over the both years 2015 and 2016 respectively.

The reason for increase in pulp weight in pruning methods without use of paclobutrazol treated tree may be due to increase in sugars and due to better resource mobilization among less numbers of fruits and these results were in conformity with the findings of Sarkar *et al*. (1998) [15] in mango. Prasanna *et al.* (2018) [16] also reported application of paclobutrazol, inhibits gibberellin biosynthesis and it has been found effectively in the manipulation of fruit characters in the many fruit crops. Gollagi *et al*. (2019) [13] reported that larger canopy surface area capture and convert the sunlight into fruit biomass in a better way than shorter canopy. Increase in production with enhanced fruit quality can be achieved by managing the tree canopy.

It is evident from the Table-2 that application of paclobutrazol significantly affected the peel weight among the different method pruning system. The maximum peel weight of 38.33 g, 40g and 39.17 g in $T_2$ ($M_2P_1$- heading back up to secondary branchlet), 41.22 g, 40.67 g and 40.94 g in $T_4$ ($M_4P_1$-heading back up to tertiary branchlet) and 41.67 g, 41.00 g and 41.33 g in $T_6$ ($M_6P_1$-heading back up to the crowded branchlet and centre opening) pruning systems with application of paclobutrazol showed during both years and pooled over the both years of 2015 and 2016 respectively. This might be due to manipulation in tree physiology with the use paclobutrazol as an important determinant of enhancement of fruit quality in many fruit crops (Gollagi *et al.* 2019) [13].

The data related to effect of paclobutrazol with different pruning methods on stone weight is presented in table-2. The application of paclobutrazol significantly affected the weight of stone. The minimum stone weight of 35.33 g, 36.00 g and 35.67 g in $T_2$ ($P_2P_1$-heading back up to secondary branchlet), 32.11 g, 32.33 g and 32.22 g in $T_4$($M_4P_1$- heading back up to tertiary branchlet) and 33.56 g, 33.67 g and 33.61 g in $T_6$ ($M_6P_1$-heading back up to the crowded branchlet and centre opening) pruning system performed better in comparison to those set of pruning system which have no used of paclobutrazol during the years 2015, 2016 and pooled over the both years respectively.

This was happen due to the greater suppression of vegetative growth causes assimilates demand in unidirectional manner to the developing fruit, resulting in high quality fruits in terms of lower stone weight with PBZ treated plants (Gollagi *et al*. 2019) [13]. They have also reported application of paclobutrazol inhibits gibberellins biosynthesis by blocking the conversion of kaurene and kaurenoic acid, which inhibits cell elongation and ultimately retards size of stone. Kurian and Iyer (1992) [4] reported that paclobutrazol application alter the source sink relationship of mango to support fruit growth with a reduction in vegetative growth.

**Table 1:** Effect of paclobutrazol and pruning on plant growth characters of mango cv. Langra.

| Treatments | Plant height (m) | | | Plant Spread (E-W)[m] | | | Plant Spread (N-S) [m] | | | Inter nodal length (cm) | | | Annual shoot growth (cm) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2015 | 2016 | Pooled | 2015 | 2016 | Pooled | 2015 | 2016 | Pooled | 2015 | 2016 | Pooled | 2015 | 2016 | Pooled |
| $T_1$-$M_1P_0$ | 4.77 | 5.53 | 5.15 | 3.89 | 4.13 | 4.01 | 3.43 | 4.30 | 3.87 | 2.14 | 2.32 | 2.23 | 12.72 | 12.87 | 12.79 |
| $T_2$-$M_2P_1$ | 4.40 | 4.93 | 4.67 | 2.38 | 4.10 | 3.24 | 2.60 | 3.77 | 3.19 | 1.57 | 1.41 | 1.49 | 9.26 | 8.52 | 8.89 |
| $T_3$-$M_3P_0$ | 4.73 | 6.57 | 5.65 | 6.00 | 7.33 | 6.67 | 6.00 | 7.83 | 6.92 | 2.17 | 2.74 | 2.45 | 12.17 | 11.42 | 11.79 |
| $T_4$-$M_4P_1$ | 4.60 | 5.27 | 4.93 | 4.30 | 4.83 | 4.57 | 3.40 | 5.33 | 4.37 | 1.80 | 1.56 | 1.68 | 8.89 | 7.47 | 8.18 |
| $T_5$-$M_5P_0$ | 8.79 | 9.35 | 9.07 | 9.52 | 10.20 | 9.86 | 9.71 | 10.51 | 10.11 | 2.21 | 2.22 | 2.22 | 13.46 | 12.41 | 12.94 |
| $T_6$-$M_6P_1$ | 7.86 | 8.27 | 8.06 | 8.26 | 9.37 | 8.81 | 8.96 | 9.67 | 9.32 | 1.46 | 1.37 | 1.42 | 9.36 | 6.74 | 8.05 |
| $T_7$-$M_7P_0$ | 7.92 | 9.90 | 8.91 | 10.80 | 11.21 | 11.01 | 10.52 | 11.86 | 11.19 | 2.27 | 2.65 | 2.46 | 13.68 | 14.00 | 13.84 |
| SEm ± | 0.57 | 0.50 | 0.38 | 0.43 | 0.66 | 0.41 | 0.29 | 0.40 | 0.25 | 0.19 | 0.17 | 0.12 | 0.85 | 0.82 | 0.57 |
| CD (P=0.05) | 1.77 | 1.56 | 1.11 | 1.33 | 2.05 | 1.19 | 0.91 | 1.24 | 0.73 | 0.58 | 0.52 | 0.33 | 2.62 | 2.53 | 1.64 |
| CV % | 16.14 | 12.29 | 14.10 | 11.56 | 15.74 | 14.62 | 7.99 | 9.15 | 8.72 | 16.77 | 14.32 | 14.17 | 12.94 | 13.55 | 12.75 |

$M_1$- Heading back up to secondary branchlet, $M_2$- Heading back up to tertiary branchlet, $M_3$- Heading back up to the crowded branchlet and centre opening, $P_0$ – No application, $P_1$ – Standard dose of the respective region at appropriate time

**Table 2:** Effect of paclobutrazol and pruning on fruit characters of mango cv. Langra

| Treatments | Fruit length (cm) | | | Fruit breadth (cm) | | | Pulp weight (g) | | | Peel weight (g) | | | Stone (g) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2015 | 2016 | pooled | 2015 | 2016 | pooled | 2015 | 2016 | pooled | 2015 | 2016 | pooled | 2015 | 2016 | pooled |
| $T_1$-$M_1P_0$ | 9.42 | 9.50 | 9.46 | 7.21 | 7.13 | 7.17 | 239.67 | 239.33 | 239.50 | 34.33 | 33.00 | 33.67 | 36.33 | 36.67 | 36.50 |
| $T_2$-$M_2P_1$ | 9.14 | 9.03 | 9.08 | 6.68 | 6.57 | 6.62 | 208.00 | 218.67 | 213.33 | 38.33 | 40.00 | 39.17 | 35.33 | 36.00 | 35.67 |
| $T_3$-$M_3P_0$ | 9.38 | 9.33 | 9.36 | 6.69 | 6.83 | 6.76 | 206.44 | 207.67 | 207.06 | 35.67 | 35.00 | 35.33 | 32.89 | 32.67 | 32.78 |
| $T_4$-$M_4P_1$ | 9.34 | 8.79 | 9.06 | 6.64 | 6.76 | 6.70 | 182.33 | 169.93 | 176.13 | 41.22 | 40.67 | 40.94 | 32.11 | 32.33 | 32.22 |
| $T_5$-$M_5P_0$ | 9.59 | 9.30 | 9.45 | 7.11 | 6.84 | 6.98 | 221.67 | 184.47 | 203.07 | 34.67 | 34.00 | 34.33 | 35.33 | 36.00 | 35.67 |
| $T_6$-$M_6P_1$ | 9.03 | 8.84 | 8.93 | 6.88 | 6.65 | 6.76 | 186.78 | 169.73 | 178.26 | 41.67 | 41.00 | 41.33 | 33.56 | 33.67 | 33.61 |
| $T_7$-$M_7P_0$ | 9.31 | 9.35 | 9.33 | 6.84 | 7.02 | 6.93 | 203.89 | 194.50 | 199.19 | 32.44 | 32.33 | 32.39 | 37.67 | 37.00 | 37.33 |
| SEm ± | 0.14 | 0.16 | 0.10 | 0.08 | 0.12 | 0.06 | 10.30 | 12.28 | 7.51 | 2.69 | 2.85 | 1.76 | 1.51 | 1.13 | 0.84 |
| CD (P=0.05) | 0.43 | 0.51 | 0.30 | 0.25 | 0.37 | 0.19 | 31.74 | 37.85 | 21.68 | 8.30 | 8.79 | 5.07 | 4.65 | 3.48 | 2.44 |
| CV % | 2.57 | 3.10 | 2.72 | 2.02 | 3.03 | 2.32 | 8.62 | 10.76 | 9.09 | 12.64 | 13.52 | 11.72 | 7.52 | 5.61 | 5.94 |

$M_1$- Heading back up to secondary branchlet, $M_2$- Heading back up to tertiary branchlet, $M_3$- Heading back up to the crowded branchlet and centre opening, $P_0$ – No application, $P_1$ – Standard dose of the respective region at appropriate time

## References


1. Rademacher W. Growth retardants: Effects on Gibberellin Biosynthesis and Other Metabolic Pathways. Annu. Rev. Plant Physiol. Plant Mol. Biol. 2000; 51:501-31.
2. Pal P, Mondal S, Kundu S. Effect of Paclobutrazol on Vegetative Response Production of Mango (*Mangifera indica* L., var. Himsagar). Int. J. Curr. Microbiol. App. Sci. 2017; 6 (12):264-1275.
3. Murti GSR, Upretp KK, Kurian RM, Reddy YTN. Paclobutrazol Modifies Tree Vigour And Flowering In Mango cv. Alphonso. Indian J. Plant Physiol. 2001; 6(4):355-360.
4. Kurian RM, Iyer CPA. Stem anatomical characteristics in relation to tree vigour in mango (*Mangifera indica* L.). Scientia Hort. 1992; 50:245-253.
5. Shinde VK, Manjarekar RG, Kadam CS, Dubale JJ. Response of Paclobutrazol Applicat-ion Time on Flowering, Fruiting and Yield of Mango cv. Alphonso. http :// www. Social research foundation. com. 2015; 1(8):1-6.
6. Subbaiah KV, Reddy NN, Reddy MLN, Dorajeerao AV D, Reddy AGK. Effect of Paclobutrazol and Other Chemicals on Yield and Flowering Characteristics of Mango cv. Banganpalli. Int. J Pure App. Biosci. 2017; 5(6):489-495.
7. Hoda MN, Singh S, Singh J. Effect of cultar on flowering, fruiting and fruit quality of mango cv. Langra. Indian. J Hort. 2001; 58(3):224-227.
8. Martinez AR, Perez ALA, Moreno JR. Effects of paclobutrazol and $KNO_3$ over flowering and fruit quality in two cultivars of mango. Inercencia. 2008; 33(7):518-522.
9. Husen S, Ashari KS, Basuki N. Induction of Flowering and Yield of Mango Hybrids Using Paclobutrazol. J Agric. Food. Tech. 2012; 2(9)153-158.
10. Tandel YN, Patel NL. Effect of chemicals on growth, yield and economics of mango (*Mangifera indica* L.), Karnataka. J Agric. Sci. 2011; 24(3):362-365.
11. Kulkarni VJ. Chemical control of tree vigour and the promotion of flowering and fruiting in mango (*Mangifera indica* L.) using paclobutrazol. J Hort. Sci. 1988; 63:557--566.
12. Yeshitela T, Robbertse PJ, Stassen PJC. Paclobutrazol suppressed vegetative growth and improved yield as well as fruit quality of 'Tommy Atkins' mango (*Mangifera indica*) in Ethiopia. New Zealand J. Crop Hort. Sci. 2004; 32:281-293.
13. Gollagi SG, Jasmitha BG, Sreekanth HS. A review on: Paclobutrazol a boon for fruit crop production. J. of Pharma. and Phyto. 2019; 8(3):2686-2691.
14. Kumar A, Singh CP, Bist D. The effect of Soil Drenches Application of Paclobutrazol on the Vegetative Growth, Fruit Quality and Storage Behaviors of Mango (*Mangifera indica* L.) CVS. Dashahari, Langra, Chuasa and Fazri. Int. J. of Eng. Sci. and Comp. 2019; 9(3):21108-21114.
15. Sarkar SK, Gautam B, Srihari D, Seethambaram Y. Regulation of tree vigour in mango. Indian J Hort. 1998; 55(1):37-41.
16. Prasanna VSSV, Bhowmick N, Chakraborty A, Debnath MK. Effect of paclobutrazol on fruiting characteristics of pineapple [*Ananas comosus* (L.) MERR.] cv. Mauritius. Int. J. of Chem.l Stud. 2018; 6(6): 1013-1017.