

# Effect of Pruning in Pomegranate (*Punica granatum* L.) for Shoot Growth, Flowering and Fruit Yield

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## Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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## ABSTRACT

The present experiment was carried out during December 2018 to May 2019 in Central Research Field, Department of Horticulture, SHUATS, Prayagraj. It is concluded that treatment T<sub>2</sub> (20 cm pruning) was best in terms of vegetative growth parameters like plant height, plant spread, number of branches etc. and treatment T<sub>4</sub> (40 cm pruning) was best in terms of earliness and fruit yield parameters, in terms of quality treatment T<sub>3</sub> (30 cm pruning) was best. In terms of economics treatment T<sub>4</sub> (40 cm pruning) recorded maximum benefit and cost benefit ratio.

**Keywords:** Treatments; vegetative parameters; yield and quality.

## 1. INTRODUCTION

Pomegranate (*P. granatum* L.) belongs to the family Punicaceae, subclass Rosidae and order Myrtales, is the only known genus of the family. It

is a genus of large shrubs or small trees with 2 species. One is *Punica protopunica* which is wild type found in Socotra Island of the Arabian Peninsula, and is considered as an ancestral species [1] and the other is *P. granatum*

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cultivated in tropical and subtropical parts of the world. *P. granatum* has been classified into two sub species chlorocarpa and porphyrocarpa, each having two varieties. These sub-species have been established on the basis of the colour of the ovary, a stable feature, which is retained even when they are reproduced by seeds. Sub-species chlorocarpa is mainly found in the transcaucasus, whereas, the second sub-species porphyrocarpa is mainly central Asian in distribution.

The number of chromosomes in Dholka, Ganesh, Kandhari, Muscat white and Patiala varieties was found to be  $2n=16$ , while the varieties double flowered had  $2n=18$  [2]. The chromosome number in Vellodu and Kashmiri varieties was found to be  $2n=18$  with 1 or 2 quadrivalent associations at meiosis [3]. Floral biology of Pomegranate has revealed that both self and cross pollination take place. The pollen from male flowers gives higher fruit set than those from the hermaphrodite ones [4].

Yield and quality of pomegranate fruit is significantly influenced by improved pruning technology shown by various research workers. Properly pruned pomegranate trees produce excellent quality fruits. Therefore, this problem attracted the attention of large number of researchers to find some positive control measures on fruit, growth, yield and quality through the process of pruning. To check these a research trail on "Effect of pruning in Pomegranate for Shoot Growth, Flowering and Fruit yield" was conducted in central research field of Department of Horticulture, SHUATS, Prayagraj. The main objectives are to study the effect of different levels of pruning on growth, yield and quality of pomegranate and to work out the economics of different levels of pruning in pomegranate.

## 2. MATERIALS AND METHODS

The Experimental was conducted in Randomized Block Design (RBD) with 8 treatments and 3 replications in Central Research field, Department of Horticulture, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj during the year 2018 - 2019. Total number of treatments were eight viz.  $T_0$  (control No pruning),  $T_1$  (10 cm pruning),  $T_2$  (20 cm pruning),  $T_3$  (30 cm pruning),  $T_4$  (40 cm pruning),  $T_5$  (50 cm pruning),  $T_6$  (60 cm pruning) and  $T_7$  (70 cm pruning).

## 2.1 Plant Material

The present studies were conducted on six years old pomegranate trees of cultivar Bhagwa. Twenty-four trees with uniform vigour and size, planted at a spacing of 5m x 5m were selected for the study. All plants were given uniform cultural practices during the period of investigation.

## 2.2 Climatic Condition in the Experimental Site

The area of Prayagraj district comes under subtropical belt in the south east of Uttar Pradesh, which experience extremely hot summer and fairly cold winter. The maximum temperature of the location reaches up to  $46^{\circ}\text{C}$ - $48^{\circ}\text{C}$  and seldom falls as low as  $4^{\circ}\text{C}$ - $5^{\circ}\text{C}$ . The relative humidity ranges between 20 to 94%. The average rainfall in this area is around 1013.4 mm annually. However, occasional precipitation is also not uncommon during winter months.

## 3. RESULTS AND DISCUSSION

### 3.1 Growth Parameters

In terms of plant height treatment  $T_2$  (20 cm Pruning) recorded maximum plant height at initial, 30, 60, 90, 120, 150 and 180 days respectively after pruning followed by  $T_6$  (60 cm pruning) where as minimum Plant height was recorded in treatment  $T_0$  (Control) at initial 30, 60, 90, 120, 150 and 180 days respectively. This might be due to an optimization of light inside the tree, likely to promote photosynthesis rate. Similar findings were reported by Chavan (2018) and Ghatul et al., [5] in pomegranate.

Similar trends was noticed in plant spreads where treatment  $T_2$  (20 cm Pruning) recorded maximum plant spread at initial, 30, 60, 90, 120, 150 and 180 days respectively after pruning followed by  $T_6$  (60 cm pruning) with, where as minimum Plant spread was recorded in treatment  $T_0$  (Control) at initial 30, 60, 90, 120, 150 and 180 days respectively. This might be due to optimization of light environment inside the tree likely to promote photosynthesis rate would improve the distribution of available mineral elements within aerials part of trees. Similar findings were reported by Kumar et al. [6] in Ber and Hiremath et al., [7] and Ghatul et al., [8] in pomegranate.

Number of branches was recorded maximum in treatment T<sub>2</sub> (20 cm Pruning) with (7.79 and 10.24) number of branch at initial and 180 days respectively after pruning followed by T<sub>0</sub> (control) with (7.33 and 9.03), where as minimum Number of branch (5.52 and 6.85) was recorded in treatment T<sub>7</sub> (70 cm pruning) at initial and 180 days respectively. This increase might be due to the pruning which remove carbon starved, exhausted fruiting, and promotes new growth to build up carbohydrates reserves for flowering and allows the sprouting of lateral buds which, ultimately influenced plant growth and other vegetative characteristics of the plant. Similar findings were reported by Kumar et al. [9] in Ber and Hiremath et al., [7] and Ghatul et al., [5] in pomegranate.

### 3.2 Flowering and Fruiting Characters

Days for first flowering recorded minimum in treatment T<sub>4</sub> (40 cm pruning) with (105.49 days) for days to first flowering after pruning followed by T<sub>5</sub> (50 cm pruning) with (121.05 days), where as maximum Days to flowering (138.04 days) was recorded in treatment T<sub>0</sub> (Control). This increase might be due to the pruning which remove carbon starved, exhausted flowering and fruiting, and promotes new growth to build up carbohydrates reserves for flowering and allows the sprouting of lateral buds which, ultimately influenced plant growth and other vegetative characteristics of the plant. Similar findings were reported by Kumar et al. [9] in Ber and Hiremath et al., [7] and Ghatul et al., [8] in pomegranate.

Number of flowers per plant recorded maximum in treatment T<sub>4</sub> (40 cm pruning) with (95.16 flowers) in a single plant after pruning followed by T<sub>5</sub> (50 cm pruning) with (82.83) Number of flowers/plant, where as minimum Number of flowers/plant (50.63) was recorded in treatment T<sub>0</sub> (Control). This increase might be due to the pruning which remove carbon starved, exhausted flowering and fruiting, and promotes new growth to build up carbohydrates reserves for flowering and allows the sprouting of lateral buds which, ultimately influenced plant growth and other vegetative characteristics of the plant. Similar findings were reported by Kumar et al. [9] in Ber and Hiremath et al., [7] and Ghatul et al., [8] in pomegranate.

Days taken to first fruit the minimum (147.80 days) for first fruit picking was recorded in treatment T<sub>4</sub> (40 cm pruning) after pruning followed by T<sub>5</sub> (50 cm pruning) with (162.71 days) for first fruit picking, where as maximum

Days taken for first fruit picking (181.38 days) was recorded in treatment T<sub>0</sub> (Control). This increase might be due to the pruning which remove carbon starved, exhausted flowering and fruiting, and promotes new growth to build up carbohydrates reserves for flowering and allows the sprouting of lateral buds which, ultimately influenced plant growth and other vegetative characteristics of the plant. Similar findings were reported by Kumar et al. [9] in Ber and Hiremath et al., [7] and Ghatul et al., [8] in pomegranate.

In terms of Number of fruits per plant the maximum (26.67) fruit per Plant was recorded in treatment T<sub>4</sub> (40 cm pruning) after pruning followed by T<sub>3</sub> (30 cm pruning) with (20.07) Fruits/Plant, where as minimum Number of Fruits/Plant (10.54) was recorded in treatment T<sub>0</sub> (Control). Maximum number of fruit in treatment T<sub>4</sub> (40 cm pruning) might be due to utilization of whole photosynthates among fewer fruit in severe pruned trees. Similar results previously also reported by Choudhary and Dhakare [10] in custard apple and Hiremath et al., [7] and Ghatul et al., [8] in pomegranate.

In terms of fruit yield/ kg plant and fruit yield q/ha maximum (3.82 kg/plant) and (15.28 q/ha) Fruit yield was recorded in treatment T<sub>4</sub> (40 cm pruning) after pruning followed by T<sub>3</sub> (30 cm pruning) with (2.26 kg/plant) and (9.04 q/ha), where as minimum Fruit yield/Plant and per hectare (1.01 kg/plant) and (4.04 q/ha) was recorded in treatment T<sub>0</sub> (Control). Maximum fruit yield in treatment T<sub>4</sub> (40 cm pruning) is might be due to utilization of photosynthates among fruit in pruned trees which promotes fruit growth and ultimately yield. Similar results previously also reported by Choudhary and Dhakare [10] in custard apple and Hiremath et al., [7] and Ghatul et al., [8] in pomegranate.

In terms of Average fruit weight (g) the maximum (143.30 g) Average fruit weight was recorded in treatment T<sub>4</sub> (40 cm pruning) after pruning followed by T<sub>2</sub> (20 cm pruning) with (129.45 g) where as minimum Average weight (95.53 g) was recorded in treatment T<sub>0</sub> (Control).

Maximum fruit weight in treatment T<sub>4</sub> (40 cm pruning) is might be due to utilization of photosynthates and availability of more metabolite among pruned trees which promotes fruit growth and size. Similar results previously also reported by Prakash et al., [11] in Guava, Dhapute et al., (2018) in custard apple and Bhuvra et al., [12] and Ghatul et al., [8] in pomegranate.

**Table 1. Effect of pruning on plant height (cm) and plant spread (cm) of pomegranate (*P. granatum*) cv. (Bhagwa)**

Treatment symbol	Treatment combination	Plant height (cm)							Plant spread (cm)						
		Initial	30 DAP	60 DAP	90 DAP	120 DAP	150 DAP	180 DAP	Initial	30 DAP	60 DAP	90 DAP	120 DAP	150 DAP	180 DAP
T <sub>0</sub>	Control (No pruning)	187.89	193.57	198.19	203.03	207.09	211.33	214.57	142.20	143.91	146.10	148.35	150.66	153.15	155.62
T <sub>1</sub>	10 cm pruning	201.64	206.42	210.79	215.02	218.42	222.48	225.47	156.84	158.50	160.60	162.77	164.83	167.10	169.20
T <sub>2</sub>	20 cm pruning	239.46	245.59	251.05	257.69	262.66	267.83	271.30	195.52	197.90	200.86	203.52	206.21	209.37	212.50
T <sub>3</sub>	30 cm pruning	217.35	221.40	225.47	229.71	232.74	236.50	238.80	172.27	173.95	175.74	177.65	179.58	181.41	183.23
T <sub>4</sub>	40 cm pruning	220.55	224.38	228.21	232.10	234.91	238.47	240.85	174.68	176.33	178.18	179.86	181.67	183.59	185.47
T <sub>5</sub>	50 cm pruning	230.11	233.79	237.71	241.36	244.51	247.22	249.78	181.95	183.83	185.44	187.47	189.33	191.28	192.85
T <sub>6</sub>	60 cm pruning	232.15	236.24	239.50	242.75	245.24	248.32	251.42	187.04	188.64	190.18	192.01	193.77	195.60	196.98
T <sub>7</sub>	70 cm pruning	202.54	206.09	208.87	211.98	213.86	216.22	218.42	157.87	159.27	160.56	162.08	163.56	164.83	166.13
F-Test		S	S	S	S	S	S	S	S	S	S	S	S	S	S
SE(d)		4.472	4.774	4.522	5.334	5.346	5.051	5.049	4.276	4.317	4.288	4.347	4.356	4.419	4.368
C.V.		2.530	2.646	2.462	2.850	2.817	2.621	2.589	3.062	3.060	3.006	3.013	2.986	2.993	2.927
C.D. at 5%		9.685	10.338	9.793	11.552	11.577	10.939	10.935	9.260	9.349	9.285	9.414	9.434	9.569	9.458

**Table 2. Effect of pruning on number of branches, days to first flower, number of flowers/plant, days taken to first fruit, number of fruits/plant and fruit yield/plant (kg) of pomegranate (*P. granatum*) cv.(Bhagwa)**

Treatment symbol	Treatment combination	Number of branches		Days to first flowering	Number of Flower/plant	Days taken to first fruit	Number of fruits per plant	Fruit yield/plant (kg)
		Initial	180 DAP					
T <sub>0</sub>	Control (No pruning)	7.33	9.03	138.04	50.63	181.38	10.54	1.01
T <sub>1</sub>	10 cm pruning	7.06	8.66	132.94	62.57	172.83	15.49	1.79
T <sub>2</sub>	20 cm pruning	7.79	10.24	128.98	62.80	168.41	16.07	2.07
T <sub>3</sub>	30 cm pruning	6.61	8.21	123.73	70.40	165.77	20.07	2.26
T <sub>4</sub>	40 cm pruning	6.29	7.87	105.49	95.16	147.80	26.67	3.82
T <sub>5</sub>	50 cm pruning	6.56	8.03	121.05	82.83	162.71	18.09	2.06
T <sub>6</sub>	60 cm pruning	5.69	7.08	125.13	75.67	169.46	15.58	1.72
T <sub>7</sub>	70 cm pruning	5.52	6.85	130.02	68.52	171.70	12.14	1.24
F-Test		S	S	S	S	S	S	S
SE(d)		0.493	0.398	7.421	3.698	5.858	1.068	0.146
C.V.		9.141	5.911	7.232	6.373	4.283	7.772	8.929
C.D. at 5%		1.068	0.862	16.071	8.009	12.686	2.313	0.315



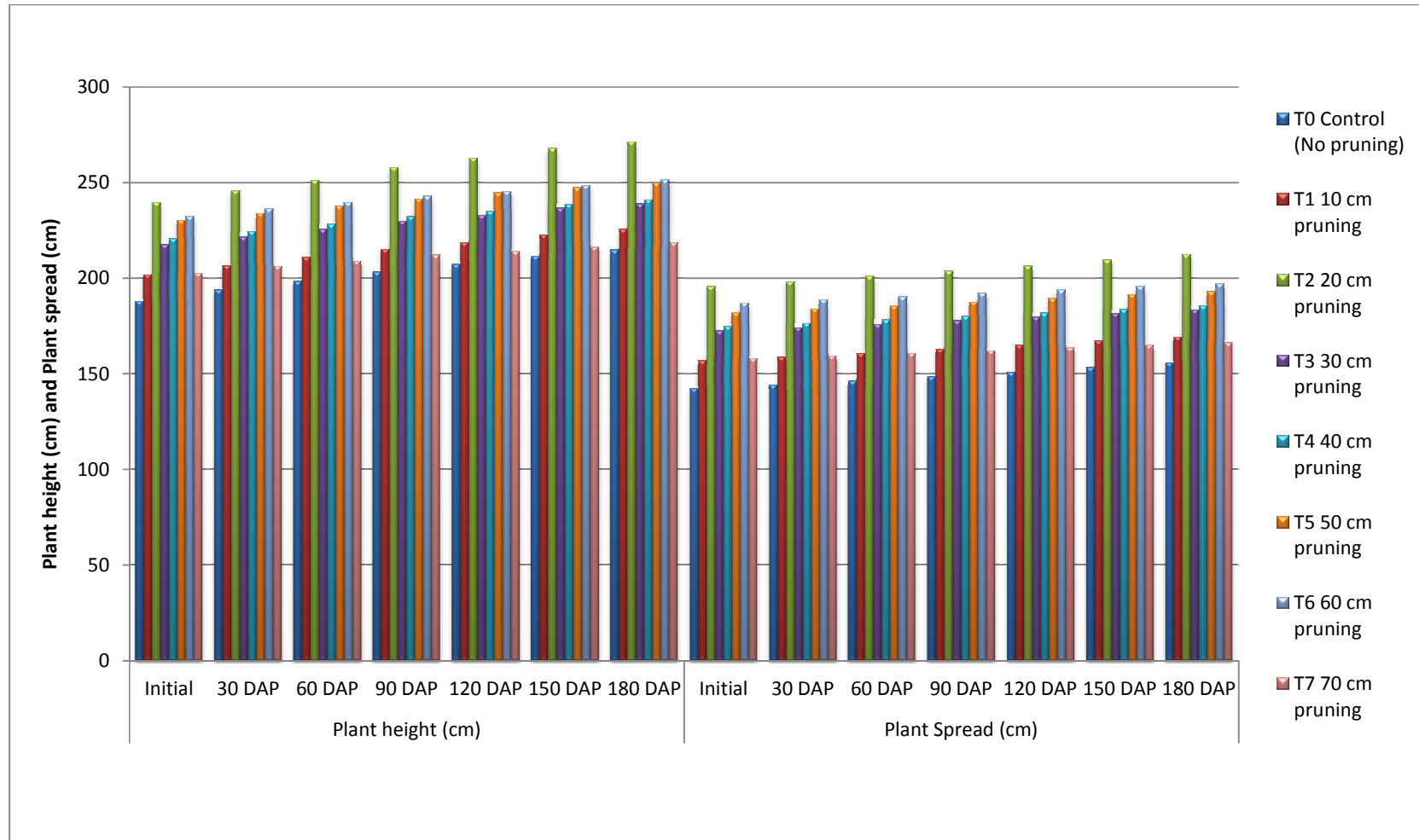


Fig. 1. Effect of pruning on plant height (cm) and plant spread (cm) of pomegranate (*Punica granatum*) cv.(Bhagwa)

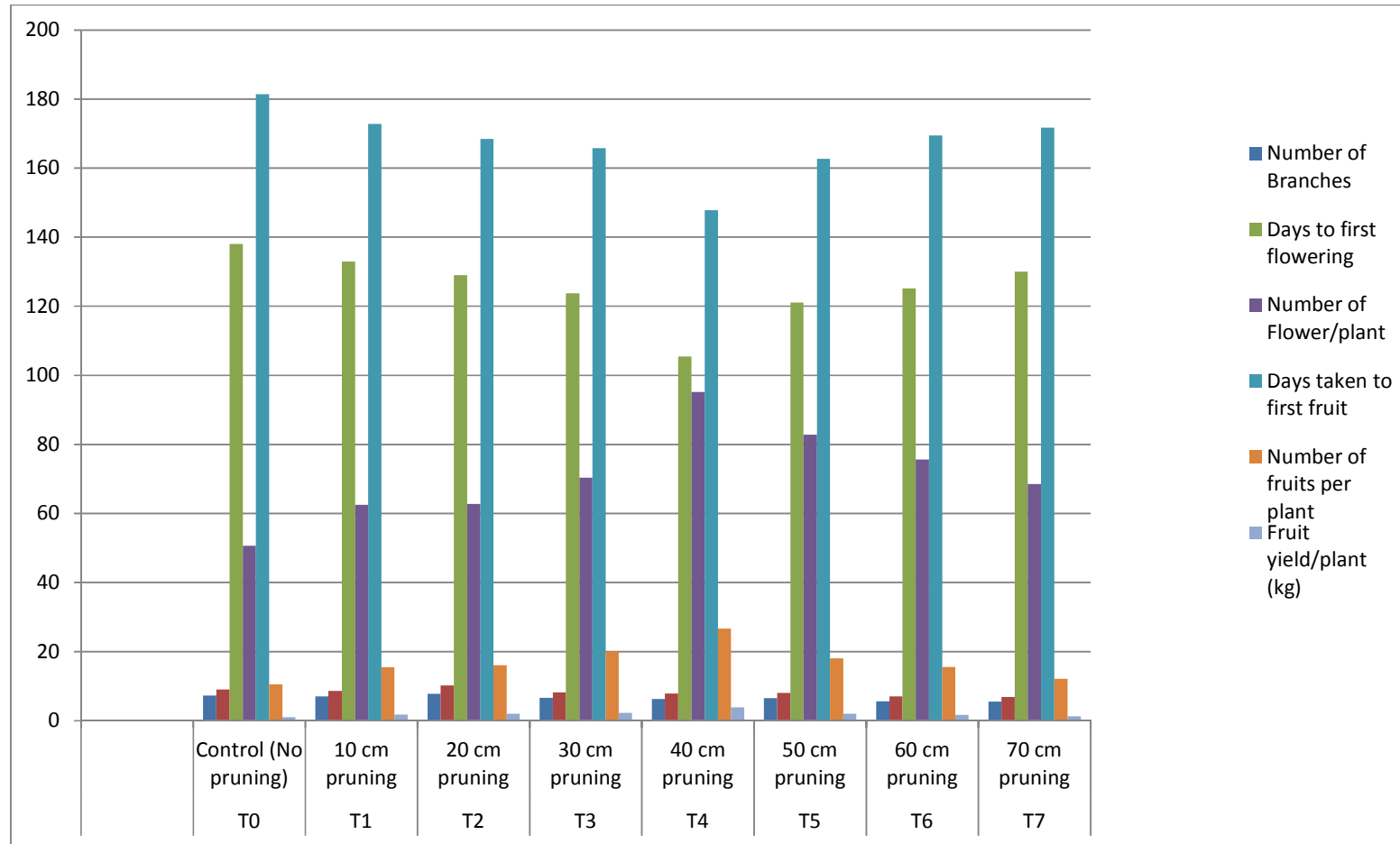


Fig. 2. Effect of pruning on number of branches, days to first flower, number of flowers/plant, days taken to first fruit, number of fruits/plant and fruit yield/plant (kg) of pomegranate (*Punica granatum*) cv.(Bhagwa)

**Table 3. Effect of pruning on fruit yield/ha (q), average fruit weight (g), TSS (°Brix),Acidity (%), ascorbic acid (mg/100 g) and of pomegranate (*P. granatum*) cv.(Bhagwa)**

Treatment symbol	Treatment combination	Fruit yield/ha (q)	Average fruit weight (g)	TSS (°Brix)	Acidity (%)	Ascorbic acid (mg/100 g)
T <sub>0</sub>	Control (No pruning)	4.04	95.53	9.87	0.56	8.29
T <sub>1</sub>	10 cm pruning	7.16	116.53	11.63	0.45	8.50
T <sub>2</sub>	20 cm pruning	8.28	129.45	11.95	0.46	9.80
T <sub>3</sub>	30 cm pruning	9.04	113.21	13.63	0.37	10.77
T <sub>4</sub>	40 cm pruning	15.28	143.30	12.17	0.42	9.46
T <sub>5</sub>	50 cm pruning	8.24	114.49	11.32	0.45	9.15
T <sub>6</sub>	60 cm pruning	6.88	111.02	10.38	0.49	8.95
T <sub>7</sub>	70 cm pruning	4.96	102.98	10.79	0.51	8.53
F-Test		S	S	S	S	S
SE(d)		0.582	4.154	0.653	0.029	0.698
C.V.		8.929	4.393	6.971	7.542	9.311
C.D. at 5%		1.261	8.995	1.413	0.062	1.512

**Table 4. Effect of pruning on cost benefit ratio of pomegranate (*P. granatum*) cv.(Bhagwa)**

Treatment symbol	Treatment combination	Cost of cultivation (Rs/ha)	Total yield (q/ha)	Selling Rate (Rs/q)	Gross return (Rs/ha)	Net return Rs./ha)	Cost benefit ratio
T <sub>0</sub>	Control (No pruning)	32766	4.04	8500	34340	1574	1.04
T <sub>1</sub>	10 cm pruning	32766	7.16	8500	60860	28094	1.85
T <sub>2</sub>	20 cm pruning	32766	8.28	8500	70380	37614	2.14
T <sub>3</sub>	30 cm pruning	32766	9.04	8500	76840	44074	2.34
T <sub>4</sub>	40 cm pruning	32766	15.28	8500	129880	97114	3.96
T <sub>5</sub>	50 cm pruning	32766	8.24	8500	70040	37274	2.13
T <sub>6</sub>	60 cm pruning	32766	6.88	8500	58480	25714	1.78
T <sub>7</sub>	70 cm pruning	32766	4.96	8500	42160	9394	1.28

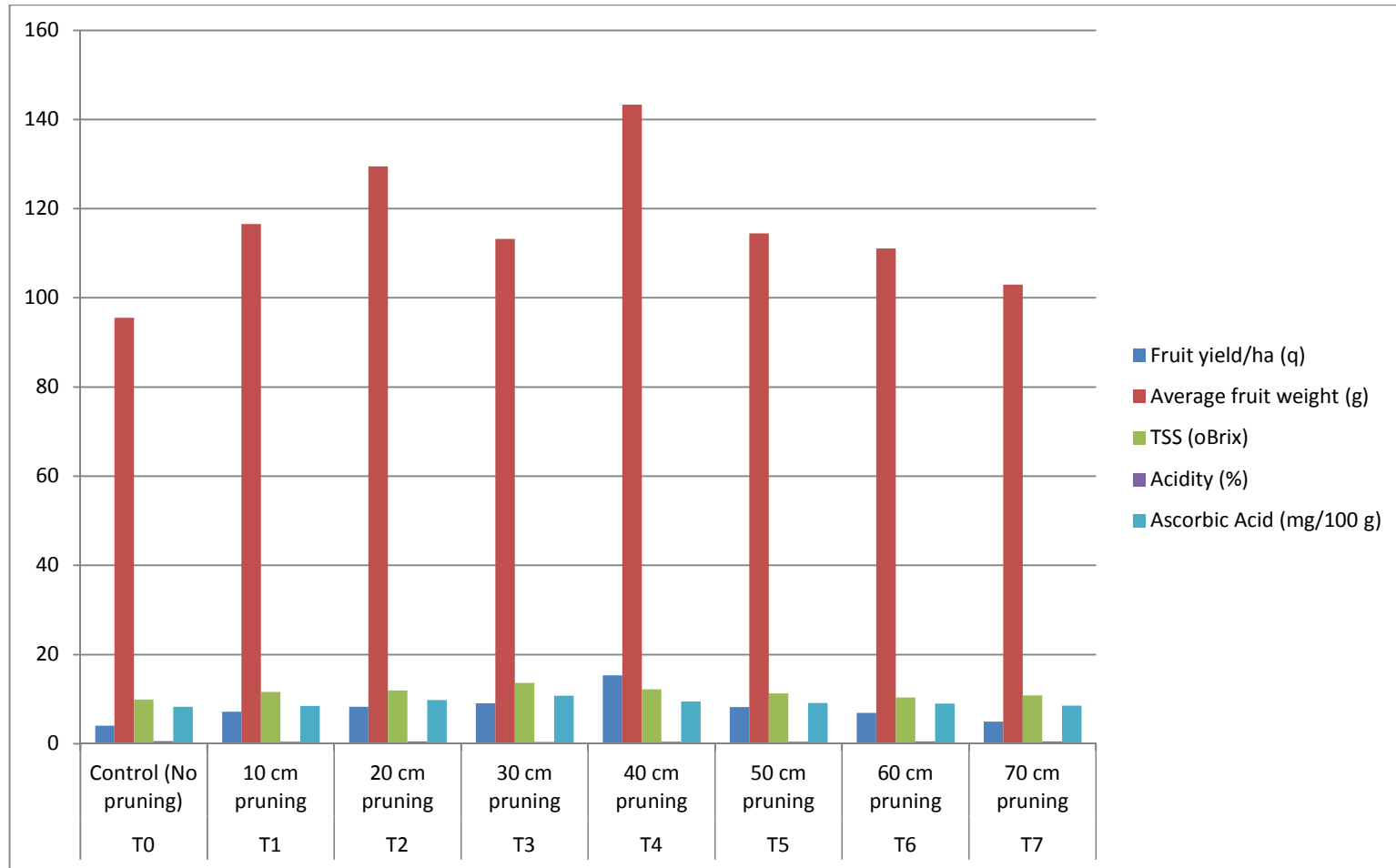


Fig. 3. Effect of pruning on fruit yield/ha (q), Average fruit weight (g), TSS (°Brix), Acidity (%), Ascorbic Acid (mg/100 g) and Cost benefit ratio of pomegranate (*Punica granatum*) cv.(Bhagwa)

### 3.3 Quality Parameters

In terms of Total soluble solids maximum (13.63 °Brix) was recorded in treatment T<sub>3</sub> (30 cm pruning) after pruning followed by T<sub>4</sub> (40 cm pruning) with (112.17°Brix) where as minimum Total Soluble Solid (°Brix) (9.87 °Brix) was recorded in treatment T<sub>0</sub> (Control). Maximum TSS in treatment T<sub>3</sub> (30 cm pruning) is might be due to the better availability of carbohydrates reserved stored in pruned shoots. Similar findings.

Ascorbic acid (8.29 mg) was recorded in treatment T<sub>0</sub> (Control). Maximum ascorbic acid in treatment T<sub>3</sub> (30 cm pruning) due to increased nutrient uptake by the trees and consequently more synthesis of carbohydrates and other metabolites and their translocation to the fruits. These results are conformity with the findings of Kadam et al., [13] in custard previously also reported by Sheikh and Rao [14] in pomegranate, Prakash et al., [11] in Guava, Sahar and Hameed [15] in guava, Ghatul et al., [8] in Pomegranate.

Acidity was recorded minimum (0.37%) in treatment T<sub>3</sub> (30 cm pruning) after pruning followed by T<sub>4</sub> (40 cm pruning) with (0.42%) Acidity, where as maximum Acidity (0.56%) was recorded in treatment T<sub>0</sub> (Control). Minimum acidity in treatment T<sub>3</sub> (30 cm pruning) is might be due to the better availability of carbohydrates reserved stored in pruned shoots. Similar findings previously also reported by Sheikh and Rao [14] and Ghatul et al., [9] in pomegranate.

Ascorbic acid mg/100 g was recorded maximum (10.77 mg) in treatment T<sub>3</sub> (30 cm pruning) after pruning followed by T<sub>2</sub> (20 cm pruning) with (9.80 mg) Ascorbic acid, where as minimum value of apple and Ghatul et al., [8] in Pomegranate. In terms of Economics the maximum gross return Rs. 129880, Net Return Rs. 97114 and Cost Benefit ratio 3.96 was found in treatment T<sub>4</sub> (40 cm pruning) followed by treatment T<sub>3</sub> (30 cm pruning) with Rs. 76840 Gross Return, Rs. 44074.00 Net Return and 2.34 Cost Benefit Ratio whereas the minimum return and cost benefit ratio was found with treatment T<sub>0</sub> (Control) i.e. 34340.00, 1574.00 and 1.04 Gross return, Net return and cost benefit ratio respectively.

### 4. CONCLUSION

Treatment T<sub>2</sub> (20 cm pruning) was best in terms of vegetative growth parameters like plant height,

plant spread, number of branches, and treatment T<sub>4</sub> (40 cm pruning) was best in terms of earliness and fruit yield parameters, in terms of quality treatment T<sub>3</sub> (30 cm pruning) was best. In terms of economics treatment T<sub>4</sub> (40 cm pruning) recorded maximum benefit and cost benefit ratio.

### COMPETING INTERESTS

Authors have declared that no competing interests exist.

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