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Effect of different levels of pruning on quality of pomegranate (*Punica granatum* L.) cv. super Bhagwa

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Abstract
The present investigation entitled "Effect of different levels of pruning on yield and quality of pomegranate (*Punica granatum* L.) Cv. Super Bhagwa" was conducted on a well-established pomegranate orchard of five years age, spaced at 2.5 x 3 m at post-Gangapur, Taluka and District-Latur during 2017-2018. The experiment was laid out in a Randomized Block Design with 07 treatments *viz.*, T_1 (10 cm pruning), T_2 (20 cm pruning), T_3 (10cm pruning), T_4 (40 cm pruning), T_5 (50 cm pruning), T_6 (5 cm shoot tip pruning) and T_7 (control) with three replications. The framed experiment was concentrated to find out optimum level of pruning for getting better quality of pomegranate. The observations on quality of pomegranate were recorded.

The quality parameters of pomegranate were significantly influenced by different levels of pruning. Among the different levels of pruning, the maximum average fruit weight (276.12 g), volume of fruit (236.03 ml), weight of hundred arils (36.18g), rind thickness (4.98 mm), weight of rind per fruit (118.63 g) and weight of arils per fruit (153.49 g) were noted under the treatment T_5 (50 cm pruning). The results revealed that, juice percentage (71.83%) was significantly increased by pruning treatment T_5 (50 cm pruning). The significantly maximum total soluble solids content (16.75%), reducing sugars (11.90%) and total sugars (13.17%) were recorded in treatment T_2 (20 cm pruning). The maximum non-reducing sugars (1.27%) and minimum titrable acidity (0.33%) were recorded under treatment T_2 (20 cm pruning) but much difference were not observed among all the treatments under this quality parameters.

Keywords: Quality, pomegranate, pruning, treatments

Introduction
Pomegranate (*Punica granatum* L.) belong to the family punicaceae having chromosome number 2n = 16 or 18. It is one of the oldest known edible fruits and capable for growing in different agro-climates ranging from tropical to temperate regions of the world. However, it's major cultivation in tropical and sub-tropical regions. It is presumed that pomegranate was domesticated in the Middle East about 5000 years ago. Interestingly, it is considered to be one of the first five domesticated edible fruit crops along with fig, date palm, grape and olive. The scientific name *Punica granatum* is derived from the name (apple) Pomum (grainy) Granatus or seeded apple. Pomegranate belongs to Punicaceae family contains a single genus Punica of two species, *Punica granatum* L. and *P. protopunica* Balf. f. The species *P. granatum* has two sub-species *viz. Chlorocarpa* and *Porphyrocarpa*.

Pomegranate is native of Iran and is extensively cultivated in Mediterranean countries like Spain, Morocco, Egypt, Afghanistan and Baluchistan. It is also grown to some extant in Burma, China, Japan, USA (California) and India. The total area under cultivation of Pomegranate in India is 246 (000 ha) and production is around 2865 (000MT) (Annon, 2018-19) [8]. In India, pomegranate is commercially cultivated in Maharashtra followed by Andhra Pradesh, Karnataka, Gujarat, Rajasthan, Madhya Pradesh, Uttar Pradesh, Tamil Nadu, Punjab and Haryana. The prominent pomegranate producing districts in Maharashtra are Solapur, Nashik, Sangli, Ahmednagar, Pune, Dhule, Aurangabad, Satara, Osmanabad and Latur. Maharashtra state accounts for 54.8 per cent of total production of the country. Among different states, Maharashtra is the main pomegranate producing state where the area under pomegranate cultivation is about 78000 hector with the production of 4.08 lakh tonnes and productivity as 5.2 tonnes per hectare (Sonawane, 2017) [14].

Pomegranate fruit contains 52 per cent edible parts of the total weight. One kilogram of pomegranate fruits yields about 452 - 500 ml of juice.

The fruit juice has 15-19 percent sugar content. The edible part of pomegranate fruit is the juicy outgrowth of the seed, called aril. The parts of the fruit are a good source of Vitamin C (16 mg/100 g), Minerals (0.7 %), Calcium (10 mg/100 g), Phosphorus (70 mg/100 g), Iron (0.3 mg/100 g) and also contain considerable amount of acids, fats and carbohydrates (Bhowmik *et al.*, 2013) [2].

Pomegranate is commercially grown for its delicious, refreshing with sweet- acidic taste. Pomegranate is also processed to make product like fruit juice, concentrate and beverage, wine, syrup and jelly. The 'Anardana' is also prepared from pomegranate. The fruit mainly used for dessert purpose but its juice have good medicinal properties to be useful for patients suffering from leprosy, diarrhea, dysentery and hemorrhages. The juice of wild pomegranate contains citric acid and sodium citrate for pharmaceutical purposes (Shastri and Pawar, 2014) [15]. Recently, it has been reported that, extract of fruits has anti-cancer properties.

Materials and Methods

The experiment was conducted on farmer's (Yuvraj Bhosale) field at Gangapur, Taluka and District- Latur during the year 2017-18. The orchard of pomegranate having five years age old and planted at 2.5 X 3.0 m spacing. Geographically Latur district of Maharashtra state is located between 17^0 52' to 18^0 50' North latitude and between 76^0 18' to 79^0 12' East latitude with the total geographical area is 7.37 million ha. Latur is situated in the Marathwada region part of the Maharashtra state. The Latur district area comes under semi-arid and tropical region of Maharashtra state. The experiment was laid out in a Randomized Block Design with 07 treatments *viz.*, T_1 (10 cm pruning), T_2 (20 cm pruning), T_3 (10 cm pruning), T_4 (40 cm pruning), T_5 (50 cm pruning), T_6 (5 cm shoot tip pruning) and T_7 (control) with three replications. The observation like fruit weight (g), volume of fruit (ml), weight of 100 arils (g), rind thickness (mm), weight of rind per fruit (g), weight of arils per fruit (g), juice percentage, total soluble solids (%), acidity (%), reducing sugars (%), non-reducing sugars (%) and total sugars (%). The statistical analysis done as per procedure given by Panse and Sukhatme (1967).

Results and Discussion

Fruit weight (g)

The data revealed that, the fruit weight showed significantly difference among the different pruning treatments. The maximum fruit weight (276.12 g) was noted under the treatment T_5 (50 cm pruning), which was found statistically at par with the treatments, T_4 (40 cm pruning) 263.46 g and T_3 (30 cm pruning) 256.14 g. However, the lowest fruit weight (173.51 g) was recorded under the treatment T_7 (control).

Increase in fruit weight might be due to utilization of whole photosynthates among fewer fruit in severe pruned trees. Similar results are reported by Hiremath *et al.* (2018) [7] in pomegranate and Choudhary and Dhakare (2018) [4] in custard apple.

Volume of fruit (ml)

The volume of fruit (236.03 ml) was significantly increased under treatment T_5 (50 cm pruning), which was at par with the treatments, T_4 (40 cm pruning) 229.97 ml, T_3 (30 cm pruning) 226.68 ml and T_2 (20 cm pruning) 215.49 ml. The lowest volume of fruit (158.62 ml) was recorded by treatment T_7 (control).

This may be attributed to the reduction in crop load on severely pruned tree which resulted in the diversion of more translocates to the remaining fruits thereby increase the fruit size. Similar results also reported by, Pratap *et al.* (2009) [9] in mango and Sahar and Hameed (2014) [12] in guava.

Weight of 100 arils (g)

The weight of hundred arils (36.18 g) was significantly increased under treatment T_5 (50 cm pruning), which was at par with the treatments, T_4 (40 cm pruning) 33.69 g. The lowest weight of hundred arils (23.31 g) was recorded in control T_7 (control).

This may be attributed to the reduction in crop load on severely pruned tree which resulted in the diversion of more translocates to the remaining fruits thereby increase the fruit size along with arils weight similar result were obtained by sheikh and Rao (2002) [13] in pomegranate.

Rind thickness (mm)

The data revealed that, the maximum rind thickness (4.98 mm) was observed under treatment T_5 (50 cm pruning), which was at par with the treatments, T_4 (40 cm pruning) 4.69 mm and T_3 (30 cm pruning) 4.38 mm. The minimum rind thickness (3.49 mm) was recorded under treatment T_7 (control).

There were significant differences due to different pruning levels. The maximum rind thickness (4.98 mm) was recorded by treatment T_5 50 cm pruning. This may be attributed to the reduction in crop load on severely pruned tree which resulted in the diversion of more translocates to the remaining fruits thereby increasing the rind thickness; it may help to reduce thrips and other insect attack on fruits to improve quality of fruits in cv. Super Bhagwa. Similar result was obtained by sheikh and Rao (2002) [13] in pomegranate.

Weight of rind per fruit (g)

The weight of rind per fruit (g) was found significant differences among the treatments. The treatment, T_5 (50 cm pruning) recorded the highest weight of rind per fruit (118.63 g), followed by treatments, T_4 (40 cm pruning) 113.32 g and T_3 (30 cm pruning) 106.94 g. The lowest weight of rind per fruit (79.61 g) was recorded in treatment T_7 (control).

This may be attributed to the reduction in crop load on severely pruned tree which resulted in the diversion of more translocates to the remaining fruits thereby increasing the physical fruit attributes like rind weight.

Weight of arils per fruit (g)

The data revealed that, the arils weight had significant differences among the treatments. The treatment, T_5 (50 cm pruning) (153.49 g) recorded maximum aril weight and followed by treatments, T_4 (40 cm pruning) 150.14 g, T_3 (30 cm pruning) 149.20 g and T_2 (20 cm pruning) 142.36 g. The lowest arils weight (93.90 g) was recorded in T_7 (control).

Effect of pruning on fruit aril weight showed significant difference between severities. Irrespective of pruning was significant and the maximum fruit arils weight (153.49 g) recorded in treatment T_5 (50 cm pruning). Increase in fruit weight, fruit size and aril weight might be due to utilization of whole photosynthates among fewer fruit in severe pruned trees. Similar results are reported by Chavan (2018) [3] in pomegranate.

Juice percentage (%)

The data revealed that, the juice percentage was significantly increased by different pruning treatments. The maximum juice percentage (71.83 %) was observed in treatment T_5 (50 cm pruning) and at par with the treatments, T_4 (40 cm pruning) 70.58 %, T_3 (30 cm pruning) 68.71 % and T_2 (20 cm pruning) 66.35 %. The minimum juice percentage (67.13 %) was recorded in treatment T_7 (control).

Increase in juice percentage might due to utilization of whole photosynthates among fewer fruit in severe pruned trees they also increase fruit aril weight and size they, so juice per cent also increase. Similar results reported by Pawar *et al.* (1994) in pomegranate and Ghosh *et al.* (2017) [6] in lemon.

Total soluble solids (%)

The data regarding on total soluble solids (%) are presented in Table 9 (Fig. 15). The data revealed that, the total soluble solids content was significantly increased by different pruning treatments. The maximum total soluble solids was observed in treatment T_2 (20 cm pruning) (16.75 %) and at par with the treatments, T_1 (10 cm pruning) 16.47 %, T_6 (5 cm shoot tip pruning) 16.34 % and T_3 (30 cm pruning) 15.83 %. The minimum total soluble solids content (14.07 %) was recorded in treatment T_7 (control).

The maximum TSS in fruits of pruning trees, as pruning intensity increase the TSS will maximum, it could be obviously due to the better availability of carbohydrates reserved stored in pruned shoots. The results are similar with the finding of Sheikh and Rao (2002) [13] in pomegranate, Prakash *et al.* (2012) [11] in guava, Sahar and Hameed (2014) [12] in guava and Dahapute *et al.* (2018) [5] in custard apple.

Acidity (%)

The data revealed that, the maximum titrable acidity (0.38 %) was recorded under treatment T_6 (5 cm shoot tip pruning). The minimum titrable acidity (0.33 %) was recorded under treatment T_3 (30 cm pruning) However, remarkable difference was not observed among all the treatments included under this investigation for this attribute. Hence, the treatments were statistically non-significant at this stage.

Reducing sugars (%)

The data revealed that, the reducing sugars were significantly increased by different pruning treatments. The maximum reducing sugars (11.90 %) were observed in treatment T_2 (20 cm pruning) and at par with the treatments, T_1 (10 cm pruning) 11.66 % T_6 (5 cm shoot tip pruning) 11.53 % and T_3 (30 cm pruning) 11.09 %. The minimum reducing sugars (9.96 %) were recorded in treatment T_7 (control).

The maximum reducing sugars (11.90 %) were observed in treatment T_2 (20 cm pruning). This might due to increase 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 Sheikh and Rao (2002) [13] in pomegranate and Kadam *et al.* (2018) [8] in custard apple.

Non-reducing sugars (%)

The data revealed that, the maximum non-reducing sugars (1.27 %) were recorded under treatment T_2 (20 cm pruning). The minimum non-reducing sugars (1.13 %) were recorded under treatment T_7 (control). However, remarkable difference was not observed among all the treatments included under this investigation for this attribute. Hence, the treatments were statistically non-significant at this stage.

Total sugars (%)

The data revealed that, the total sugars were significantly increased by different pruning treatments. The maximum total sugars (13.17 %) were observed in treatment T_2 (20 cm pruning) and at par with the treatments, T_1 (10 cm pruning) 12.89 %, T_6 (5 cm shoot tip pruning) 12.73 % and T_3 (30 cm pruning) 12.27 %. The minimum total sugars (11.09 %) were recorded in treatment T_7 (control).

The maximum total sugars (13.17 %) were observed in treatment T_2 (20 cm pruning). This might due to increase 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.* (2018) [8] in custard apple.

Table 1: Effect of different level of pruning on quality parameters of pomegranate

Sr. No.	Treatment	Average fruit weight (g)	Volume of fruit (ml)	Weight of 100 arils (g)	Rind thickness (mm)	Weight of rind/fruit (g)	Weight of arils/fruit (g)
1	T_1-10 cm pruning	213.02	187.31	26.13	3.90	90.25	122.77
2	T_2-20 cm pruning	240.79	215.49	28.56	4.10	98.43	142.36
3	T_3-30 cm pruning	256.14	226.68	30.44	4.38	106.94	149.20
4	T_4-40 cm pruning	263.46	229.97	33.69	4.69	113.32	150.14
5	T_5-50 cm pruning	276.12	236.03	36.18	4.98	118.63	153.49
6	T_6-5 cm shoot tip pruning	194.32	172.58	25.70	3.70	85.04	109.28
7	T_7-without pruning (control)	173.51	158.62	23.31	3.49	79.61	93.90
	S.E +	11.34	9.80	1.56	0.20	4.74	6.83
	C.D at 5% level	34.95	30.21	4.82	0.61	14.60	21.06

Sr. No.	Treatment	Juice percentage (%)	Total soluble solids (%)	Acidity (%)	Reducing sugars (%)	Non-reducing sugars (%)	Total sugars (%)
1	T_1-10 cm pruning	63.81	16.47	0.34	11.66	1.23	12.89
2	T_2-20 cm pruning	66.35	16.75	0.33	11.90	1.27	13.17
3	T_3-30 cm pruning	68.71	15.83	0.34	11.09	1.18	12.27
4	T_4-40 cm pruning	70.58	15.06	0.35	10.79	1.17	11.96
5	T_5-50 cm pruning	71.83	14.61	0.36	10.45	1.15	11.60
6	T_6-5 cm shoot tip pruning	62.45	16.34	0.38	11.53	1.20	12.73
7	T_7-without pruning (control)	61.13	14.07	0.37	9.96	1.13	11.09
	S.E +	1.98	0.51	0.01	0.35	0.03	0.37
	C.D at 5% level	6.11	1.57	NS	1.07	NS	1.14

Conclusion

The results of present investigation showed that, the effect of different levels of pruning have got significant influence on quality of pomegranate. On the basis of overall results obtained, it can be concluded that, the treatments T_2 (20 cm pruning) and T_5 (50 cm pruning) were found effective for better quality of pomegranate fruits.

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