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Effect of pruning and growth regulators on quality of pomegranate Cv. Bhagwa

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Abstract
The research was conducted on effect of different levels of pruning and plant growth regulators quality of pomegranate (*Punica granatum* L.) Cv. Bhagwa. The experiment was laid out with three replications and twenty treatments. Among of different levels of pruning, (pruning 10 cm, pruning 20 cm, pruning at 30 cm and control (Unpruned) in hasta bahar crop of pomegranate, pruning at 30 cm recorded maximum fruits firmness (5.99 kg/cm^2), fruits peel thickness (2.19 cm), fruit weight of 100 aril (33.07 g), Specific gravity (1.52 g/cc),total soluble solids (16.52 ^{o}Brix), observed in pruning at 20 cm. total sugars (15.41%), it was recorded in pruning at 30 cm, reducing sugars (8.46%),in control (unpruned). non-reducing sugars (6.86%), recorded in pruning at 30 cm. titrable acidity (0.68%) recorded between pruning at 20 cm and pruning at 30 cm both of equals. and ascorbic acid (13.53%), recorded between pruning at 20 cm and pruning at 30 cm both of equals shelf life (16.20%) showed significant results in pruning at 10 cm. Among plant growth regulators (NAA @ 25 ppm, NAA @ 50 ppm, GA_3 @ 25 ppm, GA_3 @ 50 ppm and water spray) in hasta bahar crop of pomegranate, GA_3 @ 50 ppm recorded maximum fruit firmness (6.21 kg cm^{-2}), fruits peel thickness (2.24 cm), and weight of 100 aril (34.83 g), Specific gravity (1.54 g/cc) significantly total soluble solids (16.51 ^{o}Brix), reducing sugars (8.57%) was observed in GA_3 @ 50 ppm, non-reducing sugars (6.92%), titrable acidity (0.75%) and total sugars (15.29%) was observed in water spray, shelf life (16.25%). The interaction between different levels of pruning and plant growth regulators shown maximum, fruit firmness (6.29 kg cm^{-2}), fruits peel thickness (2.30 cm) weight of 100 aril (37.60 g), Specific gravity (1.63 g/cc), maximum total soluble solids (17.10 ^{o}Brix), total sugars (16.40%), reducing sugars (10.00%) and non-reducing sugar (8.56%) non-reducing sugar (8.56%) with same above treatment combinations.

Keywords: pruning, growth regulators, NAA, GA_3

Introduction
Pomegranate (*Punica granatum* L.) is one of the popular table fruit mainly cultivated in tropical and subtropical eco-systems. It is called as power house of health, all parts of the plant like roots, bark, leaves, flower, rind and seeds used for medicine since ancient times. The fruits have wide consumer preference for their attractive juice, sweet-acidic and refreshing arils. There is a great demand for good quality fruits both in the form of fresh and processed products such as juice, syrup, anardana and wine (Varasteh *et al.*, 2009) [26]. The Bhagwa variety of pomegranate presently under cultivation known by different names like, Shendria, Ashtagandha and Kesar. It has attractive glossy red thick skin. This variety is very popular among the farmers and is cultivated in large area because of the good shelf life, attractive skin and aril color and tolerant to fruit cracking (Sheikh, 2006) [22]. Pruning is one of the important horticultural practices in many fruit crops, which influences both yield and quality of the fruit. Pomegranate fruits are borne on short branches known as spurs that arise from mature shoots. These spurs have capacity to bear fruits for a period of 3-4 years and with advance of age, they decline in production (Patil & Karale 1985) [17]. Therefore, there is a need to encourage growth of new spurs. However, less scientific report is available about the effect of pruning on pomegranate production. Plant growth regulators have remained an important component in horticulture from time immemorial as they were effective means of quantitative as well as qualitative improvement in growth and development of crops. Plant growth regulators are reported to play a significant role in pomegranate (Chaudhari and Desai, 1993) [4]. Different group of plant growth regulators like auxin, gibberellins and growth retardants at various concentrations have been reported to influence flowering, fruit set, fruit retention, development and quality characters of several fruit crops (Bhujbal *et al.*, 2013) [1]. Therefore, pruning in combination with application of plant growth regulators is necessary to get higher productivity with better quality.

Materials and Methods

The experiment was planned on four years old pomegranate trees at Gurrumpode village of Nalgonda district, Telangana. The orchard was laid out by adopting square systems with spacing of 3 × 4 m. Uniform trees were selected for the experiment. Standard package of practices were followed throughout the cropping season. The experiment was conducted on four years old, well grown, uniform statured trees of pomegranate Cv. Bhagwa. The experiment was laid out in a factorial completely randomized block design with three replications and twenty treatments *viz.*,The treatments consists of T_1: pruning (10 cm) + NAA @ 25 ppm, T_2: pruning (10 cm) + NAA @ 50 ppm, T_3: pruning (10 cm) + GA_3 @ 25 ppm, T_4: pruning (10 cm) + GA_3 @ 50 ppm, T_5: pruning (10 cm) + water spray, T_6: pruning (20 cm) + NAA @ 25 ppm,T_7: pruning (20 cm) + NAA @ 50 ppm, T_8: pruning (20 cm) + GA_3 @ 25 ppm, T_9: pruning (20 cm) + GA_3 @ 50 ppm, T_{10}: pruning (20 cm) + water spray, T_{11}: pruning (30 cm) + NAA @ 25 ppm, T_{12}: pruning (30 cm) + NAA @ 50 ppm, T_{13}: pruning (30 cm) + GA_3 @ 25 ppm,T_{14}: pruning (30 cm) + GA_3 @ 50 ppm, T_{15}: pruning (30 cm) + water spray, T_{16}: Control (Unpruned) + NAA @ 25 ppm, T_{17}: Control (Unpruned) + NAA @ 50 ppm, T_{18}: Control (Unpruned) + GA_3 @ 25 ppm, T_{19}: Control (Unpruned) + GA_3 @ 50 ppm and T_{20}: Control (Unpruned) + water spray observations regarding quality fruit were recorded. The pruning was carried out on main shoot and also subsequent secondary and tertiary shoots on whole plant, with different levels up to 10, 20, 30 cm shoot tip pruning and control (without pruning) from top end. Stock solution of NAA and GA_3 were prepared by dissolving one gram of these chemicals separately in 95 per cent alcohol and then made up to one liter by adding distilled water. The required concentrations of NAA and GA_3 solutions were obtained by diluting stock solution with water of required quantity. The solutions thus prepared were immediately used for spraying on the trees. The quality parameters were recorded

Results and Discussion

Fruit firmness (kg/cm^{-2})

The data with respect to fruit firmness as influenced by different levels of pruning and plant growth regulators and its interactions is presented in Table 1. The maximum fruit firmness (6.21 kg cm^{-2}) was observed in followed by NAA @ 50 ppm (6.17 kg cm^{-2}) was recorded and however, minimum fruit firmness (5.08 kg cm^{-2}) was noticed in water spray. Results revealed that among the different levels of pruning had significant effect on fruit firmness. The treatment pruning at 30 cm resulted in the maximum fruit firmness (5.99 kg cm^{-2}) which is on par with pruning at 20 cm (5.96 kg cm^{2}). Minimum fruit firmness (5.85 kg cm^{-2}) was recorded with control. The interaction of different levels of pruning and plant growth regulators shown variation Significantly high firmness (6.29 kg cm-^{2}) reading was recorded in GA3 @ 50 ppm in combination with pruning at 30 cm which is on par with GA3 @ 50 ppm in combination with pruning at 20 cm (6.26 kg cm-^{2}). The treatment NAA @ 50 ppm in combination with pruning at 30 cm (6.23 kg cm^{-2}) and GA3 @ 50 ppm in combination with pruning at 10 cm (6.22 kg cm^{-2}) is on par to NAA @ 50 ppm in combination with pruning at 20 cm (6.20 kg cm^{-2}). NAA @ 50 ppm in combination with pruning at 10 cm (6.19 kg cm^{-2}) and GA3 @ 25 ppm in combination with pruning at 30 cm (6.18 kg cm-^{2}) and minimum fruit firmness (5.05 kg cm-^{2}) was noticed in water spray in combination with control.

The ratio of cell wall to cell volume could have been increased in different levels of pruning and spray a plant growth regulators increases cell numbers, leading to improved fruit firmness. The proportion of hormones in cell walls is very important for the ripening of fruit. The increase of fruit hormone content leads to the increase in fruit firmness of fruit and delays fruit ripening. (Khurshid *et al*. 2019) [13] The above results are in agreement with Gianguzzi *et al*. (2017) [7].

Table 1: Effect of different levels of pruning and plant growth regulators on fruits firmness (kg/cm^{2}) of pomegranate Cv. Bhagwa.

Treatments	Pruning levels (P)				
PGRs (G)	P1	P2	P3	P4	Mean
G1- NAA @ 25 ppm	6.11	6.13	6.14	6.03	6.10
G2- NAA @ 50 ppm	6.19	6.20	6.23	6.06	6.17
G3- GA3 @ 25 ppm	6.14	6.16	6.18	6.05	6.13
G4- GA3 @ 50 ppm	6.22	6.26	6.29	6.08	6.21
G5- Water spray	5.08	5.09	5.12	5.05	5.08
Mean	5.95	5.96	5.99	5.85	
Factors	F test	SE(m)			CD at 5%.
PGRs (G)	*	0.02			0.05
Pruning (P)	*	0.02			0.06
Factor (GX P)	*	0.04			0. 12

Peel thickness (mm)

The data on the peel thickness was significantly affected by plant growth regulators. However; the maximum peel thickness (2.24 mm) was noticed in GA3 @ 50 ppm. and minimum peel thickness (2.02 mm) was observed in water spray. The data on the peel thickness was significantly affected by different levels of pruning. However, the maximum peel thickness (2.19 mm) was noticed in pruning at 30 cm and followed by peel thickness (2.17 mm) was observed in pruning at 20 cm and Lowest was recorded (2.08 mm) control.

The interaction between different levels of pruning and plant growth regulators was found to be significant on peel thickness. However, the maximum peel thickness (2.30 mm) was noticed in GA3 @ 50 ppm in combination with pruning at 30 cm and minimum peel thickness (2.01 mm) was observed in water spray in combination with control (Table 2).

This may be attributed to the reduction of fruits number in pruned trees which resulted in the diversion of more translocates to the remaining fruits thereby increasing the peel thickness; it may help to reduce thrips and other insect attack on fruits to improve quality of fruits in Cv. Bhagwa. Similar result was obtained by Sheikh and Rao (2002) [23] in pomegranate.

Table 2: Effect of different levels of pruning and plant growth regulators on fruits peel thickness (mm) of pomegranate Cv. Bhagwa.

Treatments	Pruning levels (P)				
PGRs (G)	P1	P2	P3	P4	Mean
G1- NAA @ 25 ppm	2.08	2.13	2.17	2.06	2.11
G2- NAA @ 50 ppm	2.17	2.22	2.26	2.13	2.19
G3- GA3 @ 25 ppm	2.12	2.19	2.21	2.07	2.14
G4- GA3 @ 50 ppm	2.25	2.28	2.30	2.15	2.24
G5- Water spray	2.02	2.03	2.04	2.01	2.02
Mean	2.13	2.17	2.19	2.08	
Factors	F test	SE(m)			CD at 5%.
PGRs (G)	*	0.02			0.06
Pruning (P)	*	0.02			0.06
Factor(GX P)	*	0.04			0. 13

Specific gravity (g cm^{-3})

The data on the specific gravity was significant affected by plant growth regulators. However, the maximum specific gravity (1.54 g cm-^{3}) was noticed in GA3 @ 50 ppm and minimum specific gravity (1.42 g cm^{-3}) was observed in water spray (Table 3). The data on the specific gravity was significant affected by different levels of pruning. However, the maximum specific gravity (1.52 g cm^{-3}) was noticed in pruning at 30 cm followed by pruning at 20 cm (1.50 g cm-^{3}) and minimum specific gravity (1.45 g cm-3) was observed in control. The interaction between different levels of pruning and plant growth regulators was found to be significant on specific gravity. However, the maximum specific gravity (1.63 g cm-3) was recorded in GA3 @ 50 ppm in combination with pruning at 30 cm and minimum specific gravity (1.41 g cm-3) was observed in water spray in combination with control.

The above results are in agreement with Sheikh and Rao (2002) [23], Nakorn *et al*. (2015) [16] in pummelo. The other possible reason for enhancement of fruit volume with different growth regulators and pruning might be due to their involvement in hormonal metabolism, increased cell division, elongation and expansion of cells. The results are in accordance with the findings reported by Hasani *et al.* (2012) [8] and Tanuja *et al*. (2016) [25] in pomegranate, Meena *et al.* (2016) [15] and and Ram Kumar *et al*. (2014) [19] in guava.

Table 3: Effect of different levels of pruning and plant growth regulators on specific gravity (g/cc) of pomegranate Cv. Bhagwa.

Treatments	Pruning levels (P)				
PGRs	P1	P2	P3	P4	Mean
PGRs (G)	1.48	1.49	1.50	1.46	1.48
G1- NAA @ 25 ppm	1.50	1.51	1.53	1.47	1.50
G2- NAA @ 50 ppm	1.49	1.50	1.52	1.46	1.49
G3- GA3 @ 25 ppm	1.52	1.55	1.63	1.47	1.54
G4- GA3 @ 50 ppm	1.42	1.43	1.43	1.41	1.42
G5- Water spray	1.48	1.50	1.52	1.45	
Mean	F test	SE(m)			CD at 5%.
Factors	*	0.00			0.01
PGRs (G)	*	0.00			0.01
Pruning (P)	*	0.00			0.01

Total Soluble Solids (^{0}Brix)

The data on the total soluble solids as affected by different levels of pruning and plant growth regulators and its interactions are presented in Table 4. The highest total soluble solid was recorded with water spray (16.51 °Brix) which was on par with NAA @ 25 ppm (16.39 °Brix) and GA3 @ 50 ppm (16.15 °Brix). The lowest total soluble solids noted in NAA @ 50 ppm (15.80 °Brix). The highest total soluble solids (16.52 °Brix) was observed in treatment pruning at 20 cm which was followed by pruning at 30 cm (16.23 °Brix) and significantly superior over the other treatments. While the lowest total soluble solids (15.80 °Brix) was obtained in control. The interaction effect of different levels of pruning and plant growth regulators shown significant variations and treatment the highest total soluble solids (17.70 °Brix) was recorded in NAA @ 25 ppm in combination with pruning at 20 cm which was on par with water spray in combination with pruning at 30 cm (17.10 °Brix). GA3 @ 25 ppm in combination with pruning at 20 cm (16.63 °Brix) and GA3 @ 50 ppm in combination with pruning at 30 cm (16.60 °Brix) is on par with NAA @ 25 ppm in combination with control. (16.33 °Brix). The lowest total soluble solids (15.39 °Brix) were noticed in NAA @ 25 ppm in combination with pruning at 30 cm. The maximum TSS in unpruned and fruits of pruning trees, as pruning intensity increase the TSS will maximum, it could be obviously due to the better availability of carbohydrates reserved stores in pruned shoots. The results are similar with the findings of Sheikh and Rao (2002) [23] in pomegranate, Prakash *et al.* (2012) [18] in guava, and Dahapute *et al*. (2018) [6] in custard apple.

Table 4: Effect of different levels of pruning and plant growth regulators on total soluble solids (^{0}Brix) of pomegranate Cv. Bhagwa.

Treatments	Pruning levels (P)				
PGRs (G)	P1	P2	P3	P4	Mean
G1- NAA @ 25 ppm	16.13	17.70	15.39	16.33	16.39
G2- NAA @ 50 ppm	16.20	15.73	15.66	15.60	15.80
G3- GA3 @ 25 ppm	16.13	16.63	16.43	15.43	16.15
G4- GA3 @ 50 ppm	15.90	16.16	16.60	15.43	16.02
G5- Water spray	16.40	16.36	17.10	16.20	16.51
Mean	16.15	16.52	16.23	15.80	
Factors	F test	SE(m)			CD at 5%.
PGRs (G)	*	0.06			0.18
Pruning (P)	*	0.07			0.21
Factor(GX P)	*	0.14			0.42

Total Sugars (%)

The data on total sugars of pomegranate Cv. Bhagwa as affected by different levels of pruning and plant growth regulators and its interactions were presented in the Table 5. The highest total sugars (15.29%) was observed with water spray followed by NAA @ 50 ppm (14.73%) which is on par with NAA @ 25 ppm (14.10%) and lowest total sugars(13.74%) was recorded in GA3 @ 25 ppm which is showed in Table 4.1.12 The data regarding the total sugars of pomegranate Cv. Bhagwa significantly affected by different levels of pruning. The treatment, pruning at 30 cm recorded highest total sugars (15.41%) followed by pruning at 10 cm (14.01). However, a lowest total sugar (13.60%) was observed in control. The interaction of different levels of pruning and plant growth regulators on total sugars shown significant variation. Highest total sugars (16.40%) was recorded in water spray in combination with pruning at 30 cm followed by NAA @ 50 ppm in combination with pruning at 30 cm and GA3 @ 25 ppm in combination pruning at 20 cm on par it recorded (16.23%). GA3 @ 50 ppm in combination with pruning at 30 cm (15.70%) and NAA @ 50 ppm in combination with pruning at 10 cm (15.63%) is on par to water spray in combination with control (15.50%). 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) [10] in custard apple.

Table 5: Effect of different levels of pruning and plant growth regulators on total sugars (%) of pomegranate Cv. Bhagwa.

Treatments	Pruning levels (P)				
PGRs (G)	P1	P2	P3	P4	Mean
G1- NAA @ 25 ppm	14.60	12.40	15.10	14.33	14.10
G2- NAA @ 50 ppm	15.63	12.09	16.23	12.33	14.73
G3- GA3 @ 25 ppm	12.57	16.23	13.63	12.50	13.74
G4- GA3 @ 50 ppm	12.63	13.66	15.70	13.38	13.84
G5- Water spray	14.63	14.63	16.40	15.50	15.29
Mean	14.01	13.80	15.41	13.60	
Factors	F test	SE(m)		CD at 5%.	
PGRs (G)	*	0.14		0.42	
Pruning (P)	*	0.16		0.47	
Factor(GX P)	*	0.32		0.94	

Reducing sugars (%)

Data pertaining to reducing sugars (%) of pomegranate Cv. Bhagwa as affected by different levels of pruning, plant growth regulators and its interaction are presented in Table 6. Significant difference was noted in relation to plant growth regulators; the highest reducing sugar (8.57%) was observed in GA3 @ 50 ppm and followed by NAA @ 25 ppm (8.19%) and lowest reducing sugar (7.80%) which was on par with GA3 @ 25 ppm and NAA @ 50 ppm. The different levels pruning had significant effect on reducing sugars. The treatment, control noted highest reducing sugars (8.46%) followed by pruning at 30 cm (8.10%). However, lowest reducing sugars (7.88%) was observed in pruning 10 cm. The interaction effect of different levels of pruning and plant growth regulators on reducing sugars shown significant variation maximum reducing sugars (10.00%) was recorded in NAA @ 25 ppm in combination with pruning at 30 cm. followed by NAA @ 50 ppm in combination with pruning at 10 cm (8.86%). NAA @ 25 ppm in combination with control (8.76%) is and par with GA3 @ 50 ppm in combination with pruning at 10 cm (8.56%). it on par to GA3 @ 50 ppm in combination with control (8.53%) is on par to water spray in combination with control (8.40%). The lowest reducing sugar (5.76%) was noticed in NAA @ 50 ppm in combination with pruning at 30 cm.

Regarding to plant growth regulators and pruning, improvement in reducing sugars and non-reducing sugars might be attributed due to reduced branches because of pruning which resulted in more synthesis, transport and accumulation of sugars in the remaining fruits. The results are in close conformity with Casierra *et al.* (2007) [3] in apple. Further, growth regulators play great importance in sugar metabolism. Pruning play major role in sugars metabolism and translocation and similar results were reported by Yadav *et al.* (2017) [27] in pomegranate.

Table 6: Effect of different levels of pruning and plant growth regulators on reducing sugars (%) of pomegranate Cv. Bhagwa.

Treatments	Pruning levels (P)				
PGRs (G)	**P1**	**P2**	**P3**	**P4**	**Mean**
G1- NAA @ 25 ppm	6.56	7.43	10.00	8.76	8.19
G2- NAA @ 50 ppm	8.86	8.30	5.76	8.30	7.80
G3- GA3 @ 25 ppm	7.20	8.26	7.46	8.30	7.80
G4- GA3 @ 50 ppm	8.56	8.10	9.10	8.53	8.57
G5- Water spray	8.23	7.83	8.20	8.40	8.16
Mean	7.88	7.98	8.10	8.46	
Factors	F test	SE(m)			CD at 5%.
PGRs (G)	*	0.06			0.17
Pruning (P)	*	0.06			0.19
Factor(GX P)	*	0.13			0.39

Non-reducing sugars (%)

The data on the non-reducing sugars (%) as affected by different levels of pruning, plant growth regulators and its interactions are presented in Table 7 reveals that non-reducing sugars (%) differed significantly among the plant growth regulators (GA3 @ 50 ppm, GA3 @ 25 ppm, NAA @ 50 ppm, NAA @ 25 ppm and water spray) Significant difference was noted in relation to plan growth regulators, the highest non reducing sugar (6.92%) was observed in water spray and followed by GA3 @ 25ppm (5.92%) and lowest non-reducing sugars (5.26%) was observed in GA3 @ 50 ppm. The data regarding the non-reducing sugars (%) of pomegranate Cv. Bhagwa was significantly affected by different levels of pruning. The treatment, pruning at 30 cm recorded a highest non-reducing sugar (6.86%) which was followed by the pruning at 20 cm (5.81%). However, lowest non-reducing sugars (5.16%) was observed in control. The interaction effect of different levels of pruning and plant growth regulators on non-reducing sugars shown significant variation highest non-reducing sugars (8.56%) was recorded in NAA @ 50 ppm in combination with pruning at 30 cm followed by GA3 @ 25 ppm in combination with pruning at 20 cm (7.96%) is on par to water spray in combination with pruning at 30 cm (7.53%) followed by water spray in combination with control (6.96%). and also water spray in combination with pruning at 20 cm (6.80%) is on par to NAA @ 50 ppm in combination with pruning at 10 cm (6.76%) is on par to GA3 @ 50 ppm in combination with pruning at 30 cm (6.60%). Data revealed water spray in combination with pruning at 10 cm (6.40%), GA3 @ 25 ppm in combination with pruning at 30 cm (6.16%) and NAA @ 25 ppm in combination with pruning at 10 cm (6.03%) and minimum non-reducing sugars (3.79%) was recorded in NAA @ 50 ppm in combination with pruning at 20 cm. The maximum non-reducing sugars (8.96%) were observed in treatment pruning at 30 cm. This might due to increased nutrient uptake by the trees and consequently more synthesis of carbohydrates and other metabolites and their translocation to the fruits. Application of plant growth regulators and pruning increases the non reducing sugars of fruits in pomegranate. The increase in sugar and different fraction of sugars might be due to plant growth regulators application and pruning probably augmented the conversion of starch to sugar and it has also been opined that plant growth regulators application and pruning increases transportation of sugars, hydrolysis of complex polysaccharides into simple sugars, synthesis of metabolites and rapid translocation of photosynthates and minerals from other parts of the plant to developing fruits (Sankar *et al.*, 2013) [20].

Table 7: Effect of different levels of pruning and plant growth regulators on non- reducing sugars (%) of pomegranate Cv. Bhagwa

Treatments	Pruning levels (P)				
PGRs (G)	**P1**	**P2**	**P3**	**P4**	**Mean**
G1- NAA @ 25 ppm	6.03	4.97	5.43	5.56	5.50
G2- NAA @ 50 ppm	6.76	3.79	8.56	4.23	5.84
G3- GA3 @ 25 ppm	5.37	7.96	6.16	4.20	5.92
G4- GA3 @ 50 ppm	4.06	5.56	6.60	4.83	5.26
G5- Water spray	6.40	6.80	7.53	6.96	6.92
Mean	5.72	5.81	6.86	5.16	
Factors	F test	SE(m)			CD at 5%.
PGRs (G)	*	0.10			0.29
Pruning (P)	*	0.11			0.33
Factor(GX P)	*	0.23			0.66

Titrable acidity (%)

Significant variation was observed among the different levels of pruning and plant growth regulators. The collective data revealed that significant variation was recorded in plant growth regulators (NAA @ 25 ppm, NAA @ 50 ppm, GA3 @ 25 ppm, GA3 @ 50 ppm and water spray) Table 8. However, the highest titrable acidity (0.75%) was observed in water spray followed by NAA @ 25 ppm (0.71%).The lowest titrable acidity (0.66%) was observed in GA3 @ 50 ppm treatment. The different levels of pruning had significant effect on titrable acidity. The maximum titrable acidity (0.71%) was observed in control and followed by pruning at 10 cm (0.70%). However, lowest titrable acidity (0.67%) was observed in the pruning at 30 cm. The interaction of different levels of pruning and plant growth regulators was found to be non-significant effect on titrable acidity. The highest titrable acidity (0.78%) was recorded in water spray in combination

with control and followed by water spray in combination with pruning at 10 cm (0.76%). And lowest titrable acidity (0.64%) was noticed in which is on par with NAA @ 25 ppm and GA3 @ 50 ppm in combination with pruning at 30 cm.
However, remarkable difference was observed among all the treatments under this investigation for this attribute. Hence, the treatments were statistically significantly at this stage. No significant differences observed between plant growth regulators and different levels of pruning it was no significant.

Table 8: Effect of different levels of pruning and plant growth regulators on titrable acidity (%) of pomegranate Cv. Bhagwa.

Treatments	Pruning levels (P)				
PGRs (G)	P1	P2	P3	P4	Mean
G1- NAA @ 25 ppm	0.71	0.73	0.68	0.71	0.71
G2- NAA @ 50 ppm	0.68	0.66	0.64	0.70	0.67
G3- GA3 @ 25 ppm	0.70	0.69	0.66	0.70	0.68
G4- GA3 @ 50 ppm	0.67	0.65	0.64	0.68	0.66
G5- Water spray	0.76	0.75	0.74	0.78	0.75
Mean	0.70	0.69	0.67	0.71	
Factors	F test	SE(m)			CD at 5%.
PGRs (G)	*	0.004			0.010
Pruning (P)	*	0.004			0.011
Factor(GX P)	N.S	-			-

Ascorbic acid (mg/100 ml of juice)
The data presented in the Table 9 revealed that there were no significant differences in the ascorbic acid with the plant growth regulators (NAA @ 25 ppm, NAA @ 50 ppm, GA3 @ 25 ppm, GA3 @ 50 ppm and water spray).However, highest ascorbic acid (13.66%) was observed in which is on par with NAA @ 50 ppm and GA3 @ 25 ppm and lowest ascorbic acid (13.00%) was observed in also which is on par between NAA @ 25 ppm and GA3 @ 50 ppm. The data on the ascorbic acid was significantly affected by different levels of pruning. The treatment, pruning at 20 cm and pruning at 30 cm ascorbic acid (13.53%) which is recorded on par and the lowest which is on par to ascorbic acid pruning at 10 cm and control ascorbic acid (13.13%) was observed The interaction between different levels of pruning and plant growth regulators was found to be significant on ascorbic acid. However, highest ascorbic acid (15.00%) was observed in GA3 @ 25 ppm in combination with pruning at 30 cm and lowest ascorbic acid (12.33%) in NAA @ 25 ppm and GA3 @ 25 ppm in combination with pruning at 10 cm, pruning at 20 cm and control. Singh and Brahmachari (1999) [24] in guava also found an increase in vitamin C content of fruits with plant growth regulators spray. The higher ascorbic acid (vitamin C) levels during early stages of fruit growth may be attributed to adequate supply of hexose sugars via photosynthetic activity (Sharma, 1984) [21].

Table 9: Effect of different levels of pruning and plant growth regulators on ascorbic acid content (mg/100 g of arils weight) of pomegranate Cv. Bhagwa.

Treatments	Pruning levels (P)				
PGRs (G)	P1	P2	P3	P4	Mean
G1- NAA @ 25 ppm	12.33	14.66	12.66	12.33	13.00
G2- NAA @ 50 ppm	13.00	13.66	14.33	13.66	13.66
G3- GA3 @ 25 ppm	13.33	12.33	15.00	14.00	13.66
G4- GA3 @ 50 ppm	13.00	13.00	13.00	13.00	13.00
G5- Water spray	14.00	14.00	12.66	12.66	13.33
Mean	13.13	13.53	13.53	13.13	
Factors	F test	SE(m)			CD at 5%.
PGRs (G)	N.S	-			-
Pruning (P)	*	0.19			0.57
Factor(GX P)	*	0.39			1.14

Shelf life (Days)
The data pertaining to shelf life of pomegranate Cv. Bhagwa as influenced by different levels of pruning and plant growth regulators and its interactions are presented in Table 10. The data presented revealed that there was no significant differences in the shelf life at ambient temperature with the maximum shelf life (16.25 days) was noticed in GA3 @ 50 ppm and followed by NAA @ 25 ppm shelf life (15.66 days) was recorded and lowest in water spray(14.16%) was recorded during the shelf life. The data on the shelf life was significantly affected by different levels of pruning. However, the maximum shelf life (16.20 days) was noted in pruning 10 cm and minimum shelf life (13.60 days) was recorded in control. The interaction between different levels of pruning and plant growth regulators was found to be significant on shelf life. However, highest shelf life (19.00 days) was observed in GA3 @ 50 ppm in combination with pruning at 20 cm and lowest shelf life (11.00 days) in water spray in combination with control.
This might be due to chemical changes within the fruits resulted in retention of more water against the rate of evaporation. Further increase in shelf life in pomegranate might be due to less breakdown of glucose and all other forms of organic compounds metabolized in the fruit tissue results in slow release of free water which reduces the metabolism as well as the rate of respiration (Katiyar *et al.*, 2008) [12].

Table 10: Effect of different levels of pruning and plant growth regulators on shelf life (days) of pomegranate Cv. Bhagwa.

Treatments	Pruning levels (P)				
PGRs (G)	P1	P2	P3	P4	Mean
G1- NAA @ 25 ppm	15.00	14.00	18.00	15.66	15.66
G2- NAA @ 50 ppm	17.00	13.66	16.00	15.33	15.50
G3- GA3 @ 25 ppm	14.66	16.00	14.00	13.00	14.41
G4- GA3 @ 50 ppm	18.00	19.00	15.00	13.00	16.25
G5- Water spray	16.33	13.33	16.00	11.00	14.16
Mean	16.20	15.20	15.80	13.60	
Factors	F test	SE(m)			CD at 5%.
PGRs (G)	*	0.37			1.08
Pruning (P)	*	0.42			1.21
Factor(GX P)	*	0.84			2.43

Conclusion
Finally it can be concluded that GA_3 @ 50 ppm in combination with pruning at 30 cm followed by NAA @ 50 ppm and GA_3 @ 25 ppm in combination with pruning at 30 cm be recommended for getting good quality for hasta bahar crop in Telangana state.

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