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Effect of foliar application of gibberellic acid (GA_3) and nutrients on yield and quality of pomegranate (*Punica granatum* L.) cv. Bhagwa

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Abstract
Present study was conducted in the farmer's field of Hire Samshi village, in Bagalkot taluk of Bagalkot district during 2016-17 with an objective of to study the effect of foliar application of gibberellic acid and nutrients on yield and quality of pomegranate cv. Bhagwa. The Experiment was consisted of nine treatments with three replications laid in Randomised block design. Treatment details include T_1- GA_3 @ 50 ppm, T_2- GA_3 @ 100 ppm, T_3- GA_3 @ 50 ppm + calcium nitrate (2 %)+ borax (0.2 %) + KNO_3 (2 %), T_4- GA_3@ 50ppm + calcium nitrate (2 %) + borax (0.2 %) + SOP(2 %),T_5- GA_3 @ 100 ppm + calcium nitrate (2 %) + borax (0.2%)+ KNO_3(2 %),T_6 - $GA_3$100 ppm + calcium nitrate (2 %)+ borax (0.2%) + SOP (2 %), T_7- Calcium nitrate (2 %)+ borax (0.2%) + KNO_3(2 %), T_8- Calcium nitrate (2 %)+ borax (0.2 %) + SOP(2 %), T_9- control (water spray). Among the different treatments the foliar application of GA_3@ 50 ppm + calcium nitrate 2 % + borax 0.2 % + SOP 2 % (T_4) has recorded highest fruit length (94.62 mm), fruit diameter (93.63 mm), fruit volume (448.67 ml), number of arils (719.33), total aril weight (297.67g) 100 aril weight(44.00g), peel weight (156.00 g), fruit weight (431.67 g), yield per plant (44.11 Kg) and yield per hectare (34.15tonnes/ha) compared to control which recorded lower yield (26.27 t/ha) and yield attributes. With respect to quality parameters high total sugar (14.64 %), reducing sugar (12.69 %), total soluble solids (15.50º Brix) content, Sugar/acid ratio (23.33 %), ascorbic acid content (15.37 mg 100 g^{-}) and juice (56.33%), highest shelf life (27.02 days) and least physiological loss in weight (14.28 %), where as highest physiological loss in weight (18.51 %) and minimum shelf life (20.19days) was recorded in control.

Keywords: *Punica granatum* L., pomegranate, gibberellic acid

Introduction
Pomegranate (*Punica granatum* L.) belongs to family Lythraceae being grown since ancient times for its fruits, ornamental and medicinal purposes. It is commonly known as 'Anar' in Hindi and 'Dalimbe' in Kannada. Pomegranate is a favourite table fruit of tropical and subtropical countries. India is the world leading country in pomegranate production. Total area under pomegranate in India is 1.93 lakh hectares, and total production in India is 21.98 lakh tonnes with a productivity of 11.39 tonnes/ha (Anon, 2017) [4]. Plant hormones are also known to improve fruit size, appearance and aril quality by having direct effects on fruit growth and development or indirectly by regulating crop load, tree vigour and canopy architecture. Pomegranate production is governed by several factors like soil, climate, irrigation status, varieties, pest and disease situation and nutritional status of soil as well as the plant. Deficiency of various nutrients causes drastic reduction in growth, yield and quality of pomegranate. Due to non-adoption of improved cultivation practices and several other horticultural practices, the growth and development of fruit, yield and quality are generally poor. Among different elite horticultural practices, use of growth regulators and nutrients have been advantageously used in the recent times to increase the fruit production and to improve the quality. Present investigation helps to find a suitable growth regulators and nutrients their doses and time of application on the yield and quality of pomegranate cv. Bhagwa.

Material and Methods
The field experiment was conducted in the farmer's field of Hiresamshi village of Bagalkot taluk of Bagalkot district. It is situated in the Northern Dry Zone (Zone-3) of Karnataka. The soil possessed slightly alkaline pH (7.70) with EC of 0.44 dS/m and having red soil. The major

nutrients *viz*., N, P_2O_5 and K_2O were 220.17 kg/ha, 43.90 kg/ha and 208.98 kg/ha, respectively. The average rainfall of 277.00 mm during crop growth period from September 2016 to March 2017. Mean relative humidity of morning and afternoon was 61.00 per cent and 40.43 per cent, respectively. The average maximum and minimum temperature was 30.00 and 17.29 °C, respectively. The experiment was laid out in a Randomized Block Design (RBD) with nine treatments, replicated thrice. Each treatment consisted of three plants in each replication were selected for recording biometric observations till harvest.

The treatments were imposed to pomegranate trees after fruit set. The foliar spray of gibberellic acid and nutrients (B, Ca) solutions were given in two intervals of time, 45 and 90 days after fruit set, KNO_3 and SOP at 15 days before harvest. Approximately 2 litre of spray solution per plant was used. Other cultural operations were attended regularly and timely in the experimental plot along with effective management of pest and disease during the experiment period. Gibberellic acid solution was prepared by dissolving 50 mg (50 ppm) and 100 mg (100 ppm) gibberellic acid (Pro Gibb) in approximately 25 ml absolute alcohol (95 %) then it was diluted with water to make 1000 ml solution. The borax 0.2 percent solution was prepared by weighing 2 gram of borax and dissolved in 1000 ml of water (2 gram per litre of water).The calcium nitrate 2 percent solution was prepared by weighing 20 gram of calcium nitrate and dissolved in 1000 ml of water (20 gram per litre of water). The potassium nitrate 2 percent and sulphate of potash 2 percent solution were prepared by weighing 20 gram of Potassium nitrate and sulphate of potash dissolved in 1000 ml of water respectively.

From each treatment, five fully matured fruits were randomly selected for studying the yield attributes. Fruit length and diameter in each treatment was measured with the help of digital vernier calipers and it was expressed in millimeters (mm). Volume of the fruits was recorded by water displacement method and expressed in ml. The numbers of arils per fruit was physically counted after harvesting and were expressed as number per fruit. Mean weight of arils of each fruit and 100 arils weight were expressed in gram (g). Weight of the fruits was recorded in digital analytical balance and expressed in grams (g). The average value of the five fruits was calculated for statistical analysis. The yield of the fruits per plant was recorded at the time of harvest and expressed in kilograms (kg/plant). The yield per hectare was computed by multiplying the yield per plant with the number of plant that can be accommodated in one hectare and was expressed in tonnes per hectare. The fruit quality parameters such as total soluble solids, titrable acidity, reducing and non-reducing sugars were recorded from fruits after harvest. The total sugar content of the pomegranate juice was estimated by anthrone reagent method. The reducing sugars in the juice were determined by Dinitro-Salicylic acid (DNSA) method (Miller, 1972) [16]. The total titrable acidity was determined in terms of citric acid by titrating against standard NaOH solution as per A.O.A.C. (Anon., 1960). The vitamin C or ascorbic acid content of juice was determined by Dye (dichlorophenol indophenol) binding method and the values were expressed as mg per 100 g of sample (Anon., 1980) [3]. Juice was extracted from arils by using manual juice

Extractor and expressed in percentage. Peel thickness was measured with the help of digital vernier calipers at widest middle point where maximum girth was noticed and it was expressed in millimeters (mm). Weight of the rind was recorded in digital analytical balance and expressed in grams (g). The initial weight of fruits was recorded on electric top pan balance in each treatment. Thereafter the weights of fruits under each treatment were recorded at four days interval after storage. The cumulative losses in weight were calculated and expressed as per cent physiological loss in weight.

Results and Discussion

Yield parameters: As observed in the present study, maximum length, diameter and volume of the fruit was recorded with the application of GA_3 and nutrients in combination as compared to application of only GA_3 and only nutrients (Table 1). Among the treatments the maximum fruit length (94.62 mm), fruit diameter (93.63 mm) and fruit volume (448.67 ml) were recorded in treatment (T_4) ofGA_3 @ 50 ppm+ calcium nitrate 2% + borax 0.2% + SOP2% (Fig.2).However, the minimum fruit length (77.87 mm), diameter (71.33 mm) and volume of the fruit (354.33 ml) were recorded in T_9 (control).This might be due to stimulation of cell elongation and membrane permeability by GA_3 which resulted in higher water uptake (Chaudhary *et al.* 2006) [7]. These results might be due to the fact that the combined effects of gibberellic acid and calcium on cell division and cell elongation. Gibberellic acid is reported to promote growth by increasing plasticity of the cell wall followed by the hydrolysis of starch into sugars which reduces the cell water potential, resulting in the entry of water into the cell and causing elongation (Richard, 2006) [19]. The number of arils per fruit, total aril weight and 100 aril weight were significantly influenced by various treatments (Table 2). Highest number of arils per fruit (719.33), total aril weight (297.67 g) and 100 aril weight (44.00g) was observed in T_4(GA_3 @ 50 ppm + calcium nitrate 2% + borax0.2% + SOP 2 %) while, lowest were found in T_9 (control). As gibberellic acid plays a major role in regulating assimilation and supply to developing sink (Taiz and Zieger. 2002) [21]. The same lines of findings were recorded by Merwad, *et al*. (2016) [15]. Both calcium and boron might have involved in assimilation and accelerate the processes of fruit growth. Findings similar to the present study were reported by (Sarrwy *et al*., 2012) [20]. There was no influence of treatments on number of fruits per plant because; the treatments were imposed after fruit set (45 and 90 days after fruit set).

The results pertaining to weight of fruit showed that, the maximum fruit weight (431.67 g) was obtained in T_4 (GA_3 @ 50 ppm + calcium nitrate 2 % + borax 0.2 % + SOP2 % (Fig.3) and which was statistically on par with T_3 (422.00 g) and T_5 (408.67 g). While the lowest fruit weight (339.00 g) was recorded in T_9 (control). This might be due to the interaction effect of gibberellic acid boron as they involved in faster loading and mobilization of photo assimilates to fruits and involvement in cell division and cell expansion which ultimately reflected into more weight of fruit in treated plants. Findings similar to the present study were reported by Digrase *et al*. (2016) [8], Bhatt *et al.* (2012) [6], and Yadlod and Kadam (2008) [22].

Yield per plant and per hectare was significantly influenced by different treatments (Table 4). Among the combination treatments, the highest yield per plant (44.11 kg) and yield per hectare (34.15t/ha) was obtained inT_4 (GA_3@ 50 ppm+ calcium nitrate 2 % + borax 0.2 %+ SOP2 %), which was statistically on par with T_3- GA_3 @ 50 ppm + calcium nitrate 2 % + borax 0.2 % + KNO_3 2 % (33.31 t/ha). With respect to yield T_1, T_2, T_5, and T_6 were statistically on par with each other and superior over the T_7 and T_8. The minimum yield per plant (33.93 Kg) and yield per hectare (26.27t/ha) was

recorded in control T_9. Generally, increasing fruit yield and its component with spraying of GA_3 and $CaCl_2$ may be due to the role of GA_3 and Ca on fruit formation, abscission, cell elongation and fruit retention percentage (Aboutalebiand Beharoznam, 2006) [1]. Increasing fruit yield is due to boron and/or calcium spray may be attributed to their effect an increasing fruit set and also it may attributed to the role of boron in enhancing many metabolic processes such as carbohydrate transport (Mengel *et al*., 2001) [14].

Quality parameters: Among the treatments, the highest total sugar (14.64 %) was recorded in T_4 (GA_3@ 50 ppm + calcium nitrate 2 % + borax 0.2 % +SOP 2 %), which was statistically on par with T_3(14.04 %) and the higher reducing sugar (12.69 %) was recorded in T_4 (GA_3@ 50 ppm+ calcium nitrate 2 % + borax 0.2 % +SOP2 %), which was statistically on par with T_3 (12.10 %). While, the lowest total sugars (13.27 %) and reducing sugars (10.30 %) were recorded in T_9 (Control). This may be due to the fact that application gibberellic acid and nutrients as foliar spray probably improved the physiology of leaves, thereby causing better translocation of vital components in the fruit followed by assimilation and utilization of photosynthates by the developing fruit. The significant improvement in reducing sugar might be due to formation and translocation of carbohydrate which improves the fruit quality which was reported by Pathak *et al.* (2008) [17]. These positive effects of boron on reducing sugar were also in agreement with the findings of Bhatt *et al*. (2012) [6], in mango. The non-reducing sugar content of fruits did not varied significantly among the treatments.

The higher total soluble solids and TSS/acid ratio (15.23^0 Brix and 23.33%) was observed in the treatment T_4 (GA_3 @ 50 ppm + calcium nitrate 2% + borax 0.2% + SOP2%), which was followed by T_3- GA_3 @ 50 ppm + calcium nitrate 2 % + borax 0.2 % + KNO_3 2 %(15.04 ^{0}Brix and (21.32 %). while the lowest TSS and TSS/acid ratio (12.60 ^{0}Brix and 15.05 % respectively) was recorded in control. It may be the reason that the spraying of GA_3 has influenced the physiological processes, particularly respiration and photosynthesis, which ultimately leads to accumulation of more dry matter, minerals and carbohydrates in fruit; it might be due to the increased activity of amylase by application of GA_3 as reported by Pawar *et al.* (2005) [18]. Boron facilitates the sugar transport within the plant and potassium has prominent role in translocation of photo-assimilates; sugars and other soluble solids. These results are in accordance with the earlier findings of Kumar *et al.* (2015) and Mandal *et al*. (2012) [13], in guava. The reduction in acidity might be due to more accumulation of sugars in the fruit.The similar results were obtained by Eiada *et al.* (2013) [9], and Hasani *et al.* (2012) [11], in pomegranate.

Among the treatments, the highest juice percent (56.33 %) was recorded in T_4 (GA_3 @ 50 ppm+ calcium nitrate 2 % + borax 0.2 %+ SOP2 %), which was followed by T_3 (52.33 %). Similarly, treatments like T_1, T_2, T_5 and T_6 were statistically on par with each other. The highest level of ascorbic acid content (15.37 mg $100g^{-1}$) was noticed in T_4 (GA_3@ 50 ppm+ calcium nitrate 2 % + borax 0.2 % + SOP2 %), which was followed by T_3 and T_5 (14.74 mg $100g^{-1}$ and 14.24 mg $100g^{-1}$ - respectively). Higher fruit weight and aril weight in this treatment might have resulted in maximum juice content per fruit. Similar findings were observed by Merwad *et al*. (2016) [15]. The increase in ascorbic acid content in treated fruits was due to stimulated actions of enzymes responsible for synthesis of ascorbic acid and its precursor (Glucose- 6-phosphate) and additive effect of slow rate of oxidation in respiration process. These results are found inconformity with the reports of Heshi, *et al.* (2001) [12]. in pomegranate. K could have helped to slow down the enzyme system that encouraged the oxidation of ascorbic acid, thus helping the plants to accumulate more ascorbic acid content in fruits (Ananthi, 2002) [21]. Maximum peel thickness and peel weight (3.54mm and 156.00 g respectively) was recorded in T_4. While, the lowest peel thickness and peel was recorded in T_9 (control). Higher fruit weight and fruit size were responsible for higher peel weight in plants applied with GA_3 @ 50 ppm + calcium nitrate 2% + borax 0.2% + SOP 2 %. The improved firmness and peel thickness of fruit is the result of foliar application of nutrients in present investigation might be because it improved the internal physiology of developing fruit in terms of better supply of water, nutrients and other compounds vital for their proper growth and development. These results were in conformity with the findings of Merwad *et al.* (2016**)** [15], and Hamouda *et al.* (2015) [10]. Physiological loss in weight of pomegranate fruits at 4th, 8th, 12th, 16th and 20th days after storage under room temperature as influenced by the foliar spray of gibberellic acid and nutrient son pomegranate cv. Bhagwa Lowest PLW was observed in T_4 (GA_3 @ 50 ppm+ calcium nitrate 2 % + borax 0.2 % + SOP 2 %) at 4th, 8th, 12th, 16th and 20th days (4.32 %, 8.99 %, 11.16 %, 18.87 % and 28.04 % respectively) Whereas, maximum was observed in T_9 (Control). The increase in the evapo – transpiration changes with progress of storage period might be responsible for high PLW of fruits. The decrease in weight loss by the application of mineral nutrients may be due to its role in the maintenance of fruit firmness, retardation of respiratory rates as well as transpiration. Similar kinds of findings were reported in aonla (*Emblica officinalis* Gaertn) fruits by Singh *et al.* (2014) and (Bangirth *et al.*, 1972; Singh *et al.*, 2001) [5].

With respect to shelf life of the fruits, the application of GA_3 and nutrients in combination was shown more shelf life as compared to only GA_3 and only nutrients. The maximum shelf life (27.02 days) was reported inT_4 (GA_3 @ 50 ppm+ calcium nitrate 2 % + borax 0.2 % + SOP 2 %),which was followed by T_3 (25.30 days). Whereas, the minimum shelf life (20.19 days) was recorded in T_9 (control). The improvement in shelf life might be due to lower physiological loss in weight and higher peel thickness. Calcium compounds extend the shelf-life of fruits by maintaining firmness, minimizing rate of respiration, protein breakdown, disintegration of tissues. The similar results were obtained in mango by Bhatt *et al*. (2012) [j].

Table 1: Effect of foliar application of gibberellic acid and nutrients on fruit growth parameters of pomegranate cv. Bhagwa

Treatment	Fruit length (mm)	Fruit diameter (mm)	Fruit volume (ml)
T_1- GA_3 @ 50 ppm	91.07	89.50	423.33
T_2- GA_3 @ 100 ppm	89.04	87.92	420.00
T_3- GA_3 @ 50ppm+calcium nitrate (2%)+borax (0.2%) + KNO_3 (2%)	91.70	91.10	435.33
T_4- GA_3 @ 50 ppm+ calcium nitrate (2%)+borax (0.2 %) + SOP (2%)	94.62	93.63	448.67
T_5- GA_3 @100 ppm+ calcium nitrate (2%)+ borax (0.2%) + KNO_3 (2%)	90.67	88.77	428.67
T_6- GA_3 @ 100 ppm+ calcium nitrate(2%)+borax (0.2%) + SOP (2%)	89.67	87.00	422.67

T_7- Calcium nitrate(2%)+borax (0.2%) +KNO_3(2%)	86.37	84.87	393.67
T_8- Calcium nitrate(2%)+borax (0.2%) +SOP (2%)	84.50	84.00	383.00
T_9- Control(water spray)	77.87	71.33	354.33
S. Em.±	0.77	0.93	6.25
C.D. at 5% 0.5% + Molybdenum 0.1%	2.32	2.77	18.72

SOP – Sulphate of potash; KNO_3– Potassium nitrate

Table 2: Effect of foliar application of gibberellic acid and nutrients on number of arils, 100 aril weight (g) and total aril weight (g) of pomegranate cv. Bhagwa

Treatment	Number of arils	100 aril weight(g)	Total aril weight(g)
T_1- GA_3 @ 50 ppm	681.00	41.33	269.33
T_2- GA_3 @ 100 ppm	646.67	40.00	257.33
T_3- GA_3 @ 50ppm+calcium nitrate (2%)+borax (0.2%) + KNO_3(2%)	679.00	42.47	275.33
T_4- GA_3 @ 50 ppm+ calcium nitrate (2%)+borax (0.2 %) + SOP (2%)	719.33	44.00	297.67
T_5- GA_3 @100 ppm+ calcium nitrate (2%)+ borax (0.2%) + KNO_3(2%)	672.00	39.33	263.00
T_6- GA_3 @ 100 ppm+ calcium nitrate (2%)+borax (0.2%) + SOP (2%)	652.67	40.31	256.33
T_7- Calcium nitrate (2%)+borax (0.2%) +KNO_3(2%)	608.67	38.26	229.00
T_8- Calcium nitrate (2%)+borax (0.2%) +SOP (2%)	599.00	37.00	226.00
T_9- Control(water spray)	503.00	34.25	197.67
S. Em.±	5.00	0.57	1.90
C.D. 5% 0.5% + Molybdenum 0.1%	14.98	1.72	5.70

SOP – Sulphate of potash; KNO_3– Potassium nitrate

Table 3: Effect of foliar application of gibberellic acid and nutrients on fruit weight (g), peel weight (g) and peel thickness (mm) of pomegranate cv. Bhagwa

Treatment	Fruit weight (g)	Peel weight (g)	Peel thickness (mm)
T_1- GA_3 @ 50 ppm	405.33	151.41	3.15
T_2- GA_3 @ 100 ppm	401.00	149.67	3.04
T_3- GA_3 @ 50ppm+calcium nitrate (2%)+borax (0.2%) + KNO_3(2%)	422.00	152.67	3.20
T_4- GA_3 @ 50 ppm+ calcium nitrate (2%)+borax (0.2 %) + SOP (2%)	431.67	156.00	3.54
T_5- GA_3 @100 ppm+ calcium nitrate (2%)+ borax (0.2%) + KNO_3(2%)	408.67	143.33	2.89
T_6- GA_3 @ 100 ppm+ calcium nitrate (2%)+borax (0.2%) + SOP (2%)	404.00	149.10	3.01
T_7- Calcium nitrate (2%)+borax (0.2%) +KNO_3(2%)	375.33	148.73	2.34
T_8- Calcium nitrate (2%)+borax (0.2%) +SOP (2%)	367.33	140.93	2.57
T_9- Control (water spray)	339.00	124.33	2.01
S. Em.±	7.78	1.20	0.11
C.D. at 5% 0.5% + Molybdenum 0.1%	23.31	3.59	0.32

SOP – Sulphate of potash; KNO_3– Potassium nitrate

Table 4: Effect of foliar application of gibberellic acid and nutrients on number of fruits per plant and fruit yield of pomegranate cv. Bhagwa

Treatment	Number of fruits per plant	Yield per plant (kg)	Yield per hectare (t)
T_1- GA_3 @ 50 ppm	101.67	40.47	31.33
T_2- GA_3 @ 100 ppm	98.67	39.90	30.89
T_3- GA_3 @ 50ppm+calcium nitrate (2%)+borax (0.2%) + KNO_3(2%)	105.33	42.17	33.31
T_4- GA_3 @ 50 ppm+ calcium nitrate (2%)+borax (0.2 %) + SOP (2%)	102.00	44.11	34.15
T_5- GA_3 @100 ppm+ calcium nitrate (2%)+ borax (0.2%) + KNO_3(2%)	100.67	41.15	31.86
T_6- GA_3 @ 100 ppm+ calcium nitrate (2%)+borax (0.2%) + SOP (2%)	101.33	40.25	31.17
T_7- Calcium nitrate (2%)+borax (0.2%) +KNO_3(2%)	103.67	38.68	29.95
T_8- Calcium nitrate (2%)+borax (0.2%) +SOP (2%)	105.00	37.50	29.03
T_9- Control (water spray)	100.00	33.93	26.27
S. Em.±	2.23	0.55	0.47
C.D. at 5% 0.5% + Molybdenum 0.1%	NS	1.65	1.39

SOP – Sulphate of potash; KNO_3– Potassium nitrate

Table 5: Effect of foliar application of gibberellic acid and nutrients on total soluble solids (^{0}Brix), acidity (%) and ascorbic acid (mg 100 g$^-$) of pomegranate cv. Bhagwa

Treatment	TSS (^{0}Brix)	Acidity (%)	Ascorbic acid (mg 100 g$^-$)
T_1- GA_3 @ 50 ppm	14.34	0.68	14.04
T_2- GA_3 @ 100 ppm	14.00	0.71	14.00
T_3- GA_3 @ 50ppm+calcium nitrate (2%)+ borax (0.2%) + KNO_3(2%)	15.04	0.66	14.74
T_4- GA_3 @ 50 ppm+ calcium nitrate (2%)+ borax (0.2 %) + SOP (2%)	15.50	0.63	15.37
T_5- GA_3 @100 ppm+ calcium nitrate (2%)+ borax (0.2%) + KNO_3(2%)	14.60	0.79	14.24
T_6- GA_3 @ 100 ppm+ calcium nitrate (2%)+ borax (0.2%) + SOP (2%)	14.47	0.72	14.00
T_7- Calcium nitrate (2%)+ borax (0.2%) +KNO_3(2%)	13.90	0.81	13.70
T_8- Calcium nitrate (2%)+ borax (0.2%) +SOP (2%)	13.53	0.79	13.57

T_9- Control (water spray)	13.04	0.88	12.64
S. Em.±	0.14	0.02	0.18
C.D. at 5% 0.5% + Molybdenum 0.1%	0.43	0.06	0.53

SOP – Sulphate of potash; KNO_3– Potassium nitrate

Table 6: Effect of foliar application of gibberellic acid and nutrients on total sugars (%), reducing sugars (%) and non-reducing sugars (%) of pomegranate cv. Bhagwa

Treatment	Total sugars (%)	Reducing sugars (%)	Non-reducing sugars (%)
T_1 GA_3@ 50 ppm	13.93	11.71	2.22
T_2- GA_3 @ 100 ppm	13.76	11.62	2.14
T_3- GA_3 @ 50ppm+calcium nitrate (2%)+borax (0.2%) + KNO_3(2%)	14.04	12.10	1.94
T_4- GA_3 @ 50 ppm+ calcium nitrate (2%)+borax (0.2 %) + SOP (2%)	14.64	12.69	1.95
T_5- GA_3 @100 ppm+ calcium nitrate (2%)+ borax (0.2%) + KNO_3(2%)	13.90	11.75	2.15
T_6- GA_3 @ 100 ppm+ calcium nitrate (2%)+borax (0.2%) + SOP (2%)	13.74	11.60	2.13
T_7- Calcium nitrate (2%)+borax (0.2%) +KNO_3(2%)	13.63	11.49	2.14
T_8- Calcium nitrate (2%)+borax (0.2%) +SOP (2%)	13.60	11.43	2.17
T_9- Control (water spray)	13.27	10.30	2.97
S. Em.±	0.22	0.27	0.22
C.D. at 5% 0.5% + Molybdenum 0.1%	0.67	0.80	NS

SOP – Sulphate of potash; KNO_3– Potassium nitrate

Table 7: Effect of foliar application of gibberellic acid and nutrients on juice percent and sugar/acid ratio (%) of pomegranate cv. Bhagwa

Treatment	Juice (%)	Sugar/Acid ratio (%)
T_1- GA_3 @ 50 ppm	51.10	20.24
T_2- GA_3 @ 100 ppm	49.01	19.55
T_3- GA_3 @ 50ppm+calcium nitrate (2%)+borax (0.2%) + KNO_3(2%)	52.33	21.32
T_4- GA_3 @ 50 ppm+ calcium nitrate (2%)+borax (0.2 %) + SOP (2%)	56.33	23.33
T_5- GA_3 @100 ppm+ calcium nitrate (2%)+ borax (0.2%) + KNO_3(2%)	50.00	17.50
T_6- GA_3 @ 100 ppm+ calcium nitrate (2%)+borax (0.2%) + SOP (2%)	48.33	19.09
T_7- Calcium nitrate (2%)+borax (0.2%) +KNO_3(2%)	43.33	16.93
T_8- Calcium nitrate (2%)+borax (0.2%) +SOP (2%)	40.67	17.32
T_9- Control (water spray)	34.00	15.05
S. Em.±	0.96	0.62
C.D. at 5% 0.5% + Molybdenum 0.1%	2.88	1.87

SOP – Sulphate of potash; KNO_3– Potassium nitrate

Table 8: Effect of foliar application of gibberellic acid and nutrients on physiological loss in weight (%) and shelf life (days) of pomegranate cv. Bhagwa

Treatments	Physiological loss in weight (%)					Mean	Shelf life(days)
	4 days	8 days	12 days	16 days	20 days		
T_1- GA_3@ 50 ppm	6.03	10.77	12.93	20.77	30.03	16.11	22.39
T_2- GA_3@ 100 ppm	6.20	10.93	13.10	20.93	30.27	16.29	22.50
T_3- GA_3@ 50ppm+calcium nitrate (2%)+ borax (0.2 %) + KNO_3(2%)	5.19	10.66	12.35	20.89	29.35	15.69	25.30
T_4- GA_3@ 50 ppm+ calcium nitrate (2%)+borax (0.2 %) + SOP (2%)	4.32	8.99	11.16	18.87	28.04	14.28	27.02
T_5- GA_3@ 100 ppm+ calcium nitrate (2%)+borax (0.2%) + KNO_3(2%)	5.96	10.18	13.06	20.18	30.06	15.89	23.97
T_6- GA_3@ 100 ppm+ calcium nitrate (2%)+ borax (0.2%) + SOP (2%)	5.93	10.89	12.83	20.66	30.00	16.06	24.17
T_7- Calcium nitrate (2%)+ borax (0.2%) +KNO_3(2%)	6.47	11.12	13.29	21.13	30.29	16.46	23.00
T_8- Calcium nitrate (2%)+ borax (0.2%) +SOP (2%)	6.91	11.21	13.38	21.10	31.27	16.77	22.05
T_9- Control (water spray)	8.29	12.62	15.09	23.26	33.27	18.51	20.19
S. Em.±	0.37	0.49	0.44	0.34	0.46		0.44
C.D. at 5%	1.10	1.46	1.32	1.01	1.38		1.31

SOP – Sulphate of potash; KNO_3 – Potassium nitrate

Conclusion

It can be concluded from the results of present study, application of GA_3 and nutrients in combination, shown increased yield and quality over the only GA_3 application and only nutrients application. Among the combination treatments, the plants treated with GA_3 @ 50 ppm + calcium nitrate 2 % + borax 0.2 % + SOP 2 % (T_4)influenced the improved fruit growth, increased yield and better quality as against the T_9 (Control) of pomegranate cv. Bhagwa.

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