International Journal of Agricultural Sciences ☞DOI:10.15740/HAS/IJAS/12.2/176-180
Volume 12 | Issue 2 | June, 2016 | 176-180 ■ e ISSN-0976-5670 Visit us : *www.researchjournal.co.in*

*RESEARCH PAPER*

# Effect of different plant growth regulators and chemicals on quality and economics of pomegranate (*Punica granatum* L.) cv. BHAGAWA

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**Abstract :** The experiment was laid out in Factorial Randomized Block Design replicated twice with two factors consisted of growth regulators and chemicals. The results of present investigation indicated that, in the qualitative parameters significantly maximum TSS, reducing sugar total sugars and ascorbic acid (17.05 °B, 14.60%, 14.99 and 17.15 mg/100 g, respectively), with the lowest titrable acidity (0.21 %), of fruit juice was recorded in treatment of $GA_3$ 75 ppm + boron 0.3 per cent. The highest gross monetary returns (Rs. 6,96,820per ha), net monetary returns (Rs. 4,90,740per ha) and B:C ratio (2.86) was reported in the treatment of $GA_3$75 ppm + boron 0.3 per cent ($T_7$) .It was followed by treatment of 2-4-D 20 ppm + boron 0.3 per cent ($T_{22}$) (Rs.6,81,560,Rs. 4,75,720 per ha and 2.81, respectively). The minimum values for all these parameters were observed in control ($T_1$) treatment.

**Key Words :** Growth regulators, Boron, Pre-harvest spray, Fruit quality, Monetary returns

**View Point Article :** Digrase, S.S., Tambe, T.B., Kadam, A.S. and Kalalbandi, B.M. (2016). Effect of different plant growth regulators and chemicals on quality and economics of pomegranate (*Punica granatum* L.) cv. BHAGAWA. *Internat. J. agric. Sci.*, **12** (2) : 176-180, **DOI:10.15740/HAS/IJAS/12.2/176-180.**

**Article History : Received :** 17.12.2015**; Revised :** 06.02.2016**; Accepted :** 09.04.2016

## INTRODUCTION

The pomegranate cultivation in India has steadily picked up during the last two decades. Demand in internal market has enhanced the scope for earning higher dividends from this crop. In India it is ideal crop for the sustainability of small holdings because of its adaptability to topography, soil and agro-climatic condition prevailing in arid and semiarid regions of India. Climate change has resulted in low productivity of some high value crops like apple, forcing the growers to shift to crops like pomegranate, which are suitable for arid and semiarid regions facing water scarcity. Fascinated by its innumerable health and monetary benefits, not only rural population but also service category urban, uncultivated ancestral land are venturing into pomegranate cultivation, to get the benefits of the fruit of paradise. Hence, by considering the need for producing best quality for export oriented production technology in pomegranate the present investigation was planned.

## MATERIAL AND METHODS

The experiment on effect of different plant growth

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regulators and chemicals on growth, yield and quality of pomegranate (*Punica granatum* L.) cv. BHAGAWA was conducted during *mrigbahar* in 2013-14 and 2014-15 in a well established 6 years old Bhagwa orchard planted at 4.5 × 3 m having uniform growth and productivity at the demonstration plot of KVK Latur, with a view to study the effect of different plant growth regulators and chemicals on growth, yield and quality of pomegranate.

The experiment was laid out in Factorial Randomized Block Design replicated twice with two factors consisted of growth regulators and chemicals. First factor of plant growth regulators included five levels *viz*., $GA_3$ 75 ppm ($G_1$), CPPU 10 ppm ($G_2$), 6BA 05 ppm ($G_3$) 2-4-D 20 ppm ($G_4$) and control ($G_0$ ). Second factor comprised of chemicals at five levels *viz*., boron (Boric acid 0.3%) ($C_1$), calcium nitrate 2 per cent ($C_2$), potassium di-hydrogen phosphate 2 per cent ($C_3$), calcium chloride 1.5 per cent ($C_4$) and control ($C_0$) along with their interaction effect consisting of 25 treatment combinations. The growth regulators were applied at the time of flowering, 45 days after flowering and 90 days after flowering while chemicals were applied at 90, 105 and 135 days after flowering. The observation on different quality and economic attributes of pomegranate plants of Bhagwa were recorded. The data collected were subjected to statistical analysis suggested by Panse and Sukhatme (1967).

## RESULTS AND DISCUSSION

Pooled data presented in Tables 1 and 2 revealed quality parameters of pomegranate fruit as influenced by individual effect of plant growth regulators and chemicals and their interaction effect. TSS of fruit juice was significantly influenced due to application of growth regulators and chemicals. The highest TSS (16.47°B and 15.97°B, respectively) was observed treatment of $GA_3$ and boron. Among the treatments significantly highest TSS of fruit juice (17.05 °B) was obtained by application of treatment ($GA_3$75 ppm + boron 0.3%) which was 14.52 per cent more as compared to control. Improvement in TSS of fruit due to $GA_3$ and boron spray might be explained from the fact that application of $GA_3$ and boron probably improved the physiology of leaves, thereby causing better translocation of vital components in the fruit and assimilation /utilization of photosynthates

**Table 1 : Effect of plant growth regulators and chemicals on quality attributes of pomegranate**

| Treatments No. | Treatments | TSS ($^{O}$B) | Acidity (%) | Reducing sugar (%) | Total sugar (%) | Ascorbic acid mg/100 g | Juice content (ml) |
|---|---|---|---|---|---|---|---|
| | | Pooled mean | Pooled mean | Pooled mean | Pooled mean | Pooled mean | Pooled mean |
| **Plant growth regulators (G)** | | | | | | | |
| $G_0$ | Control | 14.57 | 0.38 | 10.62 | 11.61 | 14.61 | 156.00 |
| $G_1$ | $GA_3$ 75 ppm | 16.47 | 0.28 | 14.07 | 14.70 | 16.67 | 194.05 |
| $G_2$ | CPPU 10 ppm | 16.04 | 0.31 | 12.84 | 13.79 | 15.60 | 178.05 |
| $G_3$ | 6BA 05 ppm | 15.95 | 0.31 | 13.73 | 14.57 | 15.33 | 171.55 |
| $G_4$ | 2-4-D 20 ppm | 16.26 | 0.29 | 13.99 | 14.70 | 15.93 | 186.20 |
| S.E. ± | | 0.013 | 0.009 | 0.149 | 0.074 | 0.115 | 1.214 |
| C.D. (P=0.05) | | 0.038 | 0.026 | 0.435 | 0.216 | 0.336 | 3.543 |
| **Chemicals (C)** | | | | | | | |
| $C_0$ | Control | 15.77 | 0.37 | 12.09 | 13.44 | 15.52 | 174.95 |
| $C_1$ | Boron 0.3% | 15.97 | 0.29 | 13.52 | 14.18 | 16.01 | 182.2 |
| $C_2$ | Calcium nitrate 2 % | 15.79 | 0.32 | 12.61 | 13.89 | 15.66 | 177.05 |
| $C_3$ | $KH_2PO_4$ 2% | 15.94 | 0.33 | 13.02 | 13.87 | 15.59 | 176.1 |
| $C_4$ | $CaCl_2$ 1.5 % | 15.81 | 0.27 | 13.07 | 13.98 | 15.86 | 175.55 |
| S.E. ± | | 0.013 | 0.009 | 0.149 | 0.074 | 0.115 | 1.214 |
| C.D. (P=0.05) | | 0.038 | 0.026 | 0.435 | 0.216 | 0.336 | 3.543 |
| **Interaction (G × C)** | | | | | | | |
| S.E. ± | | 0.047 | 0.012 | 0.169 | 0.093 | 0.134 | 1.734 |
| C.D. (P=0.05) | | 0.137 | 0.035 | 0.493 | 0.271 | 0.391 | 5.061 |

by developing fruits. The results obtained in the present study are in agreement with that reported by Shukla *et al*. (2011) in Aonla.

The reducing and total sugars of fruit were influenced and showed significant differences by spraying of plant growth regulators and chemicals. The maximum reducing and total sugars of fruit juice (14.07% and 14.70 %, respectively) was recorded when plants were sprayed with $GA_3$ and boron 0.3 per cent. The interaction effect of growth regulators and chemicals pertaining to reducing and total sugars showed significant increase due to application of different treatments combination. Among all the treatments, the maximum reducing and total sugars of fruit juice (14.60% and 14.99%, respectively) was obtained by application of treatment $T_7$ which was 32.61 per cent more as compared to control. The significantly lowest values for reducing and total sugar were recorded in control (9.84% and 10.73%). This might be due to hydrolysis of complex polysaccharides into simple sugars, synthesis of metabolites and rapid translocation of photosynthetic products and minerals from other parts of plant to developing fruits. These results are agreement with findings of Lal and Ahmed (2012) in pomegranate and Singh and Brahamachari (1999) in guava.

The application of $GA_3$ and boron recorded significantly maximum values (16.67 and 16.01 mg/100g). Among interaction effect, the treatment $T_7$ ($GA_3$75 ppm + boron 0.3%) proved to be significantly superior over rest of treatments by recording 17.15 mg ascorbic acid per 100 g which was 16.27 per cent more as compared to control. The ascorbic acid was found maximum with spray of boron, it might be due to higher level of sugars in borax treated fruit might be the possible reason behind increase in content of ascorbic acid, because it is synthesized from sugar. It is also possible that boron reduced the activities of degrading enzymes. The results

**Table 2 : Interaction effect of plant growth regulators and chemicals on quality attributes of pomegranate cv. BHAGAWA**

| Treatments | TSS ($^{O}$B) | Acidity (%) | Reducing sugar (%) | Total sugar (%) | Ascorbic acid mg/100 g | Juice content (ml) |
|---|---|---|---|---|---|---|
| | Pooled mean | Pooled mean | Pooled mean | Pooled mean | Pooled mean | Pooled mean |
| $T_1$ - $G_0C_0$ | 14.58 | 0.44 | 9.84 | 10.73 | 14.36 (0.00) | 155.50 (0.00) |
| $T_2$ - $G_0C_1$ | 14.58 | 0.40 | 11.55 | 12.14 | 14.80 (2.97) | 163.25 (4.75) |
| $T_3$ - $G_0C_2$ | 14.63 | 0.35 | 10.57 | 11.82 | 14.73 (2.48) | 156.50 (0.64) |
| $T_4$ - $G_0C_3$ | 14.60 | 0.40 | 10.62 | 11.67 | 14.78 (2.81) | 151.25 (-2.81) |
| $T_5$ - $G_0C_4$ | 14.48 | 0.32 | 10.54 | 11.73 | 14.38 (0.10) | 153.5 (-1.30) |
| $T_6$ - $G_1C_0$ | 16.40 | 0.35 | 13.60 | 14.14 | 16.10 (10.81) | 191.75 (18.90) |
| $T_7$ - $G_1C_1$ | 17.05 | 0.21 | 14.60 | 14.99 | 17.15 (16.27) | 200.50 (22.44) |
| $T_8$ - $G_1C_2$ | 16.33 | 0.25 | 14.05 | 14.85 | 16.79 (14.45) | 193.75 (19.74) |
| $T_9$ - $G_1C_3$ | 16.33 | 0.32 | 14.15 | 14.94 | 16.89 (14.98) | 192.50 (19.22) |
| $T_{10}$ - $G_1C_4$ | 16.23 | 0.26 | 13.94 | 14.59 | 16.45 (12.68) | 191.75 (18.90) |
| $T_{11}$ - $G_2C_0$ | 16.43 | 0.37 | 12.19 | 13.20 | 15.95 (9.94) | 176.25 (11.77) |
| $T_{12}$ - $G_2C_1$ | 16.08 | 0.30 | 13.29 | 14.18 | 16.04 (10.45) | 181.50 (14.33) |
| $T_{13}$ - $G_2C_2$ | 15.93 | 0.30 | 12.93 | 13.85 | 15.49 (7.27) | 178.00 (12.64) |
| $T_{14}$ - $G_2C_3$ | 15.95 | 0.31 | 12.94 | 13.88 | 15.26 (5.87) | 176.75 (12.02) |
| $T_{15}$ - $G_2C_4$ | 15.83 | 0.28 | 12.85 | 13.85 | 15.27 (5.93) | 177.75 (12.52) |
| $T_{16}$ - $G_3C_0$ | 15.88 | 0.38 | 13.59 | 14.36 | 15.28 (6.02) | 170.50 (8.80) |
| $T_{17}$ - $G_3C_1$ | 15.93 | 0.31 | 14.04 | 14.76 | 15.45 (7.06) | 176.00 (11.65) |
| $T_{18}$ - $G_3C_2$ | 15.90 | 0.29 | 13.72 | 14.52 | 15.50 (7.32) | 171.00 (9.06) |
| $T_{19}$ - $G_3C_3$ | 15.83 | 0.30 | 13.59 | 14.57 | 15.26 (5.90) | 170.00 (8.53) |
| $T_{20}$ - $G_3C_4$ | 16.20 | 0.29 | 13.74 | 14.63 | 15.15 (5.18) | 170.25 (8.66) |
| $T_{21}$ - $G_4C_0$ | 16.43 | 0.32 | 13.83 | 14.78 | 16.16 (11.11) | 186.50 (16.62) |
| $T_{22}$ - $G_4C_1$ | 16.23 | 0.31 | 14.15 | 14.86 | 16.60 (13.47) | 189.75 (18.05) |
| $T_{23}$ - $G_4C_2$ | 16.28 | 0.27 | 13.89 | 14.86 | 15.79 (9.06) | 186.00 (16.40) |
| $T_{24}$ - $G_4C_3$ | 16.15 | 0.31 | 14.05 | 14.33 | 15.75 (8.83) | 184.25 (15.60) |
| $T_{25}$ - $G_4C_4$ | 16.23 | 0.28 | 14.02 | 14.68 | 15.37 (6.57) | 184.50 (15.72) |
| S.E. ± | 0.047 | 0.012 | 0.169 | 0.093 | 0.134 | 1.734 |
| C.D. (P=0.05) | 0.137 | 0.035 | 0.493 | 0.271 | 0.391 | 5.061 |

Figures in parenthesis indicates per cent values increase over control

are in close proximity with the findings of Brahamachari *et al.* (1997) in litchi.

It was observed that the application of growth regulator and chemicals reduced the acidity content to statistically significant level over control. Significantly lowest acidity was recorded with $GA_3$ and calcium chloride (0.28%). In the interaction effect significantly lowest acidity (0.21%) was recorded in treatment $T_7$ ($GA_3$75 ppm + boron 0.3%). The decrease in titrable acidity appears to be due to conversion of acids into sugars and then utilization as respiratory substrate during growth and development of fruit. The results obtained in the present study are in agreement with that reported by Lal and Ahmed (2012) in pomegranate and Shukla *et al*. (2011) in Aonla.

The application of $GA_3$ and boron recorded significantly highest values (194.05 ml and 182.2 ml, respectively) for juice content. Significant differences by the application of interactive treatments were observed among all the interaction treatments regarding juice content. The highest juice content (200.50 ml) was found in treatment $T_7$ ($GA_3$75 ppm + boron 0.3%), which was 16.27 per cent more as compared to control treatment.

Perusal of data as presented in Table 3 regarding, to the cost of cultivation indicated that the lowest cost of cultivation (Rs. 1,90,590 per ha) was found in control treatment. The highest cost of cultivation (Rs.2, 14,090 per ha) was recorded in treatment $T_{12}$ (CPPU 10 ppm + boron 0.3 %). The highest gross monetary returns and net monetary returns (Rs. 6,96,820 per ha and Rs. 4,90,740 per ha) was obtained in treatment $T_7$ ($GA_3$75 ppm + boron 0.3 %). Regarding, the B: C ratio, it was

**Table 3 : Interaction effect of plant growth regulators and chemicals on benefit : cost ratio of pomegranate per hectare**

| Treatments | Cost of cultivation (Rs./ha) | Gross monetary returns (Rs./ha) | Net monetary returns (Rs./ha) | B: C Ratio |
|---|---|---|---|---|
| | Pooled mean | Pooled mean | Pooled mean | Pooled mean |
| $T_1$ - $G_0C_0$ | 190590 | 285400 | 94814 | 1.00 |
| $T_2$ - $G_0C_1$ | 190590 | 389910 | 194320 | 1.50 |
| $T_3$ - $G_0C_2$ | 190590 | 342180 | 146580 | 1.23 |
| $T_4$ - $G_0C_3$ | 190590 | 315250 | 119660 | 1.11 |
| $T_5$ - $G_0C_4$ | 198340 | 426500 | 228160 | 1.67 |
| $T_6$ - $G_1C_0$ | 198340 | 507420 | 309080 | 2.07 |
| $T_7$ - $G_1C_1$ | 206090 | 696820 | 490740 | 2.86 |
| $T_8$ - $G_1C_2$ | 206090 | 629420 | 423330 | 2.58 |
| $T_9$ - $G_1C_3$ | 206090 | 579260 | 373160 | 2.33 |
| $T_{10}$ - $G_1C_4$ | 207340 | 659170 | 451820 | 2.70 |
| $T_{11}$ - $G_2C_0$ | 207340 | 410240 | 202900 | 1.47 |
| $T_{12}$ - $G_2C_1$ | 214090 | 599070 | 384980 | 2.30 |
| $T_{13}$ - $G_2C_2$ | 214090 | 491360 | 277270 | 1.77 |
| $T_{14}$ - $G_2C_3$ | 214090 | 457260 | 243160 | 1.65 |
| $T_{15}$ - $G_2C_4$ | 208340 | 574810 | 366460 | 2.25 |
| $T_{16}$ - $G_3C_0$ | 208340 | 396960 | 188620 | 1.43 |
| $T_{17}$ - $G_3C_1$ | 207590 | 452280 | 244690 | 1.65 |
| $T_{18}$ - $G_3C_2$ | 207590 | 410000 | 202400 | 1.47 |
| $T_{19}$ - $G_3C_3$ | 207590 | 401120 | 193540 | 1.43 |
| $T_{20}$ - $G_3C_4$ | 204090 | 426260 | 222170 | 1.56 |
| $T_{21}$ - $G_4C_0$ | 204090 | 452480 | 248380 | 1.73 |
| $T_{22}$ - $G_4C_1$ | 205840 | 681560 | 475720 | 2.81 |
| $T_{23}$ - $G_4C_2$ | 285840 | 566630 | 360780 | 2.26 |
| $T_{24}$ - $G_4C_3$ | 205840 | 515260 | 309420 | 2.02 |
| $T_{25}$ - $G_4C_4$ | 205840 | 632970 | 427120 | 2.50 |
| S.E. ± | 2096.8 | 24535 | 24387 | 0.13 |
| C.D. (P=0.05) | 6110.8 | 71151.5 | 70722.3 | 0.38 |

observed that the application of $GA_3$75 ppm + boron ($T_7$) (2.86) has produced significantly highest B: C ratio followed by the application of 2-4-D 20 ppm + boron over other interaction treatments. Present findings are in agreement with the findings of Lal and Ahmed (2012), El-Khawga (2007) and Mohamad (2004) in pomegranate.

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