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Effect of plant bio-regulators and chemicals on fruit physico-chemical traits of pomegranate (*Punica granatum* L.) cv. Bhagwa

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Abstract
Pomegranate (*Punica granatum* L.) is a favorite table fruit of the tropical region, valued very much for its refreshing juice consisting of nutritional and medicinal properties. The experiment was conducted to study the effect of some plant bio-regulators and chemicals on fruit physico-chemical traits of 2 years old young pomegranate cv. Bhagwa under Lucknow subtropical condition having dry element and high pH (8.2) soil. The experiment was comprised with 9 treatments (T_0-control (water spray), T_1-NAA @ 50 ppm, T_2-NAA @ 75 ppm, T_3-GA3 @ 50 ppm, T_4- GA3 @ 75 ppm, T_5-Borax @ 25 ppm, T_6-Borax @ 50 ppm, T_7-2,4-D @ 5 ppm, T_8-2,4-D @ 15 ppm] laid out in randomized block design with three replications. The observation revealed that the application of treatment T_8 (2,4-D @ 15 ppm) was better for improvement of fruit weight (101.67 g), fruit length (6.00 cm), fruit volume (92.00), specific gravity (1.10), number of aril/fruit (363.33), number of segment/fruit (5.00), acidity (0.45%), vitamin C (10.20 mg/100g), total sugar (6%) and non-reducing sugar (1.93%). While the maximum T.S.S: Acid ratio and reducing sugar was recorded under treatment T_1 (NAA @ 50 ppm). The biggest fruit (4.73 cm diameter) increase by the application of NAA @ 75 ppm under treatment T_2. The maximum pericarp thickness (4.73 mm) and total soluble solids (12.57 ^{0}Brix) was recorded under treatment T_4 (GA_3 @ 75ppm) and T_6 (Borax @ 50 ppm).

Keywords: Pomegranate, NAA, Gibberellic acid, 2, 4-D and Borax

Introduction
In the punicaceae family pomegranate (*Punica granatum* L.) is the foremost fruit for its delicious taste and flavour. This is suitable for growing in different agroclimatic conditions ranging from tropical to sub-tropical (Levin, 2006) [9]. And (Jalicop, 2007) [1]. and can with stand alkaline and wet soil Sing, (2008) [17]. Pomegranate is also important in human medicine and its components have a wide range of clinical applications (Lansky and Newman, 2007) [8]. Aanthocyanins from pomegranate fruit have been shown to have higher antioxidant activity than vitamin E (tocopherol), vitamin C (ascorbic acid) or carotene (Shukla, *et al.* 2008) [16]. Moreover, commercial pomegranate juice has been shown to have three times higher antioxidant activity than green quality such as nitrogen, phosphorus, potassium and tea and red wine (Gil, *et al.* 2000) [5]. In India, pomegranate is commercially cultivated in Maharashtra, Karnataka and Andhra Pradesh and the most important cultivar in this pomegranate belt is 'Bhagwa' which covers around 80% area under pomegranate in Maharashtra. Since last two decades, its cultivation has popularized in arid and semi-arid regions of India, not only because of its sweet acidic taste, precocious bearing and better shelf-life but as a remunerative crop as well. Among various arid fruits, pomegranate occupies second largest area after ber. The importance of synthetic plant growth regulators in achieving higher yield and better quality of horticultural crop has been well recognized in recent time. Plant growth regulators have given encouraging results in case of pomegranate fruit crop (Anawal, *et al.* 2015) [1]. However, practically, there has been very little work done on use of plant growth regulators in pomegranate crop. The plant growth regulators (PGR) act as messengers and are needed in small quantities at low concentrations. Generally their site of action and biosynthesis are different. Most of the plant growth regulators exhibit a broad spectrum and thus a single PGR may influence several entirely different processes. Moreover, plant growth regulators enhance the rapid changes in physiological and biochemical characters and improve crop productivity. Those among agricultural practices which may increase the fruit production and improve the quality of several other fruit crops are the applications of plant growth regulators, especially gibberellic acid. Gibberellic acid has been reported to influence vegetative growth, flowering, fruiting and various disorders in many fruit crops**.** Although these references are available in the literature and efforts have been improve fruit quality by applying of plant growth

Regulators. Therefore, this study was carried to evaluate the effect of plant bio-regulators and chemical on fruit physico-chemical traits of pomegranate (*Punica granatum* L.) cv. Bhagwa under Lucknow conditions.

Materials and Methods

The presented experiment was conducted at Horticulture research Farm, Department of Applied Plant science (Horticulture), Babasaheb Bhimrao Ambedkar University, Lucknow 226025, Uttar Pradesh during 2014 to 2015. The experimental site was located at 26°50N latitude, 80°52E longitudes and at alleviation of 111 m above mean Sea Level. The experiment was comprised with 9 treatments i.e. T_0-control (water spray) T_1 (NAA @ 50 ppm), T2 (NAA @ ppm), T_3 (GA3 @ 50 ppm), T_4 (GA3 @ 75 ppm), T5 (Borax @ 25 ppm), T_6 (Borax 2 50 ppm), T_7 (2, 4-D @ 5 ppm) and T_8 (2, 4-D @ 15 ppm) and it was replicated three times following randomized block design. Pomegranate plants cv. Bhagawa was planted at the spacing of 5 × 3 m and plant bio-regulators and chemicals were applied as foliar spray 3 times at 15 days interval. GA3 and NAA solutions were prepared by dissolving required amount of bio regulators in 1 (N) NaOH solution and pH was adjusted to acidic (5.6–6.8). Before foliar spray the plants of almost uniform growth were selected and pruning was done to remove all unwanted shoots. Observations were recorded for each replications and treatments on quality parameters of pomegranate fruits like morphological characters i.e. fruit weight (g), fruit length (cm), fruit diameter (cm), fruit volume (ml), specific gravity of fruit, pericarp thickness (mm), number of aril/fruit and number of segment\fruit and chemical characters viz. acidity, vitamin C, total soluble solids, T.S.S:acid ratio, total sugars, reducing sugar and non-reducing sugar were estimated after harvesting following standard method of (AOAC, 1990) [2]. All quality parameters were analyzed in the laboratory. The observed data were statistically analysed using analysis of variance as formulated at 5% level of significance (Sahu and Das, 2014) [15].

Result and Discussion

The data (Table 1) indicate that effect of various plant bio-Regulators and chemicals significantly improved the physical parameters of the pomegranate fruits. Maximum fruit weight (101.67 g), fruit length (6.00 cm), fruit volume (92.00 ml) specific gravity (1.10), number of aril/fruit (363.33) and number of segment/fruit (5) was recorded with foliar spray of @ 15 ppm 2,4-D as compared to control. While the maximum fruit diameter (4.73) was increased with the spraying of NAA @ 75 ppm. This may be due to Endogenous hormones and their balance play a modulating role in the mobilization of nutrients to the developing organs and can influence the longevity of a bud. The dependence of abscission relative to the endogenous content of auxins has been proven by exogeneous application of 2,4-D or NAA, as the transportation of auxins by the plant lasts for a long time without ethylene appearing to affect it (Suman *et al.* 2017) [18]. This result confined with reported by Ghosh *et al* (1995) [4]. In sweet orange, Hasan and Chattopadhyay (1996) [7]. In litchi Pandey (1999) [13]. In ber and Pawar *et al.* (2005) [14]. in pomegranate.

The maximum pericarp thickness (4.95 mm) was increased with spraying of GA3 @ 75 ppm. These results are in agreement with Dawood (1986) [19]. Who indicated that spray paclobutrazol and GA_3 increased the thickness of the fruit cuticle and the epidermal layers. Similar finding were reported by Agusti *et al* (1999) [12]. Demonstrated that application synthetis auxins increased fruit size in peach fruit.

Table 2 revealed that significant effect of various plant bio-regulators and chemicals on chemical traits of pomegranate fruit. The maximum acidity (0.45%), vitamin C (10.20 mg/100g), total sugar (6.00%) and non-reducing (4.60%) were recorded under treatment T_8 (2, 4-D @ 15 ppm) as compared to other treatments. The similar result recorded by Ingle *et al* (2001) [8]. Revealed that foliar application of 2, 4-D @ 10 ppm increased the fruit weight, volume, TSS, ascorbic acid, peel and yield over control in Nagpur mandarin. While, the total soluble solids (12.57 ^{0}Brix) was increased with the foliar application of Borax @ 50 ppm under treatment T_6. However, the maximum TSS: acid ratio (33.68) and reducing (4.60%) was recorded under treatment T_1 (NAA @ 50 ppm). Similar result as reported by Pandey (1999) [13]. in ber.

Table 1: Effect of plant bio-regulators and chemical on fruit morphological character of pomegranate

Treatment	Fruit weight (g)	Fruit length (cm)	Fruit diameter (cm)	Fruit volume (ml)	Specific gravity	Pericarp thickness (mm)	Number of aril/fruit	Number of segment/fruit
T_0 Control	61.00	5.00	3.67	60.33	1.01	3.15	219.00	3.00
T_1 NAA@ 50 ppm	62.00	5.40	4.30	61.00	1.02	3.60	205.00	4.00
T_2 NNA@ 75 ppm	61.00	5.50	4.73	59.67	1.02	3.73	262.67	4.33
T_3 GA_3 @ 50ppm	61.33	5.67	4.00	60.00	1.03	4.15	230.00	4.00
T_4 GA_3 @ 75 ppm	66.00	5.00	4.50	65.00	1.02	4.95	219.00	3.33
T_5 Borax @ 25 ppm	61.33	5.60	3.83	60.00	1.02	3.57	238.33	4.33
T_6 Borax @ 50 ppm	61.33	5.63	4.33	60.67	1.01	3.42	273.00	4.33
T_7 2,4-D @ 5 ppm	77.00	5.17	4.00	71.00	1.08	3.92	258.33	3.67
$T_8$2,4-D @ 15 ppm	101.67	6.00	4.57	92.00	1.10	4.43	363.33	5.00
SE(m)	9.74	0.98	0.95	9.53	0.16	0.87	34.99	0.77
CD (P=0.05)	20.65	2.08	2.01	20.2	0.34	1.86	74.20	1.64

Table 2: Effect plant bio-regulator and chemical on fruit chemical characters of pomegranate

Treatment	Titrrable acidity (%)	Vitamin C (mg/100g)	TSS (^{0}Brix)	TSS:Acid ratio	Total sugar (%)	Reducing sugar (%)	Non reducing sugar (%)
T_0 Control	0.33	8.00	8.50	25.55	4.93	3.87	1.07
T_1 NAA@ 50 ppm	0.33	8.75	11.10	33.68	5.55	4.60	0.95
T_2NNA@ 75 ppm	0.37	9.00	11.83	32.16	5.83	4.00	1.83
T_3 GA_3 @ 50ppm	0.36	9.50	13.33	37.07	5.33	3.87	1.47
T_4 GA_3 @ 75 ppm	0.42	9.20	11.50	27.54	5.00	3.83	1.17
T_5 Borax @ 25 ppm	0.37	9.30	11.47	31.17	5.07	3.90	1.17
T_6 Borax @ 50 ppm	0.41	9.60	12.57	30.33	5.33	4.07	1.27
T_7 2,4-D @ 5 ppm	0.43	9.70	11.97	27.83	5.57	4.07	1.50
T_8 2,4-D @ 15 ppm	0.45	10.20	11.90	26.29	6.00	4.07	1.93
SE(m)	0.05	1.46	1.98	5.96	0.92	0.741	0.274
CD(P=0.05)	0.11	3.09	4.21	12.63	1.95	1.57	0.58

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