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Effects of bioextracts and its application in enhancing yield characters of pomegranate (*Punica granatum* L.) cv. Bhagwa under central dry zone of Karnataka

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Abstract
Pomegranate is a significant fruit crop cultivated in the dryland regions of India, where achieving optimum yield and quality is often hindered on chemical fertilizers. A field experiment on "Effects of Bioextracts and its application in enhancing yield characters of pomegranate (*Punica granatum* L.) cv. Bhagwa under Central Dry Zone of Karnataka was carried out in a farmer's field at Aluru village, Hiriyur taluk, Chitradurga district during the year 2024-25. The experiment was laid out in a Randomized Complete Block Design (RCBD) with eight treatments and three replications *viz*., T_1 - Seaweed extract @ 2000 ppm, T_2 - Moringa leaf extract @ 6000 ppm, T_3 - *Prosopis juliflora* leaf extract @ 5000 ppm, T_4 - Seaweed extract @ 2000 ppm + Moringa leaf extract @ 6000 ppm, T_5 - Seaweed extract @ 2000 ppm + *prosopis juliflora* leaf extract @ 5000 ppm, T_6 - Moringa leaf extract @ 6000 ppm + *prosopis juliflora* leaf extract @ 5000 ppm, T_7 - Seaweed extract @ 2000 ppm + Moringa leaf extract @ 6000 ppm + *Prosopis juliflora* leaf extract @ 5000 ppm, T_8 - Control, Among the different treatments, T_7 (SWE @ 2000 ppm + MLE @ 6000 ppm + PJLE @ 5000 ppm) recorded best characters such as number of fruits per plant (66.21), fruit yield (16.41 kg/plant), maximum fruit weight (265.13 g), fruit length (7.75 cm), fruit diameter (7.81 cm), fruit volume (293.13 cc), rind weight (98.90 g), rind thickness (2.71 mm), arils weight (177 g/fruit), rind - aril ratio (0.55), number of arils per fruit (427.12),100 arils weight (41.82 g) and seed weight (27.09 g). Hence, the combined application of T_7 proved highly effective in enhancing the yield of pomegranate under dryland conditions**.**

Keywords: Pomegranate, Bioextracts, Yield, Bhagwa

Introduction
Pomegranate (*Punica granatum* L.), often referred to as the "Fruit of paradise" is a deciduous shrub or small tree belonging to the family Lythraceae. It is diploid in nature with a chromosome number of 2n = 18. Native to the region of modern day Iran and northern India, the pomegranate has been cultivated since ancient times that has gradually spread to tropical and subtropical regions across the world. The fruit is highly esteemed both as a fresh table fruit and for its processed products such as juice, syrup and anardana (dried arils). Its unique taste and nutritional profile have made it increasingly popular in both national and international markets.

Bioextracts including seaweed extract, moringa leaf extract and *Prosopis juliflora* leaf extracts are natural substances that contain beneficial compounds such as nutrients, growth hormones, antioxidants and bioactive molecules. These extracts have gained importance in modern agriculture due to their ability to enhance crop growth, yield and quality in an eco-friendly and sustainable manner. By reducing reliance on synthetic fertilizers and chemicals, bioextracts support environmental health, maintain soil fertility, contributing to sustainability while maintaining quality and quantity.

Seaweed (*Ascophyllum nodosum* L.) a bioextract which is a rich source of plant growth regulators, including cytokinins and auxin like compounds, as well as organic matter, amino acids, vitamins, complex polysaccharides, betaines, betaine like compounds and sterols, all of which play vital roles in plant metabolism and productivity (Khan *et al*., 2009) [8].

The leaf extracts of *Moringa oleifera*, one of the thirteen species in the genus *Moringa* and family Moringaceae, contains growth promoting substances such as cytokinins, auxins and

abscisic acid like compounds, making it an effective natural biostimulant. Its leaves are also a rich source of vitamins (A, B and C) essential minerals K, Ca, Fe and amino acids, along with powerful natural antioxidants such as ascorbate and phenolics. Numerous studies have shown that foliar application of *M. oleifera* leaf extract enhances plant vigour, promotes deeper root development, improves seed germination, delays fruit senescence and enhances both quality and quantity in yield (Yuniati *et al*., 2022) [17]. It also strengthens crops ability to withstand adverse environmental stresses.

Prosopis juliflora, a member of the Leguminosae family, is widely used in traditional medicine for treating ailments such as cold, diarrhoea, wounds and inflammation. Preparations from its leaves, seeds and pods are employed for wound healing, digestive issues and nutritional benefits (Tene *et al*., 2007) [14].

In light of the growing need for sustainable and eco-friendly alternatives to chemical inputs and acknowledging the proven benefits of various plant based bioextracts an effort was made to explore their potential in pomegranate cultivation, with the following objective to evaluate the effect of different bioextracts on yield and yield attributes.

Material and methods

An investigation was conducted in farmer's field in Aluru village in Chitradurga district during the year 2024 - 25. All trees were selected based on their uniformity in growth, size and vigour which planted at 5×5 meters apart. Treatments of different bioextracts had been imposed on pomegranate *viz*., seaweed extract, moringa leaves extract and *Prosopis juliflora* leaf extract of varied concentrations. The experiment was laid out in randomised complete block design with three replications comprising eight treatments and two plants for each treatment. Foliar sprays of bioextracts were applied during the stage of fruit set. Physical parameters were assessed *viz.*, number of fruits per plant, fruit weight, yield (kg/tree), fruit length (cm), fruit diameter (cm), fruit volume (cc), Number of arils per fruit, aril weight per fruit (g), 100 aril weight per fruit (g), Rind weight (g), Rind thickness (mm), Rind - aril ratio and seed weight (g).

Statistical analysis

The data collected were analysed by using OPSTAT software.Whenever the 'F' test was found significant for comparing the means of two treatments, the critical difference (C.D. at 5%) was worked out and differences among means were compared using Duncan's multiple range test 0.05 per cent (Duncan, 1955) [5].

Results and Discussion

Yield parameters

Number of fruits per plant

The application of different bioextracts foliar treatments significantly influenced the number of fruits per plant in pomegranate (Table 2). The maximum number of fruits per plant (66.21) was recorded with treatment T_7 - SWE @ 2000 ppm + MLE @ 6000 ppm + PJLE @ 5000 ppm, followed by T_4 - SWE @ 2000 ppm + MLE @ 6000 ppm (64.10). The minimum number of fruits per plant (50.00) was observed under the control treatment (T_8). The enhanced number of fruits per plant could be attributed to the synergistic effect of the bioextracts, which may have improved physiological processes such as photosynthesis, nutrient uptake and hormonal balance. The results are in agreement with the findings of Norrie and Keathley (2006) [10] and Ashour *et al*. (2024) [3].

Average Fruit weight (g)

The average fruit weight of pomegranate was significantly influenced by the different treatments (Table 2). The highest fruit weight (265.13 g) was recorded in treatment T_7 - SWE @ 2000 ppm + MLE @ 6000 ppm + PJLE @ 5000 ppm, which was followed by T_4 - SWE @ 2000 ppm + MLE @ 6000 ppm (252.41 g). The minimum fruit weight (198.00 g) was observed in the control treatment (T_8). The increase in fruit weight may be attributed to the effect of the applied bioextracts, which likely enhanced the metabolic activities, nutrient assimilation and translocation of photosynthates towards developing fruits. These natural extracts are rich in phytohormones, vitamins and minerals that promote fruit development and enlargement. These findings are in line with various fruit crops such as sour orange (Musawi *et al*., 2018) [9] and banana (Thammadi *et al*., 2024) [16]

Yield (kg/plant)

Yield per plant was significantly influenced by the various treatments applied, as presented in Table 2. The highest yield per plant (16.41 kg/plant) was recorded in treatment T_7 - SWE @ 2000 ppm + MLE @ 6000 ppm + PJLE @ 5000 ppm, which was statistically *at par* with treatment T_4 - SWE @ 2000 ppm + MLE @ 6000 ppm (16.38 kg/plant). The lowest yield (10.91 kg/plant) was recorded in T_8 - control.

The enhanced yield observed under these treatments may be attributed to the effect of seaweed extract (SWE), moringa leaf extract (MLE) and *Prosopis juliflora* leaf extract (PJLE), which are known to contain essential macro and micronutrients, growth hormones and antioxidants Siddhuraju and Becker (2003). These bioextracts likely promoted better physiological activity, improved nutrient uptake and enhanced photosynthetic efficiency, ultimately leading to increased fruit yield.These findings are in line with various fruit crops such as (Sharma *et al*., 2021) [12] and (Anwar *et al*., 2007) [2].

Fruit length (cm)

The application of different treatments significantly influenced fruit length, as shown in Table 2. Among all treatments, the maximum fruit length (7.75 cm) were obtained from plants treated with T_7 - SWE @ 2000 ppm + MLE @ 6000 ppm + PJLE @ 5000 ppm. Which was followed by T_4 - SWE @ 2000 ppm + MLE @ 6000 ppm, which produced fruits with an average length of (7.58 cm). The minimum fruit length (6.28 cm) was recorded in the control treatment (T_8), indicating the positive impact of bioextract application on fruit development.

The increase in fruit length under treatments can be attributed to the combined effect of natural growth enhancers present in seaweed extract, moringa leaf extract and *Prosopis juliflora* leaf extract. These substances are rich in cytokinins, auxins, gibberellins, vitamins and essential minerals that promote cell division and elongation. Their synergistic action likely contributed to enhanced fruit growth, leading to increased fruit size. Additionally, the improvement in overall plant vigor and nutrient assimilation under these treatments may have supported better translocation of assimilates toward fruit development.These

findings are consistent with earlier studies by Khan *et al.* (2009) [8] on pomegranate and El-Miniawy *et al*. (2014) [6] on strawberry.

Fruit diameter (cm)

It is evident from the data that the fruit size estimated in terms of fruit diameter was significantly affected by all the treatments Table 2. The maximum fruit diameter (7.81 cm) was recorded in T_7 - SWE @ 2000 ppm + MLE @ 6000 ppm + PJLE @ 5000 ppm which was *on par* with T_4 - SWE @ 2000 ppm + MLE @ 6000 ppm (7.74 cm). The minimum fruit diameter was recorded in T_8 - control (6.27 cm)

The increase in fruit diameter undertreatments may be attributed to the presence of growth-promoting substances in SWE, MLE and PJLE. These bioextracts contain natural hormones, nutrients and antioxidants that enhance cell division and expansion, leading to larger fruit size. Improved nutrient uptake and physiological activity also likely contributed to better fruit development compared to the control. Similar findings with Bakhsh *et al.* (2020) [4] on pear and Musawi (2018) [9] on sour orange.

Fruit volume (cc)

It is revealed from the data that the various treatments significantly varied with respect to the fruit volume Table 2. Among the different treatments, T_7 - SWE @ 2000 ppm + MLE @ 6000 ppm + PJLE @ 5000 ppm recorded the highest fruit volume (293.13 cc) which was followed by T_4 - SWE @ 2000 ppm + MLE @ 6000 ppm (280.02 cc). The lowest fruit volume (248.32 cc) was observed in T_8 - control.

The increased fruit volume in treated plants is likely due to the combined effects of bioextracts, which supply essential nutrients and growth hormones that enhance cell division and expansion. This leads to improved fruit development and greater accumulation of water and nutrients, resulting in larger fruit size compared to control plants. These findings are consistent with earlier studies by Khan *et al*. (2009) [8] on pomegranate, El-Miniawy *et al*. (2014) [6] on strawberry, Bakhsh *et al.* (2020) [4] on pear, Musawi (2018) [9] on sour orange and Sheren and El-Amary (2015) [13] on pear.

Rind weight (g) and Rind thickness (mm)

The highest rind weight of (98.90 g) was recorded in T_7 - SWE @ 2000 ppm + MLE @ 6000 ppm + PJLE @ 5000 ppm, which was followed by T_4 - SWE @ 2000 ppm + MLE @ 6000 ppm (97.40 g) and T_6 - MLE @ 6000 ppm + PJLE @ 5000 ppm (97.52 g). Whereas, the least rind weight (90.28 g) was recorded in T_8 - control.

The rind thickness had significant differences among the treatments Table 3. T_7 - SWE @ 2000 ppm + MLE @ 6000 ppm + PJLE @ 5000 ppm registered the maximum rind thickness of (2.71 mm) which was followed by T_4 - SWE @ 2000 ppm + MLE @ 6000 ppm (2.59 mm). The minimum rind thickness (2.17 mm) was recorded in T_8 - control.

The increase in fruit size and weight was directly associated with greater rind weight and thickness. This might be attributed to enhanced hypodermal and mesocarp cell division, strengthening of cell walls through calcium pectate formation and improved translocation of carbohydrates to the pericarp. The bioactive compounds present in the applied bioextracts also promote lignification, cuticle development and the deposition of structural carbohydrates that contribute to increased rind firmness and resistance. Additionally, the improved chlorophyll content and enhanced CO_2 assimilation likely supported a higher assimilate supply to the developing fruit. These observations are in agreement with the findings of Sheren and El-Amary (2015) [13] on pear and Musawi *et al.* (2018) [9] on sour orange.

Rind - aril ratio and seed weight (g)

The maximum rind to aril ratio (0.77) was recorded in T_8 - control Table 3. Whereas, it was minimum (0.55) in T_7 - SWE @ 2000 ppm + MLE @ 6000 ppm + PJLE @ 5000 ppm, which was followed by T_4 - SWE @ 2000 ppm + MLE @ 6000 ppm (0.59).

The seed weight was significantly different among the treatments (figure 1). T_7 - SWE @ 2000 ppm + MLE @ 6000 ppm + PJLE @ 5000 ppm registered the lowest seed weight (27.09 g), which was *on par* with T_4 - SWE @ 2000 ppm + MLE @ 6000 ppm (27.21 g) the maximum seed weight (29.74 g) was recorded in the T_8 - control.

The decrease in rind-aril ratio and seed weight was due to the application of bioextracts which increased aril weight and reduced the rind and seed weight this might be due to the enhanced nutrient availability due to the reduced evaporative losses and better water conductance in the plant system. The findings were in line with that of Anbhu *et al*. (2022) [1] on pomegranate, Roshdy (2014) [11] on banana and El-Sharony *et al*. (2015) [7] on mango.

Number of arils per fruit, aril weight per fruit(g) and 100 aril weight per fruit(g)

All the treatments showed significant differences with respect to number of arils per fruit when compared to control (Table 3). T_7 - SWE @ 2000 ppm + MLE @ 6000 ppm + PJLE @ 5000 ppm recorded the highest number of arils per fruit (427.12). which was followed by T_4 - SWE @ 2000 ppm + MLE @ 6000 ppm (392.22). The minimum number of arils per fruit (328.34) was recorded in T_8 - control.

Aril weight per fruit significant differences among the different treatments (Table 2). T_7 - SWE @ 2000 ppm + MLE @ 6000 ppm + PJLE @ 5000 ppm aril weight per fruit of (177 g) which was followed by T_4 - SWE @ 2000 ppm + MLE @ 6000 ppm (164 g) whereas, the minimum aril weight per fruit (117 g) was recorded in T_8 - control.

100 aril weight per fruit varied significantly among the different treatments (Table 2). T_7 - SWE @ 2000 ppm + MLE @ 6000 ppm + PJLE @ 5000 ppm recorded the maximum 100 aril weight per fruit (41.82 g), which was *on par* with T_4 - SWE @ 2000 ppm + MLE @ 6000 ppm (41.75 g). However, minimum 100 aril weight was recorded in T_8 - control (36.21 g).

The application of bioextracts significantly enhanced aril number and weight, likely due to the improved supply of essential nutrients, growth-promoting hormones cytokinins, auxins and bioactive compounds present in the extracts. These compounds enhance photosynthetic efficiency, stimulate cell division and enlargement and promote assimilate translocation towards developing fruits, resulting in higher aril production and weight. The improvement in aril traits may also be attributed to increased metabolic activity and better nutrient mobilization under bioextract treatments.These findings are in agreement with earlier reports by Sharma *et al*. (2023) [12] on kiwi fruit and Thabet *et al*. (2022) [15] on date palm.

Conclusion

The combined foliar application of Seaweed Extract (2000 ppm), Moringa leaf extract (6000 ppm) and *Prosopis juliflora* leaf extract (5000 ppm) significantly enhanced yield and fruit attributes in pomegranate cv. Bhagwa under dryland conditions. Treatment T_7 consistently recorded superior results across all parameters including fruit weight, aril yield and fruit attributes. The synergy of bioactive compounds, growth hormones and micronutrients in the bioextracts contributed to improved physiological and metabolic functions. These findings demonstrate the potential of natural bioextracts as sustainable alternatives to synthetic inputs in pomegranate cultivation. Adoption of such eco-friendly practices can improve productivity while promoting environmental sustainability.

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Table 1: Treatment details

Treatment	Treatment details
T_1	Seaweed extract @ 2000 ppm
T_2	Moringa leaf extract @ 6000 ppm
T_3	*Prosopis juliflora* leaf extract @ 5000 ppm
T_4	Seaweed extract @ 2000 ppm + Moringa leaf extract @ 6000 ppm
T_5	Seaweed extract @ 2000 ppm + *prosopis juliflora* leaf extract @ 5000 ppm
T_6	Moringa leaf extract @ 6000 ppm + *prosopis juliflora* leaf extract @ 5000 ppm
T_7	Seaweed extract @ 2000 ppm + Moringa leaf extract @ 6000 ppm + *Prosopis juliflora* leaf extract @ 5000 ppm
T_8	Control

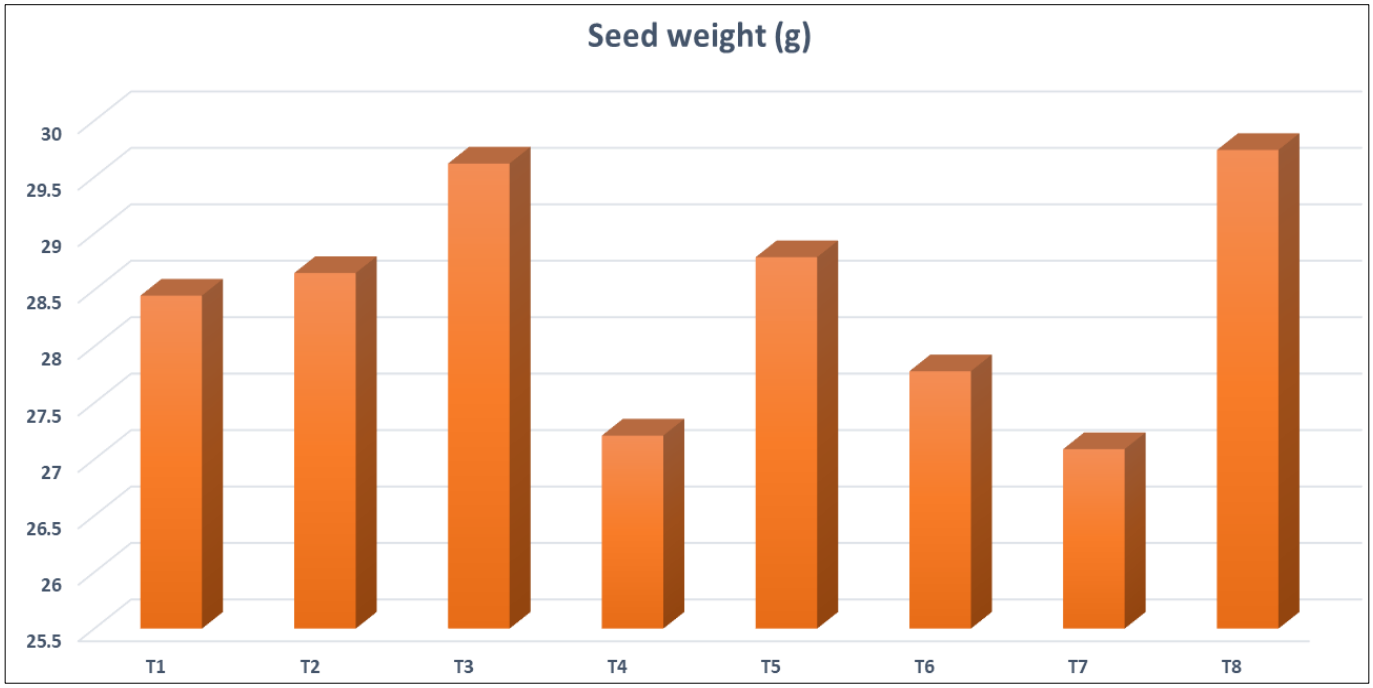
Table 2: Effects of bioextracts on yield parameters of Pomegranate (*Punica granatum* L.) cv. Bhagwa

Treatments details	Number of fruits per plant	Fruit weight (g)	Yield (kg/ plant)	Fruit length (cm)	Fruit Diameter (cm)	Fruit volume (cc)
T_1	57.00^{e}	222.74^{d}	13.62^{c}	6.87^{e}	6.49^{cd}	260.20^{e}
T_2	58.11^{d}	230.13^{e}	14.21^{c}	6.94^{d}	6.53^{bc}	269.10^{d}
T_3	55.00^{f}	208.11^{f}	12.61^{d}	6.72^{f}	6.42^{d}	255.03^{f}
T_4	64.10^{b}	252.41^{b}	16.38^{a}	7.58^{b}	7.74^{a}	280.02^{b}
T_5	58.30^{d}	239.22^{c}	14.00^{c}	6.98^{d}	6.55^{bc}	271.21^{cd}
T_6	60.00^{c}	243.12^{c}	15.11^{b}	7.28^{c}	6.61^{b}	273.01^{c}
T_7	66.21^{a}	265.13^{a}	16.41^{a}	7.75^{a}	7.81^{a}	293.13^{a}
T_8	50.00^{g}	198.00^{g}	10.91^{e}	6.28^{g}	6.27^{e}	248.32^{g}
S. Em ±	0.32	5.14	0.22	0.09	0.07	1.11
C.D.@ 5%	0.97	15.60	0.68	0.28	0.22	3.36

Table 3: Effects of bioextracts on fruiting charactersof Pomegranate (*Punica granatum* L.) cv. Bhagwa

Treatments details	Rind weight (g)	Rind thickness (mm)	Arils weight (g/fruit)	Rind -aril ratio	Number of arils per fruit	100 arils weight (g)
T_1	94.28^{d}	2.35^{e}	145^{f}	0.64^{c}	375.21^{c}	39.12^{c}
T_2	94.15^{d}	2.40^{d}	146^{e}	0.64^{c}	377.62^{c}	39.20^{c}
T_3	93.06^{e}	2.29^{f}	138^{g}	0.67^{b}	358.33^{d}	39.05^{e}
T_4	97.40^{b}	2.59^{b}	164^{b}	0.59^{d}	392.22^{b}	41.75^{a}
T_5	95.41^{c}	2.41^{d}	153^{d}	0.63^{c}	390.51^{b}	39.18^{c}
T_6	97.52^{b}	2.44^{c}	155^{c}	0.62^{c}	391.43^{b}	40.41^{b}
T_7	98.90^{a}	2.71^{a}	177^{a}	0.55^{e}	427.12^{a}	41.82^{a}
T_8	90.28^{f}	2.17^{g}	117^{h}	0.77^{a}	328.34^{e}	36.21^{d}
S. Em ±	0.27	0.06	0.28	0.01	0.79	0.13
C.D.@ 5%	0.82	0.18	0.86	0.03	2.40	0.41

Means in the column followed by same letters are not statistically significant as Duncan multiple range test at p = 0.05%



T_1 - Seaweed extract @ 2000 ppm
T_2 - Moringa leaf extract @ 6000 ppm
T_3 - *Prosopis juliflora* leaf extract @ 5000 ppm
T_4- SWE @ 2000 ppm + MLE @ 6000 ppm
T_5 - SWE @ 2000 ppm + PJLE @ 5000 ppm
T_6 - MLE @ 6000 ppm + PJLE @ 5000 ppm
T_7 - SWE @ 2000 ppm + MLE @ 6000 ppm + PJLE @ 5000 ppm
T_8 - Control

Fig 1: Effects of bioextracts on seed weight of Pomegranate (*Punica granatum* L.) cv. Bhagwa

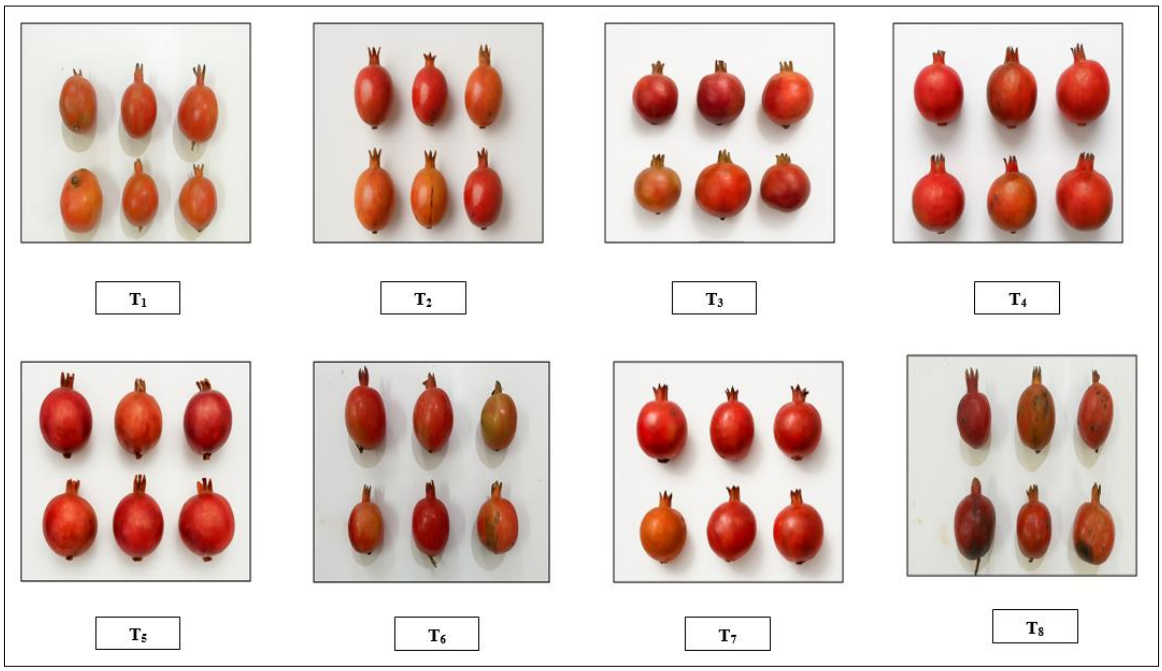


Plate 1: Effect of bioextrats on fruit attributes of pomegranate cv. Bhagwa

References

1. Anbhu VA, Rajangam J, Premalakshmi V, Venkatesan K. Influence of bioextracts on improving the yield and quality of pomegranate (*Punica granatum* L.) var. Bhagwa. Biol Forum. 2022;14(3):230-234.
2. Anwar F, Latif S, Ashraf M, Gilani AH. *Moringa oleifera*: A food plant with multiple medicinal uses. Phytother Res. 2007;21(1):17-25.
3. Ashour NE, Saleh MMS, Mostafa EAM. Improving fruit set, yield and fruit quality of Barhee date palms using some natural plant extracts. Int J Adv Multidiscip Res Stud. 2024;4(4):313-318.
4. Bakhsh A, Javaad HW, Hussain F, Akhtar A, Raza MK. Application of *Moringa oleifera* leaf extract improves quality and yield of peach (*Prunus persica*). J Pure Appl Agric. 2022;5(2):42-51.

5. Duncan DB. Multiple range and multiple F test. Biometrics. 1955;11:1-42.
6. El-Miniawy SM, Ragab ME, Youssef SM, Metwally AA. Influence of foliar spraying of seaweed extract on growth, yield and quality of strawberry plants. J Appl Sci Res. 2014;10(5):88-94.
7. El-Sharony TF, El-Gioushy SF, Amin OA. Effect of foliar application with algae and plant extracts on growth, yield and fruit quality of mango trees cv. Fagri Kalan. J Hortic. 2015;28(2):1-4.
8. Khan MA, Hanjra MA. Enhancing the productivity of pomegranate through improved irrigation practices. Agric Water Manag. 2009;96(9):1297-1305.
9. Musawi MAH. Effect of foliar application with algal extract on fruit quality of sour orange (*Citrus aurantium* L.). J Environ Sci Pollut Res. 2018;28(4):250-252.
10. Norrie J, Keathley JP. Benefits of *Ascophyllum nodosum* marine-plant extract applications to Thompson Seedless grape production. Acta Hortic. 2006;727:243-248.
11. Roshdy KA. Effect of spraying silicon and seaweed extract on growth and fruiting of Grand Naine banana. Egypt J Agric Res. 2014;92(8):979-991.
12. Sharma V, Rana VS, Almutairi KF, Avila-Quezada GD, Abdallah EF, Gudeta K. Improving kiwifruit yield and quality with seaweed extract treatments. Horticulturae. 2023;9(4):432.
13. Sheren AAH, El-Amary EI. Improving growth and productivity of pear trees using some natural plant extracts under North Sinai conditions. J Agric Vet Sci. 2015;8(1):1-9.
14. Tene V, Malagon O, Finzi PV, Vidari G, Armijos C, Zaragoza T. An ethnobotanical survey of medicinal plants used in Loja and Zamora-Chinchipe, Ecuador. J Ethnopharmacol. 2007;111(4):63-81.
15. Thabet AYI, Abdel-Hak RS, Ashour NE, Hassan HSA. Influence of foliar application with *Moringa oleifera* aqueous leaf extract on fruit set, yield and fruit quality of Selmy date palms. Egypt J Chem. 2022;65(9):119-126.
16. Thammadi S, Vijaya G, Srinivasa R, Mallesh S. Studies on the effect of fruit growth enhancing substance and bunch covering on fruit growth, yield and sunburn percentage of banana cv. KarpuraChakkera Keli. Int J Adv Biochem Res. 2024;8(10):1296-1303.
17. Yuniati N, Kusumiyati K, Mubarok S, Nurhadi B. The role of *Moringa* leaf extract as a plant biostimulant in improving the quality of agricultural products. Plants. 2022;11(17):2186.
18. Yakubu OE, Boyi RN, Shaibu C, Abah MA, Akighir J. Antioxidant parameter and GC-MS phytochemical analysis of *Hymenocardia acida* stem bark ethanolic extract. Trends Appl Sci Res. 2019;14:263-270.
19. Gurib-Fakim A. Medicinal plants: Traditions of yesterday and drugs of tomorrow. Mol Aspects Med. 2006;27(1):1-93.
20. Efferth T, Greten HJ. Quality control for medicinal plants. Med Aromat Plants. 2012;1:7-9.
21. Zhang J, Wider B, Shang H, Li X, Ernst E. Quality of herbal medicines: Challenges and solutions. Complement Ther Med. 2012;20(1-2):100-106.
22. Mgbeje BIA, Abu C. Chemical fingerprinting of *Nauclea latifolia*, an antidiabetic plant, using GC-MS. J Complement Altern Med Res. 2020;9(4):25-34.