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Effect of partial root drying technique and fertigation on organoleptic sensory parameters of pomegranate (*Punica granatum* L.) *Cv*. Bhagwa

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Abstract
A investigation was conducted to study the effect of partial root drying technique and fertigation on soil nutrients of pomegranate (*Punica granatum* L.) Cv. Bhagwa was carried out through a field experiment. The experiment comprising of 8 treatments, T1 is a partial root drying technique that requires 100% water and 100% nutrition (NPK); T2 is a partial root drying technique that requires 100% water and 75% nutrition (NPK); T3: Half-drying method (75% water needed) + 100% nutrition through fertigation using 100% RDF of NPK; T4: Half-drying method (75% water needed) + 75% nutrition through fertigation using 75% RDF of NPK; T5: 50% water need for partial root drying + 100% nutrition through fertigation with 100% RDF of NPK, T6: 50% water need for partial root drying + 75% nutrition through fertigation with 75% RDF of NPK, T7: Management, or standard drip irrigation (requiring 100% water) and 100% nutrition through fertigation using 100% RDF of NPK, T8: Control, or standard drip irrigation with 100% water need on both plant sides with 75% nutrition through fertigation using 75% RDF of NPK. In interaction effect on taste and flavour of arils, T_4 recorded maximum value of 8.80. Which is at par with T_6 treatment (8.32). Whereas, minimum values for taste and flavour of arils (7.37) was recorded in 1_4N_1 treatment. T_3 recorded maximum value of 8.75. Which is at par with T_4 treatment (8.65) whereas, minimum values for overall acceptability (7.90) were recorded in T_5 treatment.

Keywords: Pomegranate, PRD, Bhagwa, organoleptic, drought, sensory

Introduction
The pomegranate, or *Punica granatum* L., is a significant fruit crop that thrives in desert and subtropical areas because of its resilience to harsh weather and soil. It is thought to have originated in South-West Asia, most likely in Iran, and is a member of the Lythraceae family. Its chromosomal numbers are 2n = 16 and 18. Due to its exceptional mix, remarkable dessert quality, and sweet-acidic taste, it is one of the most widely consumed commercial fruits worldwide. The fruit's organoleptic qualities, or the seeds' ability to cure leprosy, cancer, and other ailments, as well as its nutritional value and medicinal properties, are further reasons for its popularity (Sonawane, 2017) [6]. Pomegranates are currently grown in 2.62 lakh hectares of land in India, where they produce 30.34 lakh MT. The top pomegranate-producing states are Maharashtra, Karnataka, Andhra Pradesh, Gujarat, and Tamil Nadu. (Anon., 2021) [1]. Pomegranates are typically irrigated commercially using drip irrigation, which is the most efficient way to provide water to the plants for their consumptive use. However, because pomegranates are a highly drought-tolerant crop, growers can save even more water by implementing innovative irrigation techniques like partial root drying, which is a sustainable method that saves water without compromising fruit quality or yield. This innovative irrigation method involves watering just half of the plant's root system, leaving the other half dry and the soil moist. This allows the plant to take water from one portion of the root system while leaving the other dry until the next irrigation cycle. Pomegranates grow heavily in sub-tropical climates, which can exhaust the plant and deplete vital soil nutrients necessary for healthy growth and development. Drip irrigation is used in the fertilization process to provide plants with water-soluble solid or liquid fertilizers. Due to its simplicity, efficiency, and ease of maintenance of the ideal fertility level and water

supply in accordance with the particular demand to nourish the crop adequately to promote growth and productivity without adversely affecting the environment, this method of applying fertilizer is the most widely used. In addition to reducing labor costs for external application, fertilization increases the capacity of the root mass to retain and trap water and nutrients, hence improving the efficiency of both nutrient and water usage. Additionally, it makes it possible to precisely and accurately distribute nutrients at crucial periods of crop growth.

Material and Methods

The current study was conducted in the Fruit Orchard, Sector 70, UHS, Bagalkot, pomegranate orchard, to examine the impact of fertigation and partial root drying technique on soil nutrients of pomegranate (*Punica granatum* L.) Cv. Bhagwa in the years 2019–2020 and 2020–2021. Situated at 16. 10° N latitude and 75.42° E longitude, the area is under Karnataka's Northern Dry Zone (Zone-3), and it is 542.00 m above Mean Sea Level (MSL). The experiment was set up as a two-factor RCBD, with 24 plots total. The first factor had four distinct irrigation treatments, and the second factor had two different fertigation treatments. Both factors were reproduced three times. The treatment details include**.**

Main treatments

1. **I_1:** Partial root zone irrigation technique to replenish 100 % CP_E (100 % water requirement)
2. **I_2:** Partial root zone irrigation technique to replenish 75 % CP_E (75 % water requirement)
3. **I_3:** Partial root zone irrigation technique to replenish 50 % CP_E (50 % water requirement)
4. **I_4:** Control *i.e.* normal drip irrigation on both sides of the plant to replenish 100 % CP_E (100% water requirement)

- **Sub treatments**

1. **N_1:** 100 % nutrition by fertigation with 100 % RDF of NPK (400:200:200 g /plant)
2. **N_2:** 75 % nutrition by fertigation with 75 % RDF of NPK (300: 150:150 g /plant)

- **Calculation of water requirement of the crop:** Based on CPE, using FAO Penman- Monteith method (http://wwww.fao.org or https://aggiehorticulture.tamu.edu)

Score card for sensory evaluation of pomegranate fruits

The fruits borne on the plant were tagged individually in all replications in each treatment, Matured fruits were harvested from each replication for each treatment and utilized for organoleptic evaluation.

Sensory score card
Name:
Date:
We are presenting samples of fresh pomegranate fruits and arils before you. Please evaluate the given coded samples for various organoleptic characteristics on 9- Point Hedonic scale.

Treatments	Colour and appearance of fruits	Mouth feel of arils	Taste and flavor of arils	Overall acceptability	Scale	
					9	**Like extremely**
T_1					8	Like very much
T_2					7	Like moderately
T_3					6	Like slightly
T_4					5	Neither like or dislike
T_5					4	Dislike slightly
T_6					3	Dislike moderately
T_7					2	Dislike very much
T_8					1	Dislike extremely

Note: Please look for calyx freshness to judge for appearance

Signature of the Evaluator

(Gidagiri, 2019) [2]

Results and Discussion

Organoleptic properties like colour and appearance of fruits, mouth feel of arils, taste and flavour of arils and overall acceptability are tabulated in Table 1. The interpretation of data regarding colour and appearance of fruits revealed significant differences. Among four different irrigation, its interaction effect with fertigation in both the years of experimentation. Whereas, fertigation treatments alone did not vary significantly.

As shown by pooled data of two years, among four different irrigation treatments, the values of colour and appearance of fruits was recorded maximum (8.79) in I_2 treatment (PRD_{75}) followed by I_3 treatment (PRD_{50}) (8.36). Whereas, minimum values for colour and appearance of fruits (7.10) was recorded in I_4 treatment (CDI_{100}). Among the two different fertigation treatments, maximum values for colour and appearance of fruits (7.96) was noticed in N_1 (RDF_{100} treatment). In interaction effect on colour and appearance of fruits, T_4 recorded maximum value of 8.80. Which is at par with T_3 treatment (8.78). Whereas, minimum values for colour and appearance of fruits (7.00) was recorded in 1_4N_2 treatment. The values of mouth feel of arils was recorded maximum (8.32) in I_1 treatment (PRD_{100}) followed by I_2 treatment (PRD_{75}) (7.71). Whereas, minimum values for mouth feel of arils (7.17) was recorded in I_4 treatment (CDI_{100}). Among the two different fertigation treatments, maximum values for mouth feel of arils (7.71) was noticed in N_1 (RDF_{100} treatment). In interaction effect on mouth feel of arils, T_4 recorded maximum value of 8.43. Which is at par with T_2 treatment (8.22) whereas, minimum values for mouth feel of arils (7.06) was recorded in 1_4N_2 treatment.

As shown by pooled data of two years, among four different irrigation treatments, the values of taste and flavour of arils was recorded maximum (8.47) in I_2 treatment (PRD_{75}) followed by I_1 treatment (PRD_{100}) (8.25). Whereas, minimum values for taste and flavour of arils (7.64) was

recorded in I_4 treatment (CDI_{100}). Among the two different fertigation treatments, maximum values for taste and flavour of arils (8.27) was noticed in N_2 (RDF_{75} treatment). In interaction effect on taste and flavour of arils, T_4 recorded maximum value of 8.80. Which is at par with T_6 treatment (8.32). Whereas, minimum values for taste and flavour of arils (7.37) was recorded in 1_4N_1 treatment. The value of overall acceptability was recorded maximum (8.70) in I_2 treatment (PRD_{75}) followed by I_1 treatment (PRD_{100}) (8.13). Whereas, minimum value for overall acceptability (7.85) was recorded in I_3 treatment (PRD_{75}). Among the two different fertigation treatments, maximum values for overall acceptability (8.21) were noticed in N_2 (RDF_{75} treatment). In interaction effect on over all acceptability, T_3 recorded maximum value of 8.75. Which is at par with T_4 treatment (8.65). Whereas, minimum values for overall acceptability (7.90) were recorded in T_5 treatment. The values of colour and appearance of fruits, taste and flavour of arils and overall, acceptably was recorded maximum in I_2 treatment (PRD_{75}) whereas, minimum values was recorded in I_4 treatment (CDI_{100}). This superiority of I_2 (mild water stress PRD irrigation strategy) regarding sensory evaluation parameters is attributed to accumulation of compatible solutes (Amino acids, polyamines and hydroxyl compounds), Increase in antioxidants (Ascorbic acid, tocopherols), sugar, anthocyanin concentration and other enzymes under mild water stress especially PRD irrigation strategy significantly than that of normal conventional irrigation strategy with complete evapotranspiration replenishment, and these findings are in line with those opined by Reddy *et al.* (2004) [4] by describing physiological, biochemical and molecular responses of drought stress and Santos *et al*. (2005) [6] this is because, as a result of reduction in canopy density, Exposure to sunlight influenced fruit pulp composition, suggesting that anthocyanin and other secondary products metabolism in response to both light and temperature. Among the fertigation treatments, maximum scores for organoleptic parameters are given to N_2 (RDF_{75} treatment), and this could be due to increased TSS, color of arils and peel than that of full dose of fertilizers application. In interaction effect on over all acceptability, T_3 recorded maximum value of 8.75. Which is at par with T_4 treatment (8.65) whereas, minimum values for overall acceptability (7.90) were recorded in T_5 treatment.

Table 1 : Organoleptic properties (9 points scale) of fruit as influenced by different irrigation and fertigation in pomegranate *cv*. Bhagwa

Irrigation (I)	Colour and appearance of fruits									Mouth feels of arils								
	2019-20			2020-21			Pooled			2019-20			2020-21			Pooled		
	N_1	N_2	Mean	N_1	N_2	Mean	N_1	N_2	Mean	N_1	N_2	Mean	N_1	N_2	Mean	N_1	N_2	Mean
I_1	7.30	6.99	7.14	7.48	7.12	7.30	7.39	7.05	7.22	8.40	8.20	8.30	8.46	8.24	8.35	8.43	8.22	8.32
I_2	8.72	8.683	8.70	8.83	8.92	8.87	8.78	8.80	8.79	7.72	7.64	7.68	7.78	7.71	7.74	7.75	7.67	7.71
I_3	8.41	8.19	8.30	8.55	8.31	8.43	8.48	8.25	8.36	6.94	6.82	6.88	7.86	7.61	7.73	7.40	7.21	7.31
I_4	7.11	6.98	7.05	7.30	7.03	7.16	7.20	7.00	7.10	7.31	7.04	7.18	7.24	7.08	7.16	7.27	7.06	7.17
Mean	7.89	7.71		8.04	7.84		7.96	7.78		7.59	7.428		7.83	7.66		7.71	7.54	
For comparing means of	S.Em. ±	C.D. at 5%		S.Em. ±	C.D. at 5%		S.Em. ±	C.D. at 5%		S.Em. ±	C.D. at 5 %		S.Em. ±	C.D. at 5%		S.Em. ±	C.D. at 5%	
Irrigation (I)	0.08	0.25		0.27	0.84		0.10	0.28		0.07	0.23		0.21	0.66		0.08	0.24	
Nutrients (N)	0.05	0.18		0.19	NS		0.14	NS		0.05	0.16		0.15	NS		0.12	NS	
Irrigation (I) x Nutriments (N)	0.11	0.36		0.39	1.18		0.20	0.57		0.10	0.32		0.30	0.93		0.17	0.49	

PRD: Partial root drying, **Factor-II:** Two different levels of fertigation, **CI**-Conventional (Normal two side irrigation), **N_1**- RDF $_{100}$
Factor-1: Four different levels of irrigation (PRD and conventional), **N_2** – RDF $_{75}$, **I_1** - PRD $_{100}$, **I_2** - PRD_{75}, **I_3** – PRD_{50}, **I_4**- Conventional $_{100}$, **NS**- Non-Significant

Contd...

Irrigation (I)	Taste and flavour of arils									Over all acceptability								
	2019-20			2020-21			Pooled			2019-20			2020-21			Pooled		
	N_1	N_2	Mean	N_1	N_2	Mean	N_1	N_2	Mean	N_1	N_2	Mean	N_1	N_2	Mean	N_1	N_s	Mean
I_1	8.10	8.33	8.22	8.28	8.30	8.29	8.19	8.31	8.25	7.16	8.38	7.77	8.54	8.43	8.49	7.85	8.40	8.13
I_2	8.38	8.61	8.50	8.42	8.48	8.45	8.40	8.55	8.47	8.75	8.68	8.71	8.75	8.63	8.69	8.75	8.65	8.70
I_3	7.68	7.83	7.76	8.61	8.81	8.71	8.15	8.32	8.23	7.87	7.74	7.81	7.93	7.85	7.89	7.90	7.79	7.85
I_4	7.55	7.68	7.61	7.20	8.15	7.67	7.37	7.91	7.64	8.23	8.01	8.12	8.09	7.99	8.04	8.16	8.00	8.08
Mean	7.93	8.11		8.13	8.43		8.03	8.27		8.00	8.208		8.33	8.22		8.16	8.218	
For comparing means of	S.Em. ±	C.D. at 5%		S.Em. ±	C.D. at 5%		S.Em. ±	C.D. at 5 %		S.Em. ±	C.D. at 5%		S.Em. ±	C.D. at 5%		S.Em. ±	C.D. at 5%	
Irrigation (I)	0.03	0.11		0.18	0.55		0.07	0.22		0.33	1.02		0.19	0.58		0.13	0.38	
Nutrients (N)	0.02	0.08		0.12	NS		0.11	NS		0.23	NS		0.13	NS		0.18	NS	
Irrigation (I) x Nutrients (N)	0.05	0.16		0.25	0.78		0.15	0.45		0.47	1.44		0.27	0.83		0.26	0.77	

PRD: Partial root drying, **Factor-II:** Two different levels of fertigation, **CI**- Conventional (Normal two side irrigation), **N_1**- RDF $_{100}$, **Factor-1:** Four different levels of irrigation (PRD and conventional), **N_2**- RDF $_{75}$, **I_1** -PRD $_{100}$, **I_2** - PRD_{75}, **I_3** - PRD_{50}, **I_4** - Conventional $_{100}$, **NS**- Non Significant

Conclusion

The present study reveals that among four different irrigation treatments, the values of colour and appearance of fruits, taste and flavour of arils and overall, acceptably was recorded maximum in I_2 treatment (PRD_{75}). Among two different fertigation treatments, maximum scores for organoleptic parameters were given to N_2 (RDF_{75} treatment). Whereas, T_3 recorded maximum value of 8.75 with respect to overall acceptability.

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