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Studies on the effect of organic and inorganic fertilizers on plant growth and quality attribute of pomegranate (*Punica granatum* L.) under precision farming

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Abstract

The present investigation the effect of organic and inorganic fertilizers on growth and quality of pomegranate (*Punica granatum* L.) under precision farming was conducted at PFDC (Precision farming development centre), Department of fruit science, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya Raipur during the year 2020 – 2021 season on two to three year old pomegranate tree cv. Super bhagwa. The experiment was laid out in a Randomized Block Design with 10 treatments viz., T₀ (100% of RDF as soil application and irrigation through drip), T₁ (60% RDF through drip), T₂ (80% RDF through drip), T₃ (100% RDF through drip), T₄ (60% of RDF + Vermiwash through drip (1 litre/ week), T₅ (80% of RDF + Vermiwash through drip (1 litre/ week), T₆ (60% of RDF + Cow urine through drip (1 litre/ week), T₇ (80% of RDF + Cow urine through drip (1 litre/ week), T₈ (60% of RDF + Vermiwash + Cow urine through drip (1 litre/ week) and T₉ (80% of RDF + Vermiwash + Cow urine through drip (1 litre/ week) with three replications. Results revealed that 80% of RDF + Vermiwash + Cow urine through drip (1 litre/ week) recorded significantly highest plant growth (plant height, Average shoot length, number of shoot per plant, plant spread in N-S and E-W, number of flower per plant and 80% of RDF + Vermiwash + Cow urine through drip (1 litre/ week)) recorded significant fruit quality (total soluble solid, acidity, TSS acid ratio, pH, ascorbic acid, reducing sugar, non-reducing sugar and total sugar).

Keywords: Growth and quality, organic fertilizer (cow urine, vermiwash), Pomegranate, RDF

Introduction

The pomegranate (*Punica granatum* L.) is a common table fruit and is very much liked for its refreshing juice, which has a high medicinal value. The hardy nature, low maintenance cost high yields, better keeping quality and survival without irrigation make pomegranate cultivation a paying proposition.

Pomegranate belonging to the family Lythraceae new name and Punicaceae old name is a favourite table fruits of tropical and subtropical regions. It has both cultivated (*Punica granatum*) and wild type (*Punica protopunica*). The fruit is native of Iran, where it was first cultivated in about 2000 B.C. ago. In general, Pomegranate are diploid with chromosome number, $2n = 2x = 18$.

Pomegranate is considered a nutritious fruit. The edible part of this fruit is 68%. It contains water 78%, protein 1.6%, carbohydrate 14.5%, calcium 10 mg/100g, phosphorus 70 mg/100 g, iron 0.3 mg/100 g, riboflavin 0.10 mg/100 g and vitamin C 16 mg/100 g fruit. The fruit is mainly used for dessert purposes. Fresh fruits are of high quality, and processed products such as bottled juice, syrup, and jelly are highly regarded. This juice is considered useful for leprosy patients. The juice is easy to ferment and can be used for winemaking. Wild pomegranate juice is used to make citric acid and sodium citrate for medicinal purposes. It is also used to treat dysentery and diarrhoea. The most famous is the treatment of chronic gastric disease. Pomegranate seeds contain oils with potential for industrial application. The fruit is rare and is mainly used for dessert purposes, but its juice has good medicinal value and is useful for patients with leprosy, diarrhea, dysentery and bleeding. Wild pomegranate juice contains citric acid and sodium citrate, which are used for pharmaceutical purposes. Recently, fruit extracts have been reported to have anti-cancer properties (Sudhakar *et al.*, 2015) [4].

Pomegranate producing countries are Iran, India, Turkey, Spain, Tunisia, Morocco, Afghanistan, China, Greece, Japan, etc. India contribute per cent to the world pomegranate market. The good quality pomegranate is produced in Turkey, Iran, Afghanistan, Syria, Morocco and Spain. In India, pomegranate is cultivated on 275 thousand hectares area and production of 3256 thousand MT in India (Anon, 2019-20) [1]. Pomegranate growing states in India are Maharashtra, Karnataka, Gujarat, Andhra Pradesh, Madhya Pradesh, Tamil Nadu and Rajasthan. In Chhattisgarh it occupies 850 hectare and production 5714 MT (Anon, 2019-20.) [1] Major pomegranate producing areas in Maharashtra are Nasik, Sangli, Solapur, Satara, Ahmednagar, Buldhana, Beed, Aurangabad, and Washim. In Karnataka, it is growing mainly in Bijapur, Bellary, Koppal, Bagalkot etc.

Although a crop of semi- arid region large area of pomegranate is brought under drip irrigation, because of higher yield and improved quality of the fruit. Consequent upon the adaptation of drip irrigation system fertilization practices have also been altered and adjusted to suit the crop and system needs Fertigation is assuming greater importance in recent year due to escalation in energy costs and depleting water resources.

Materials and Methods

The experiment was conducted in the PFDC at Department of Fruit Science, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya Raipur during the year 2020 – 2021. The experiment was conducted on two to three year old pomegranate tree of cv. Super Bhagwa with ten treatment and three replication in Randomized block design. The total number of tree included in the experiment were 90 and were space at 2m x 2m.

Fertilizer doses applied during the month of October Nitrogen, phosphorus and potassium were applied through urea, Di-ammonium phosphate and Murat of potash, respectively for T₀ soil application. Recommended doses of N, P₂O₅ and K₂O used were 250g N, 100g P₂O₅ and 250g K₂O per plant respectively. Half dose of Urea and full dose of D.A.P. & M.O.P. were applied in soil application and remaining half dose of urea applied at fruit setting stage. The

fertilizers for the treatment T₁ to T₉ were applied by water soluble fertilizer (19: 19: 19), Recommended doses of N, P₂O₅ and K₂O used were 250g N, 100g P₂O₅ and 250g K₂O per plant respectively, and other inorganic fertilizer in combined treatment be used.

Statistical analysis was done by using method of analysis of variance (ANOVA) for randomized block design (RBD) by Fischer and Yates (1963) [6]. Whenever 'F' test was found significant for comparing the means of two treatments, critical difference (C. D. at 5%) was worked.

Results and Discussion

80% of RDF + Vermiwash + Cow urine through drip (1 litre/week) recorded significantly maximum growth parameters plant height (2.96 m) crop growth treatments showed increased plant height recording the maximum height of 2.63 m in T₆ 100% Fertigation (Tanari *et al.*, 2018), average shoot length (95.98 cm), No. of shoot/ plant (38.33), Plant spread N-S(2.64 m), E-W (2.67 m). Results revealed that 100% RDN through vermicompost recorded significantly highest plant spread N-S (2.43 m) and E-W (2.67 m) (kurer *et al.*, 2017) [9], No. of flower per plant (21) (Table 1.) and it was followed by Followed by T₈ – 60% Of RDF + Vermiwash + Cow urine through drip (1 litre/week). Better growth and development of plants with the application of 100 per cent RDN through vermicompost might be due to increased microbes in the rhizosphere which might have helped in enhanced release of growth factors like auxins, gibberellins and cytokinins in pomegranate (Mir *et al.*, 2015) [7]. Vermiwash is a liquid coelomic fluid earthworm body collected without harming is vermiwash. The application of vermiwash is in plant growth enhancement and peat management. Vermiwash contains several enzyme, plant growth hormones and vitamins along with micro and macro nutrients that stimulate the growth and yield of crops and even develop resistance in crop receiving this spray. Such preparation would certainly have the soluble plant nutrients a part from some organic acids and mucus of earthworms and microbes. (Sivasubramanian and Ganeshkumar, 2004, Zambare *et al.*, 2008, Rai and Bansiwai, 2008) [10, 11, 12].

Table 1: Effect of organic and inorganic fertilizes on vegetative growth of Pomegranate cv. Super Bhagwa

Treatments	Plant height (m)	Average shoot length (cm)	Number of shoot/ plant	Plant spread (m)		Number of flower / plant
				N-S	E-W	
T ₀	2.10	70.37	29.66	1.87	2.12	11.66
T ₁	2.18	74.93	30	1.92	2.13	13.33
T ₂	2.29	76.13	30.66	1.96	2.17	12.33
T ₃	2.30	77.32	33	1.96	2.29	10.33
T ₄	2.45	78.83	33.33	1.98	2.23	14.66
T ₅	2.39	77.59	33.66	2.02	2.31	15.33
T ₆	2.53	86.23	34	2.22	2.34	15.66
T ₇	2.64	89.77	34.33	2.38	2.37	17.33
T ₈	2.78	92.22	36.66	2.42	2.46	17.66
T ₉	2.96	95.98	38.33	2.67	2.64	21
S.Em+	0.007	0.40	1.85	0.02	0.01	1.87
CD at 5%	0.02	0.83	5.47	0.05	0.02	5.52

Table 2: Effect of organic and inorganic fertilizes on fruit quality of Pomegranate cv. Super Bhagwa

Treatments	Total soluble solids (°Brix)	Acidity (%)	TSS: Acid	pH	Ascorbic acid mg/100g	Reducing Sugar (%)	Non-Reducing Sugar (%)	Total Sugar (%)
T ₀	12.09	0.41	29.48	3.23	19.15	10.03	1.04	11.09
T ₁	11.31	0.40	28.27	3.33	19.29	10.27	1.04	11.81

T ₂	13.19	0.39	33.82	3.46	20.10	10.47	1.13	11.54
T ₃	12.88	0.38	33.89	3.53	20.39	10.57	1.12	11.91
T ₄	14.67	0.37	39.64	3.60	21.89	10.66	1.13	11.88
T ₅	14.12	0.36	39.22	3.60	22.10	10.47	1.14	12.65
T ₆	15.14	0.36	42.05	3.61	22.81	10.47	1.15	12.30
T ₇	15.48	0.34	45.52	3.65	22.89	11.00	1.15	12.61
T ₈	15.57	0.33	47.18	3.70	23.75	11.10	1.16	12.79
T ₉	15.67	0.31	50.54	3.71	23.90	11.70	1.17	12.83
S.Em+	0.81	0.01	0.725	0.01	1.04	0.30	0.01	0.15
CD at 5%	2.43	0.03	2.172	0.03	3.13	0.89	0.03	0.45

The quality parameters of T₉ - 80% Of RDF + Vermiwash + Cow urine through drip (1 litre / week) significantly maximum total soluble solids (15.67° Brix), titrable acidity (0.31%), TSS: Acidity (50.54), pH (3.71), ascorbic acid (23.90mg/100g) Khayyat *et al.* (2012) [3] reported increased titrable acidity and ascorbic acid content in pomegranate fruit juice with the application of 250 mg L⁻¹ plant⁻¹ of K during fruit enlargement stage owing to its role in accumulation of higher photosynthates (carbohydrates) in fruits. Further, higher levels of nitrogen stimulate synthesis and catalytic activity of several enzymes and co-enzymes which are instrumental in ascorbic acid synthesis (Boora & Singh 2000, Sheikh & Manjula 2012) [5], reducing sugar (11.70%), non-reducing sugar (1.17%), total sugar (12.83%) of Pomegranate fruits juice. (Table -2) and it was Followed by T₈ - 60% of RDF + Vermiwash + Cow urine through drip (1 litre / week).

Conclusion

The results of the present investigation revealed that the nutritional requirement of pomegranate could be fulfilled with the exclusive use of organic sources without affecting growth performance and quality. The effect of organic and inorganic fertilizers treatment T₉ -80% of RDF + Vermiwash + Cow urine through drip (1 litre/ week) were found superior for on plant growth character.

Application of 80 per cent of recommended dose of fertilizer through water soluble fertilizer + Vermiwash + cowurine was found the better to increase the plant growth and quality of pomegranate fruits. The fruit juice parameter *viz.*, TSS, minimum acidity, pH, ascorbic acid, reducing sugar, non-reducing sugar and total sugar was highest in 80% of RDF + Vermiwash + Cow urine through drip (1 litre/ week) (T₉) as compared to (100% of RDF as soil application and irrigation through drip) or control (T₀).

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