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Effect of fertigation on flowering and yield of tissue culture pomegranate (*Punica granatum* L.) cv. MIRDULA grown under ultra high density planting (UHDP)

T. SHANMUGASUNDARAM AND **G. BALAKRISHNAMURTHY**[1]

Members of the Research Forum

Associated Authors:
[1]Department of Fruit Crops, Horticultural College of Research Institute (T.N.A.U.), COIMBATORE (T.N.) INDIA
Email : gbalki2001@yahoo.com

Author for correspondence :
T. SHANMUGASUNDARAM
Department of Fruit Crops, Horticultural College of Research Institute, (T.N.A.U.), COIMBATORE (T.N.) INDIA
Email : shaland4@yahoo.com

ABSTRACT : The study was conducted during 2011-12 and 2012-13 to find out the effect of fertigation on flowering and yield of tissue culture (TC) pomegranate (*Punica granatum* L.) cv. Mirdula grown under ultra high density planting (UHDP).The experiments was laid out in Randomized Block Design with five treatment of fertigation levels *viz*., 50, 75, 100 and 125 % recommended dose of water soluble fertilizers (applied twice in a week) including soil application (control) and replicated four times and to test various yield attributes of 2-3 years old TC pomegranate (*Punica granatum* L.) cv. Mirdula was grown under UHDP. The investigation indicated 50 % recommended dose of fertilizers through fertigation (T_2) resulted in maximum number of hermaphrodite flower (63.05), number of male flower (55.95), number of fruits per tree (52.38), fruit set percentage (83.57 %), average fruit weight (211.43 g), fruit volume (228.75 cc), peel weight (62.83 g), total aril weight (127.53 g), 100 aril weight (22.31 g),total seed weight (14.87 g) and fruit yield / plant (11.1kg) as compared with soil application of recommended doses of NPK and higher doses of NPK applied through fertigation. Therefore (T_2) 50 % recommended dose of NPK in the form of water soluble fertilizers can be recommended for getting increased flowering and the highest yield for two to three years old TC pomegranate cv. MRIDULA.

KEY WORDS : TC pomegranate, UHDP, Fertigation, Flowering, Yield

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Drip irrigation is the best method of irrigation to most of the tropical, sub tropical annual and perennial horticulture crops to get the highest yield and quality fruits. Modern drip irrigation has arguably become the world's most valued innovation in agriculture since the invention of the impact sprinkler, which replaced flood irrigation. This is because high water application efficiencies are often possible with drip irrigation, since there is reduced surface evaporation, less surface runoff, as well as minimal deep percolation. Moreover, a drip irrigation system can easily be used for fertigation, through which crop nutrient requirements can be met accurately. Due to the way the water is applied in a drip system, traditional surface applications of timed- release fertilizer are sometimes ineffective, so drip systems often mix liquid fertilizer with the irrigation water. Water is the most limiting natural resource hindering the economic development of any developing country. In the present-day context, improvement in irrigation practices, including schedules and methods, is needed to increase crop production and to sustain productivity levels. Many researchers have reported the higher application efficiency of drip irrigation systems over the conventional basin irrigation systems in fruits (Salvin *et al.*, 2000; Bharambe *et al.*, 2001; Agrawal and Agrawal, 2007 and Ramniwas, 2012).

Pomegranate has emerged as one of the important fruit crops owing to its high demand for fruits throughout the year besides hardiness and ability to withstand adverse soil and climate conditions. Today out of the world production of ten

lakh tons; India contributes 40-45 per cent. Currently the export of pomegranate is around 10,000 tons, which is just 5% of total export (Hiwale, 2009). As on date it is cultivated in an area of 1.12 lakh ha, with the production of 7, 72,000 MT. (NHB, Statistical data 2011-2012). The concept of high density orcharding has been successfully applied in a number of arid and semi arid fruit crops by using various techniques in India. Accordingly, efforts have been made in different parts of world to find out the optimum spacing for different fruit plants along with the related technologies so as to derive maximum return per unit area. However, the information regarding drip irrigation and fertigation scheduling in newly planted pomegranate under high density planting system is lacking. Keeping these in view, the present experiment was taken up to study the effects of fertigation treatment on yield and quality parameters of TC pomegranate plants under (UHDP).

RESEARCH METHODS

The experimental field was located at Jain Irrigation Systems Pvt. Limited Farms, Elayamuthur, Udumalpet, Thirupur District which is about 90 km away from Horticultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore. The present experiment was carried out in two and three years old tissue cultured pomegranate plants of cv. MRIDULA. The spacing adopted was 3 x 2 m, with a plant population of 1667 plants ha^{-1}. The experiment was laid out with five levels of NPK in randomized block design and replicated four times. There are three main seasons of flowering known as Ambe bahar, Mrig bahar and Hasta bahar. In this study Ambe bahar (January – February) flowering season was used and observation registered.

Treatment details :

Recommended fertilizer schedule adopted with the dosage of (250:125:125 and 500:125:125 g^{-1} $plant^{-1}$ $year^{-1}$), respectively for second and third year plants.

Nutrients for the treatments T_2 to T_5 were applied through drip irrigation system (fertigation). Weighed quantity of water soluble fertilizers (WSF) as per schedule was dissolved in water and then injected to sub-main through venturi tank and then to lateral lines as per treatment. Fertilizers were applied twice a week through drip irrigation. Nutrient for the treatment T_1 (control) was applied in the soil as conventional fertilizer and irrigated through drip. The plants were grown under drip system of irrigation with the following design having 5 Hp motor, pump discharge 5.5 lps, main line diameter 63 mm, sub main diameter 40 mm, lateral diameter 16 mm, lateral spacing 3m, emitter spacing 60 cm, emitter model outline, emitter discharge rate 4 lph and filter size (Screen filter) 63 mm. The observations namely, number of hermaphrodite flowers per plant, number of male flowers per plant, fruit set percentage, total number of fruits per tree, average fruit weight, fruit volume, peel weight, total aril weight, 100 aril weight, total seed weight and fruit yield per plant were recorded from five representative plants.

Mechanical analysis of soil showed that the soil organic carbon, available nitrogen, phosphorus and potassium of soil were 0.76%, 210, 20 and 295 kg ha^{-1}, respectively.

RESEARCH FINDINGS AND DISCUSSION

The number of hermaphrodite and male flower per tree was significantly increased by drip fertigation treatments. Among the different treatments, application of 50 per cent RDF through drip fertigation (T_2) treatment registered the highest number of hermaphrodite and male flowers per tree. It was followed by 75 per cent RDF drip fertigation (T_3) and the lowest number of hermaphrodite and male flowers per tree was recorded by (T_1) control (Table 1). The total number of flowers per plant in the first year was lower as compared to that of the second year. This may be due the availability of more quantity of soil nutrients and leaf area for photosynthesis in the second year. The fertigation treatments imposed in the first year would have influenced emergence of more number of flowers per plant only in the second or later years. The present investigation is in line with findings of Mongi Zekri and Koo (2003).

Treatments	Fertigation schedule for the second year (2011-2012)	Fertigation schedule for the third year (2012-2013)
T_1 (control)	100 % of RDF as soil application and irrigation through drip (250:125:125g^{-1} $plant^{-1}$ $year^{-1}$)	100 % of RDF as soil application and irrigation through drip (500:125:125 g^{-1} $plant^{-1}$ $year^{-1}$)
T_2	50 % of RDF through fertigation (125 :62.5:62.5 g^{-1} $plant^{-1}$ $year^{-1}$)	50 % of RDF through fertigation (250 :62.5:62.5 g^{-1} $plant^{-1}$ $year^{-1}$)
T_3	75 % of RDF through fertigation (187.5:93.75:93.75 g^{-1} $plant^{-1}$ $year^{-1}$)	75 % of RDF through fertigation (325: 93.75:93.75 g^{-1} $plant^{-1}$ $year^{-1}$)
T_4	100 % of RDF through fertigation (250:125:125g^{-1} $plant^{-1}$ $year^{-1}$)	100 % of RDF through fertigation (500 :125:125 g^{-1} $plant^{-1}$ $year^{-1}$)
T_5	125 % of RDF through fertigation (312.5:156.25:156.25 g^{-1} $plant^{-1}$ $year^{-1}$)	125 % of RDF through fertigation (625 :156.25:156.25 g^{-1} $plant^{-1}$ $year^{-1}$)

*RDF-Recommended dose of fertilizer

The percentage of fruit set is the most important characters which directly reflect on yield. In the present study, (Table 1) the highest fruit set per cent was observed in the treatment T_2 (50 % RDF fertigation) followed by 75 per cent RDF (T_3). The lowest percentage of fruit set was recorded in the (control) 100 per cent of RDF soil application and irrigation through drip (T_1). The highest fruit set observed in the treatment (T_2) might be due to increased uptake of nutrients which resulted in enhanced synthesis of hormones like auxins and gibberellins. Water applied through drip irrigation nearer to the root zone always maintains soil moisture in field capacity range and no moisture stress occurred during the flowering and fruit development stage and thereby the fruit drop was minimized. This might have resulted in higher per cent of fruit set. Similar results were also made by Singh *et al*. (2006) in mango and Krishnamoorthy (2011) in cocoa.

Among the different treatments, application of 50 per cent RDF through drip fertigation (T_2) treatment registered the highest number of fruits per tree, average fruit weight, highest fruit volume, 100 aril weight per fruit, peel weight and fruit yield per plant. It was followed by 75 per cent RDF drip fertigation (T_3) and the lowest was recorded by control (T_1) 100 per cent of RDF soil application and irrigation through drip (control) (Table 2 and 3). The increase in number of fruits per tree was due to the production of highest number of hermaphrodite flowers per tree and also due to the better growth of the plant and mineral assimilation which

Table 1 : Effect of fertigation on number of hermaphrodite flowers per tree, male flower per tree and fruit set percentage of TC pomegranate cv. MIRDULA under UHDP

Treatments	Number of hermaphrodite flowers per tree			Number of male flower per tree			Fruit set (%)		
	2011	2012	Mean	2011	2012	Mean	2011	2012	Mean
T_1-100 % of RDF as soil application and irrigation through drip	39.30	43.35	41.33	33.10	40.25	36.68	82.82	75.87	79.35
T_2-50 % of RDF through fertigation	57.65	68.45	63.05	48.75	63.15	55.95	87.94	79.20	83.57
T_3-75 % of RDF through fertigation	54.15	61.25	57.70	47.80	56.05	51.93	87.77	78.42	83.09
T_4-100 % of RDF through fertigation	47.65	57.30	52.48	43.70	49.20	46.45	84.13	74.94	79.53
T_5-125 % of RDF through fertigation	38.90	48.60	43.75	35.75	44.65	40.20	88.03	74.46	81.24
S.E.±	5.70	1.89	3.00	5.06	3.11	2.97	2.99	1.80	1.74
C.D. (P=0.05)	12.43	4.13	6.19	11.03	6.79	6.12	6.53	3.92	3.60

Table 2 : Effect of fertigation on number of fruits per tree, average fruit weight, fruit volume and peel weight of TC Pomegranate cv. MIRDULA under UHDP

Treatments	Number of fruits per tree			Average fruit weight (g)			Fruit volume (cc)			Peel weight (g)		
	2011	2012	Mean	2011	2012	Mean	2011	2012	Mean	2011	2012	Mean
T_1-100 % of RDF as soil application and irrigation through drip	32.45	32.75	32.60	113.40	138.95	126.18	131.00	154.75	142.88	30.89	38.64	34.77
T_2-50 % of RDF through fertigation	50.65	54.10	52.38	181.50	241.35	211.43	207.75	249.75	228.75	51.06	74.60	62.83
T_3-75 % of RDF through fertigation	46.95	48.05	47.50	151.75	197.60	174.68	176.50	212.75	194.63	51.64	52.68	52.16
T_4-100 % of RDF through fertigation	39.95	42.85	41.40	132.80	187.70	160.25	161.50	203.50	182.50	41.42	57.98	49.70
T_5-125 % of RDF through fertigation	34.15	36.15	35.15	100.15	169.30	134.73	120.00	183.75	151.88	27.93	46.45	37.19
S.E.±	4.57	1.65	2.43	8.17	6.61	5.25	9.55	7.48	6.07	0.60	0.41	0.36
C.D. (P=0.05)	9.98	3.61	5.01	17.81	14.41	10.82	20.83	16.31	12.50	1.31	0.89	0.75

Table 3 : Effect of fertigation on total aril weight, 100 aril weight, total seed weight and fruit yield per plant of TC Pomegranate cv. MIRDULA under UHDP

Treatments	Total aril weight (g)			100 aril weight (g)			Total seed weight (g)			Fruit yield per plant (kg)		
	2011	2012	Mean	2011	2012	Mean	2011	2012	Mean	2011	2012	Mean
T_1-100 % of RDF as soil application and irrigation through drip	64.08	84.41	74.24	13.67	17.20	15.44	10.20	10.65	10.42	3.7	4.6	4.1
T_2-50 % of RDF through fertigation	110.40	144.65	127.53	21.88	22.75	22.31	13.68	16.06	14.87	9.2	13.1	11.1
T_3-75 % of RDF through fertigation	95.29	120.76	108.02	20.63	20.93	20.78	11.07	12.66	11.86	7.1	9.5	8.3
T_4-100 % of RDF through fertigation	83.66	115.09	99.37	17.70	20.39	19.05	9.94	12.15	11.05	5.2	8.0	6.6
T_5-125 % of RDF through fertigation	66.16	106.01	86.09	18.98	19.52	19.25	7.30	11.52	9.41	3.4	6.1	4.8
S.E.±	7.67	4.40	4.42	0.94	0.81	0.62	0.72	1.01	0.62	0.09	0.11	0.07
CD (0.05)	16.72	9.60	9.11	2.06	1.77	1.28	1.58	2.21	1.28	0.21	0.25	0.15

resulted in increase fruit volume and peel weight as reported in apple (Singh *et al*., 2007). The results are in conformity with the finding of Rao and Subramanyam (2009) in pomegranate cv. Mirdula. The increase in yield was largely as a consequence of higher fruit number and fruit weight. Apart from this, drip irrigation restricts the fluctuations in soil water potential within narrow range and maintained favourable water regime leading to higher yield (Bresler, 1977).

This investigation clearly indicated that application of 50 per cent RDF through drip fertigation (T_2) treatment had beneficial effect on increasing flowers, yield and yield attributes of TC pomegranate cv. Mirdula under ultra high density planting.

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