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Drip fertigation and it's implication on vegetative growth and leaf nutrient content of mango cv. Pant Sinduri

Pooja Devi, CP Singh and Mansi Darmwal

Abstract
A field experiment was conducted during 2017-18 to study the effect of drip fertigation on vegetative growth, yield and quality of mango cv. Pant Sinduri at Horticulture Research Centre, Patharchatta, G.B. Pant University of Agriculture and Technology, Pantnagar, Uttarakhand. The experiment was laid out in randomized block design with four replications. The investigation comprised of six treatments involving drip fertigation at 100, 80, 60, 40 and 20% recommended fertilizer dose with one control (in which no fertilizer was applied). The result of experimentation revealed that drip fertigation produced no significant effect on vegetative parameters like tree height, stem circumference, trunk cross sectional area, canopy spread and volume. However, leaf NPK content varied significantly with different drip fertigation levels. Maximum leaf N (1.65%), P (0.87%) and K (0.7%) were recorded in treatment T_1 i.e. fertigation 100 % recommended dose. However, the leaf N (1.64%) P (0.84%) and K (0.65%) content were found statistically at par with treatment T_2 i.e. fertigation with 80% recommended dose. On the other hand, the minimum leaf N (1.22%), P (0.17%) and K (0.44%) were obtained in control. Therefore, it was concluded that fertigation at 80% recommended dose is economically ideal for mango cv. Pant Sinduri.

Keywords: Mango, fertigation, Pant Sinduri, treatment, recommended dose

Introduction
Mango (*Mangifera indica*) is the most important fruit of Asia and currently ranks fifth in production among fruit crops worldwide. Due to its high palatability, excellent taste and flavor and exemplary medicinal and nutritive values it is regarded as king of fruits (Singh, 1990) [17]. Presently it is grown in India, China, Thailand, Mexico, Indonesia, Pakistan, Brazil, Egypt, Bangladesh and Nigeria. In India, mango is grown over an area of 2262.8 '000' ha with annual production of 19686.9 '000'MT and having productivity of 8.8 MT/ha (Anonymous, 2017) [1, 2]. The major mango producing states are Andhra Pradesh, Uttar Pradesh, Karnataka, Bihar, Gujarat, Tamil Nadu, Odisha, West Bengal. In Uttarakhand, area and production in mango crop are 35.93 '000' ha and 149.76 '000' MT, respectively (Anonymous, 2017) [1, 2].

Mango grows well in tropical and sub-tropical climate conditions. The optimum temperature for its growth ranges from 23.9-26.7 °C. The nutritional requirement as well as water requirement of mango depends upon climate, soil type and age of tree. Among major nutrient element, nitrogen has major effect on the growth and development of branches, leaves and fruits, while phosphorous helps in better root as well as fruit development and timely ripening. Potassium imparts biotic and abiotic stress tolerance and also improves fruit quality including better shelf life.

Despite India being one of the major mango producing country in the world sharing 36% of world mango production. The productivity of mango in India is quite low (8.8 MT/ha) compared to other countries such as Brazil and Indonesia where productivity stands at 18 MT/ha and 12 MT/ha respectively (Anonymous, 2017) [1, 2]. Among several factors governing the productivity of mango, irrigation and fertilizer are the indispensable input which directly affect plant growth development, yield and quality. The conventional practice of fertilizer and irrigation application has resulted in detrimental effect on the soil health and quality of produce besides, its poor nutrient and water use efficiency. Moreover, imbalance and overuse of fertilizer has resulted in low crop response to fertilizer application. Thus, fertigation which is the application fertilizer with irrigation water offers vast potential for more accurate and timely crop nutrition leading to an increased yield and quality besides considerable saving in fertilizers (Raina, 2002) [13]. Fertigation provides nutrient directly near the feeder root zone. Thereby, improving nutrient use efficiency by reducing nutrient losses from leaching, volatilization and fixation in soil. It has been reported that fertilizer use efficiency of nitrogen goes up to the tune of 95% under drip fertigation compared to 30-35% under soil application and ensures saving of fertilizer by 40-60% (Kumar and Singh, 2002) [9]. Also, less weed infestation, saving of labor and time, flexibility in time of application makes fertigation economically profitable (Singh, 2002) [16]. But, still the farmers are reluctant to adopt this technology despite financial assistance given by government which is due to lack of knowledge on fertigation scheduling. In recent past, though many experimental works had been done on fertigation in various crops including fruit crops like banana, guava, citrus, mango etc. But its scheduling needs to be standardize according to crop and location in order to make its easier adoption by farmers. Therefore, the present study was undertaken with the aim to study the effect of fertigation on vegetative growth and leaf nutrient content of mango cv. Pant Sinduri and to suggest the most efficient fertigation schedule that would attain the highest growth and yield of crop.

Material and Methods

The present experiment was conducted at Horticulture Research Center, Patharchatta, Govind Ballabh Pant University of Agriculture and Technology, Pantnagar, Distt. U.S. Nagar during the year 2017-18. The center is located at *tarai* region of Uttarakhand, India, about 30 km southwards in foothills of Shivalik range of Himalayas. It is situated at 29º North latitude, 79.3º East longitude at an altitude of 243.84 m above mean sea level. The site exhibits humid subtropical climate with maximum temperature ranging from 32-45ºC in summer and minimum temperature ranging from 0-9ºC in winter. The experiment was conducted on 12 years-old trees of mango cv. Pant Sinduri planted at 10 m distance in square system and maintained under uniform cultural practices. It was laid out in simple randomized block design with four replications and one tree served as a unit of treatment in each replication. There were six treatments incorporated in experiment which were T_1: 100% recommended dose of fertilizer through drip (NPK@: 1000 g : 750 g : 1000 g), T_2: 80% recommended dose of fertilizer through drip (NPK@: 800 g : 600 g : 800 g), T_3: 60% recommended dose of fertilizer through drip (NPK@: 600 g : 450 g : 6 00 g), T_4: 40% recommended dose of fertilizer through drip (NPK@: 400 g : 300 g : 400 g), T_5: 20% recommended dose of fertilizer through drip (NPK@: 200 g : 150 g : 200 g), T_6: No fertilizer applied (Control). NPK fertilizer were applied in the form of urea, sulphate of potash and monoammonium phosphate. The scheduling of fertilizer was done at weekly intervals starting from IVth week of February and was continued till last week of May. Thus, there were twelve split doses.

Experimental observations recorded

Observations were recorded on different growth parameters and leaf nutrient status of mango cv. Pant Sinduri. The tree height was measured from ground level to the tip of growing point using graduated pole. The stem girth was taken at 15 cm height above the ground level with the help of measuring tape. The trunk cross-sectional area (TCSA) was computed using formula mentioned below:

$TCSA= (Girth)^2/4\pi$

The canopy spread in N-S and E-W directions were measured and averaged. Tree canopy volume was calculated from values of the tree height and spread (Westwood, 1978). The impact of fertigation on plant nutrient status was assessed by estimating leaf nitrogen (N), phosphorus (P) and potassium (K). For estimation of leaf nutrient content, 3-4 months old leaves were taken prior to flowering stage from middle portion of shoots. The leaf samples were kept up to 25-30 leaves. The leaves were than washed and dried in oven at 60℃± 1℃ for 48 hours (Ranganna, 1986) [15]. Finally, dried leaves were grinded in a Willey Mill to powder form and passed through mesh to obtain finally ground sample. Total Nitrogen was determined by using modified micro-kjeldahl method (Jackson, 1973) [5]. Similarly, leaf phosphorous content was determined by using yellow colour method, whereas, flame photometer was used for estimation of leaf potassium content (Jackson, 1973) [5].

Results and Discussion

Effect of drip fertigation on vegetative parameters

The data indicated that drip fertigation had no significant effect on different vegetative parameters like tree height, stem circumference, trunk cross sectional area, canopy spread and canopy volume. The values for tree height (m), stem circumference (cm) and trunk cross sectional area (cm^2) ranged from 5.01-4.21, 78.25-67.25 and 496.91-369.48 respectively (Table 1). Similarly, for average canopy spread (m), canopy area (m^2) and canopy volume (m^3) the values recorded were in the range of 6.87-6.09, 37.50-29.79 and 86.16-56.50 respectively (Table 2). This might be attributed to the fact that mango is a slow growing perennial tree with deep tap root system. Thus, its vegetative characters are less sensitive to treatments such as fertigation when applied for short term. Hence, no significant impact of fertigation was observed as the present experiment was carried for one year only. The above findings were in confirmation with those of Goramnagar *et al*. (2017) [3] in acid lime, Khan *et al*. (2013) [7] in guava, Kumar *et al*. (2013) [10] in sweet orange, Singh *et al*. (2009) [18] in mango cv. Dashehari and Raina *et al*. (2005) [14] in apricot.

Evaluation of leaf nutrient content of mango cv. Pant Sinduri as influenced by different levels of drip fertigation

The effect of drip fertigation on leaf NPK content was evaluated. The results revealed that leaf N, P and K content varied significantly among various fertigation treatments. The maximum leaf N (1.65%), P (0.85%) and K (0.71%) content were obtained in treatment T_1 i.e. fertigation with 100% recommended dose of fertilizers which was statistically at par with treatment T_2 i.e. fertigation with 80% recommended dose of fertilizers for leaf N (1.64%), P (0.84%) and K (0.65%). Whereas, the treatment T_6 i.e. control registered minimum leaf N (1.22 %), P (0.17 %) and K (0.44 %) (Table 3).

The significant effect of drip fertigation on leaf NPK content might be attributed to the fact that fertigation aids in precise application of fertilizers in the active root zone and also reduces the leaching losses. These implications might have led to better nutrient uptake by the plants and eventually improved nitrogen use efficiency resulting into increased leaf nitrogen content. Phosphorous which helps in profuse root development and ultimately aids in better nutrient uptake. However, fixation of this element in soil creates hindrance in its activity. But, drip fertigation provides favorable micro-environment around root zone by maintaining optimum moisture for P dissolution thereby, preventing its fixation.

Similarly, the higher leaf potassium content in drip fertigated plants might be attributed to the fact that fertigation helps in better uptake of nutrients due to frequent and timely application of fertilizers directly to the feeder root zone. Thus, results in better nutrient uptake by the plants and eventually improved nutrient use efficiency resulting into higher leaf NPK content of plants subjected to fertigation. These findings were in close conformity with Kuchanwar *et al.* (2017) [8] in Nagpur mandarin, Naik *et al*. (2016) [11] in banana cv. Grand Naine, Haneef *et al*. (2014) [4] in pomegranate cv. Bhagwa, Pramanik *et al.* (2013) [12] in banana cv. Martaman, Tank and Patel (2013) [20] in papaya cv. Madhu Bindu, Jeyakumar *et al.* (2010) [6] in papaya cv. Co.7, and Srinivas *et al*. (2010) [19] in passion fruit.

Table 1: Effect of drip fertigation on tree height, stem girth and trunk cross sectional area in mango cv. Pant Sinduri

Treatments	Tree height (m)	Stem girth (cm)	Trunk cross sectional area (cm^2)
T_1(100% RDF)	5.01	78.25	496.91
T_2(80% RDF)	5.15	79.00	505.454
T_3(60% RDF)	4.78	77.75	491.26
T_4(40% RDF)	4.58	76.75	485.64
T_5(20% RDF)	4.40	68.25	395.08
T_6 (CONTROL)	4.21	67.25	369.48
SEm ±	0.36	6.99	77.74
CD@5%	NS	NS	NS

Table 2: Effect of drip fertigation on canopy spread, canopy area and canopy volume in mango cv. Pant Sinduri

Treatments	Canopy spread (m)			Canopy area (m^2)	Canopy volume (m^3)
	N-S (m)	E-W (m)	Average (m)		
T_1 (100% RDF)	6.95	6.80	6.87	37.50	86.16
T_2 (80% RDF)	6.81	6.76	6.78	36.53	88.09
T_3 (60% RDF)	6.45	6.52	6.48	33.10	73.23
T_4 (40% RDF)	6.22	6.57	6.40	32.25	69.13
T_5 (20% RDF)	6.05	6.11	6.08	29.66	62.28
T_6 (Control)	6.11	6.06	6.09	29.79	56.50
SEm ±	0.374	0.368	0.367	3.61	9.73
CD@5%	NS	NS	NS	NS	NS

Table 3: Effect of fertigation on leaf nitrogen, phosphorous and potassium in mango cv. Pant Sinduri

Treatments	Nitrogen (%)	Phosphorus (%)	Potassium (%)
T_1 (100% RDF)	1.65	0.85	0.71
T_2 (80% RDF)	1.64	0.84	0.65
T_3 (60% RDF)	1.45	0.47	0.54
T_4 (40% RDF)	1.42	0.35	0.50
T_5 (20% RDF)	1.35	0.22	0.48
T_6 (Control)	1.22	0.17	0.44
SEm ±	0.063	0.094	0.022
CD@5%	0.186	0.36	0.068

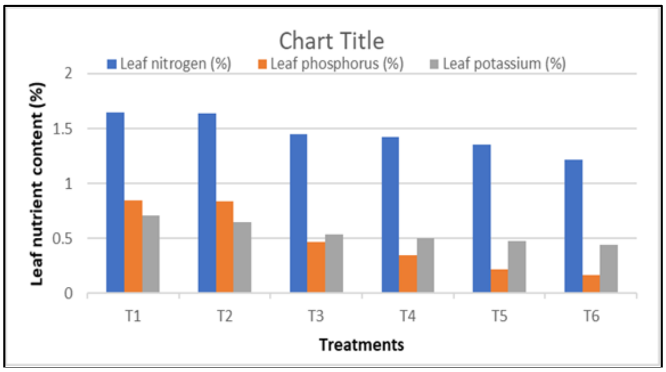

Fig 1: Effect of drip fertigation on leaf N, P and K content

Conclusion

It can be concluded from the above research findings that various vegetative parameters were not influenced significantly by different levels of drip fertigation as the present trial was conducted for one cropping season. However, leaf NPK content was significantly influenced by different drip fertigation levels. Drip fertigation with 100% recommended dose recorded highest leaf N, P and K content. However, it was statistically at par with drip fertigation at 80% recommended dose. Thus, fertigation at 80% recommended dose is economically profitable.

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