

Effects of NPK Fertigation on Leaf Nutrient Status and Yield of *Citrus sinensis* Osbeck cv Mosambi under High Density Planting

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Received 11 February 2017; Accepted 14 March 2017; Published online 31 March 2017

Abstract The field experiment was conducted during 2013-14 to study the effects of fertigation on the leaf nutrient status and yield of mosambi plant. The experiment was laid out in randomized block design with seven fertigation level, viz. T₁- 120% of RDF ; T₂- 100% of RDF ; T₃-80% of RDF ; T₄-60% of RDF ; T₅- 40% of RDF; T₆- 100% RDF in basal with drip irrigation and T₇- 100% RDF in basal without drip irrigation and each treatment were replicated three times. Result obtained showed that the plants fertigated with 120% RDF followed by 100% RDF recorded higher leaf nitrogen, zinc, iron and boron whereas, phosphorus and potassium content was found non-significant. The same treatments were found significantly superior for yield characters and benefit : Cast ratio. Therefore, on the basis of results obtained, 120% RDF

found superior in maintaining leaf nutrient status and yield of mosambi plant under high density planting.

Keywords Citrus, Fertigation, Leaf nutrient, Yield, Economics.

Introduction

Citrus is one of the most popular fruit of sub-tropical region of North India and gaining popularity among fruit growers of Bihar due to its high profitability. Most of the citrus fruits are consume freshly, while the marmalades, squashes, juices and drinks are the some valuable post-harvest products. Nutritional requirements are prime objective for growing citrus under high density planting. Intensive growing of citrus under high density and ultra-high density plant population has further put an additional pressure on soil fertility conservation. But, concept of fertigation in tree fruit crops has given a definite edge over conventionally used method of irrigation coupled with basal or top dressing of fertilizers within the perimeter of trees [1]. Drip irrigation and fertigation are the most efficient methods of modern irrigation systems which have a potential advantage of water and fertilizer saving [2]

The adequate supply of nitrogen, phosphorus and potassium is essential for proper growth of citrus tree [3]. The NPK play major role in various physiologically function of citrus plant throughout its life. The tree of citrus is also considered as micro nutrient

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loving plant and hence it is important to maintain the proper nutritional demand of orchard, Leaf chemical analysis is commonly used as a diagnostic criterion for nutrient recommendation and fertilization for citrus groves. Analysis of 4-6 month old spring flush of citrus trees for mineral nutrients provide a valuable information for evaluating the nutritional status of the trees [4]. Citrus plants are more sensitive to the deficiency of certain elements than many other cultivated crops. Most of the farmers are less aware of fertilizers application and provide almost constant dose of fertilizer every year than the requirement of the plants, which ultimately affects the growth of plant. Therefore, analysis of both soil and leaves for nutrient composition is a one of the better strategy to assess the fertilizer requirements of crop at different stage of growth. Also the information available on this aspect are scanty under Bihar condition, furthermore, mosambi have shown good performance in scattered planting under Bihar conditions and has shown promise in bearing at Sabour condition but there is lack of knowledge about its proper fertigation scheduling at different stages of growth and age of plant for better growth and yield. In view of the above, the present investigation was aimed to evaluate the effects of NPK fertigation on leaf nutrient status and yield contributing parameters of mosambi under high density planting.

(The authors acknowledge all kind of help and support rendered by Head, Department of Horticulture (Fruit & Fruit Technology) and Department of Soil Science and Agricultural Chemistry, Bihar Agricultural University, Sabour, India, for all the required infrastructure and facilities in making the assignment successful. We also acknowledge funding support from the Indian Council of Agricultural Research for providing ICAR-Junior Research Fellowship to the first author).

Materials and Methods

The field experiment was carried out at high density orchard of the permanent experimental area of Bihar agricultural university (87°2'42'' E, 25°15'40'' N) at Sabour, Bihar, at an altitude of 46 m above mean sea level in the heart of vast Indo-Gangatic plains of North India, during 2013-14. The climate of this place is sub-

tropical of slightly semi-arid nature. The soil of the experimental plot had well drained sandy-loam texture with levelled surface and fertile. The initial soil status was pH 7.4, Electric conductivity 0.42 ds/m, Organic carbon 0.53%, N 213.50 kg/ha, P₂O₅ 29.75 kg/ha and K₂O 165.25 kg/ha at 0-15 cm depth.

The experiment was laid out in randomized block design with seven fertigation level based on recommended dose of fertilizer (RDF) i.e., 300:90:90 g/plant/year, the treatments were T₁-120% of RDF (360:108:108g); T₂-100% of RDF (300:90:90g); T₃-80% of RDF (240:72:72g); T₄-60% of RDF (180:54:54g); T₅-40% of RDF (120:36:36g); T₆-100% RDF in basal with drip irrigation and T₇-100% RDF in basal without drip irrigation. Each treatment were replicated thrice with four plant in each replication. The treatment T₁, T₂, T₃, T₄, T₅ were applied in split doses whereas, treatment T₆ and T₇ supplied directly in plant basin. Fertigation scheduling was administrated at monthly interval starting from November to August. The fertilizer source used for fertigation were urea for nitrogen and mono potassium phosphate and sulfate of potash for phosphorus and potassium. The four year old mosambi plants were planted under high density planting (HDP), at a spacing of 3.0 × 2.5 m apart.

The leaf samples from each treatment at maturity stage (August-September) were harvested for nutrient analysis. The total nitrogen was determined by Kjeltac 2300 (Foss Tecator). The phosphorus was estimated by vanado-molybdate color reaction method. The potassium content was determined by a micro-processor based flame photometer. Total micronutrients present in leaf was determined by known volume of digest with the help of atomic absorption spectrophotometer whereas, the boron content was analyzed as per method given by Adhikari et al. [5]. The parameters related to yield characters were calculated manually by frequently visiting the orchard.

The experimental data were subjected to statistical analysis in order to find out which of the treatments showed significant variation in different parameters studied under investigation. The technique of analysis of variance (ANOVA) for randomized block design (RBD) was adopted as suggested by Panse and Sukhatme [6].

Table 1. Effect of NPK fertigation on leaf nutrient status of *Citrus sinensis* cv Mosambi.

Treatments	N (%)	P (%)	K (%)	Zn (PPM)	Cu (PPM)	Fe (PPM)	Mn (PPM)	B (PPM)
120% RDF	2.22	0.12	0.80	25.66	5.33	277.67	42.00	44.33
100% RDF	2.42	0.11	0.81	24.66	3.43	224.33	42.00	43.33
80% RDF	2.05	0.13	0.78	22.66	3.80	217.77	46.66	38.33
60% RDF	2.17	0.13	0.76	22.33	6.13	209.77	48.00	42.00
40% RDF	1.83	0.18	0.86	23.33	7.66	222.73	48.33	30.33
100% RDF with drip irrigation	2.03	0.15	0.78	23.00	5.93	204.80	30.33	36.33
100% RDF without drip irrigation	2.03	0.12	0.773	20.33	3.40	169.90	36.00	22.66
CD at 5%	0.23	NS	NS	2.52	0.52	25.61	4.17	3.72
CV (%)	6.09	6.77	6.99	6.14	5.76	6.60	5.60	5.70
SEm (\pm)	0.10	0.007	0.04	1.16	0.23	11.75	1.91	1.71

Results and Discussion

Leaf nutrient content

The data on leaf nutrient status under different treatments of fertilizer are presented in Table 1. The scrutiny of data clearly indicates that the plant fertigated with T₁ and T₂ had higher leaf nutrient content during the year of investigation. The highest leaf nitrogen content (2.42%) was recorded in T₂ followed by 2.22% in T₁ compared to lowest (1.83%) in T₅ which receiving lower amount of nitrogen. Whereas, there was statistically non-significant variation observed due to different treatments in relation to leaf phosphorus and potassium content. Higher dose of nitrogen in T₁ and T₂ might be one of the reasons for high leaf nitrogen content because nitrogen is very mobile in plant as well as soil and supplied nutrients, improved physi-

cal properties of soil coupled with better absorption of water and nutrients [7–9].

The fertigation treatment T₁ recorded the highest concentration of micronutrients (Zn 25.66 ppm, Fe 277.67 ppm and B 44.33 ppm) followed by T₂ as compared to rest of the treatments. Whereas, the lowest leaf nutrient levels (Zn 20.33 ppm, Fe 169.80 ppm, B 22.66 ppm and Cu 3.40 ppm) were observed in T₇. The highest content of leaf Cu (7.66 ppm) and Mn (48.33 ppm) was recorded under T₅. The possible reason behind an increased micronutrient concentration with higher dose of fertigation treatments may be ascribed as the effect of higher and continuous supply of NPK fertilizer and water throughout the growing season resulted in maintaining the proper physical properties of soil to absorb more nutrient from the same piece of land [10].

Table 2. Effect of NPK fertigation on yield attributes and economics of *Citrus sinensis* cv Mosambi.

Treatments	Number of fruits/plant	Yield in kg/plant	Yield in t/ha	Total expenditure (rupees)	Net income (rupees)	Benefit : Cost ratio
120% RDF	33.67	8.95	11.93	146469.8	211430.2	1:2.44
100% RDF	29.08	8.02	10.69	135421.2	185278.8	1:2.37
80% RDF	24.33	7.01	9.34	124374.1	155825.9	1:2.25
60% RDF	29.5	7.00	9.33	113327.0	166573.0	1:2.47
40% RDF	25.67	5.67	7.55	100541.9	125958.1	1:2.25
100% RDF with drip irrigation	18.83	6.99	8.11	99947.9	143349.1	1: 2.43
100% RDF without drip irrigation	24.83	5.76	7.67	102282.1	127817.9	1:2.25
CD at 5%	3.29	0.82	1.08	-	-	-
CV (%)	6.54	5.64	7.04	-	-	-
SEm (\pm)	1.41	0.32	0.53	-	-	-

Yield and economics

The data pertaining to yield attributes and economics of experiment due to different dose of fertigation are presented in Table 2. The data concerning with the numbers of fruit per tree under different treatments have indicated that these is significant variations in yield and yield attributing characters among different treatments. The maximum number of fruits per tree (33.67) was recorded in T₁, which was found significantly higher than rest of the treatments followed by (29.08) in T₂, whereas lowest number of fruits per tree (18.83) was recorded in T₆. The maximum yield (8.95 kg) per plant was recorded in T₁, which was found significantly higher than rest of the treatments followed by (8.02 kg) in T₂, whereas lowest yield (5.67kg) was recorded in T₇ which found statistically at par with T₅ consequently, the maximum yield (11.93 t/ha) was recorded in T₁, which was found significantly superior than rest of the treatments followed by (10.69 t/ha) in T₂. Whereas, lowest yield (7.55 t/ha) was recorded in T₅ which was found statistically at par with T₆ and T₇. The higher dose of NPK enhances leaves chlorophyll, photosynthesis and other physiological activities of mosambi plant which accelerate translocation of metabolites from the source to sink and responsible for production of more number of fruits and productivity as compared to lower doses [11]. The present study also revealed that fertilizer requirement under high density planting was found high due to accommodation of more number of plant than traditional planting system and low nutritional status of orchard soil during the period of investigation, resulted in absorption of more nutrients. Hence, the result of the present investigation have, thus confirmed the immense possibility of raising per hectare yield of the fruits by applying the balance dose of fertilizers [1 – 10]. The economics of experiment is very important as farmer is convinced with specific recommendation through economic aspect of the research. The cost of cultivation due to different treatments and gross income were calculated and presented in Table 2. The price of fruit was fixed at the prevailing market rate. Total price per hectare was depended upon the yield in different treatments.

The maximum Benefit : Cost ratio (1:2.47) was calculated under T₄ followed by 1:2.44 in T₁. However, the treatment T₁ can be recommended to citrus grower as the T₁ has found significantly superior in other parameters studied. Whereas, minimum Benefit: Cost ratio (1:2.25) was observed in T₃, T₅ and T₇.

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