Research Article

Effects of NPK Fertigation Onphysico-Chemical Attributes and Leaf Nutrient Status of *Citrus Reticulata* Blancocv. Kinnow

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Abstract

In present investigation, studies were carried out with 7 different fertilizer levels and 3 replications in randomized block design to study the effect of fertigation on physico-chemical attributes and nutrient status in *Citrus reticulata* Blancocv. Kinnow. The treatments showed significant difference in respect to weight (184.33 g), length (63.51 mm),width (75.70 mm), juice percent (49.23 %), total soluble solids (10.21° Brix), ascorbic acid (50.29 mg/100g), total sugar (7.62%) and yield (32.07 t/ ha.) with higher dose of fertigation*i.e.*100% and 120% RDF. However, 100% RDF with drip irrigation was found significantly superior forleaf nitrogen (2.28 %) and zinc (29.30 ppm)with 100 % RDF without drip irrigation and manganese content (70.76 ppm) with 80 % RDFwhereas, iron (270.10 ppm) and boron content (45.67 ppm) was found higher with 60% RDF.Therefore, on the basis of result obtained it can be concluded that Kinnow is highly responsive to fertilizer application for yield, quality and leaf nutrient status. The fertilizer dose 120% RDF followed by 100% RDF appear to be the best at the age of 4 year, when applied in different split under high density planting condition.

Keywords: Citrus, Fertigation, Physico-chemical attributes and Leaf nutrient status

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Introduction

Citrus fruits play an important role in the economic development of country and these fruits form the third largest fruit industry. In India, citrus is being cultivated from very ancient time. The fruits are cultivated in India in four different zones *i.e.* central India, southern India, north-western India and north-eastern India. These zones have different leading cultivars that occupy a place of prominence in the respective area. Among citrus fruits, only lime, lemon and pummelo are grown throughout the Bihar but large commercial establishments are not common [1]. Fertigation which facilitate irrigation along with fertilizers to the crop plant is well recognized as the most effective, economical and convenient means of maintaining optimum fertility and water supply according to the specific requirement and resulting in higher yields and better quality fruits [2]. Fertigation practices are one of the most efficient techniques for enhancing fertilizer use efficiency which results in reduction in the total dose of fertilizers and may also save some amount of costly fertilizers. The nutrition constitutes an important component of successful and healthy citrus cultivation. An adequate nutrition leads to the proper growth and increased productivity of the citrus trees. The technique also provides a way to enhance production and thereby productivity by improved fruit qualitative and quantitative attributes. 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 provides valuable information for evaluating the nutritional status of the trees [3]. 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 yield and quality 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, Kinnow have shown good performance in scattered planting under Bihar conditions but there is lack of knowledge about its proper fertigation scheduling at different stages of growth and age of plant.Therefore, the main objective of this investigation was to standardize the dose of NPK fertigation on fruit physico-chemical and leaf nutrient status of Kinnow mandarin under high density orchard.

Materials and Methods

The field experiment was conducted during 2014-15 in high density orchard of the permanent experimental area of Bihar Agricultural University, Sabour, Bhagalpur. The four year old *Citrus reticulata* cv. Kinnow plants were planted under high density planting (HDP), at a spacing of 3.0 × 2.5 meter apart. Four plants of Kinnow per treatment in triplicate grown according to randomized block design (RBD). The recommended dose of fertilizer (RDF) for scatter kind of planting system in terms of N, P_2O_5 and K_2O was 300, 90 and 90 gram per plant per year at 4 years of age, respectively. To standardize optimum dose under high density orchard conditions, different treatments were taken into consideration. The treatments were T_1- 120% of RDF; T_2-100% RDF; T_3-80% RDF; T_4-60% RDF; T_5- 40% RDF; T_6-100% RDF in basal with drip irrigation and T_7-100% RDF in basal without drip irrigation.

The physical parameters of fruit *viz.* weight of ten fully mature fruits were recorded by weighing the samples on an open pan balance. The total soluble solids (TSS) of samples were estimated using digital hand refractometer (Atago Co. Ltd, Tokyo, Japan). Total acidity, ascorbic acid and sugars content of fruit juice were estimated as per standard method [4].For estimation of leaf nutrients the samples from each treatment at maturity stage (August-September) were harvested. The total nitrogen was determined by Kjeltec 2300 (Foss Tecator). The Phosphorus was estimated by vanado-molybdate colour reaction method. The Potassium content was determined by a microprocessor 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 analysed using standard method [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 was adopted [6].

Results and Discussion

Physico-chemical parameters and yield

Fruit quality attributes is claimed to be a function of both water and nutrient use efficiencies. The data pertaining to physico-chemical attributes under different treatments are presented in **Table 1**. The highest fruit weight (184.33 g) was recorded in the treatment T_2 followed by 181.83 g in T_1while the minimum fruit weight (143.0 g) was recorded in T_5. The maximum fruit length (65.28 mm) was recorded in the treatment T_3followed by 63.51 mm in T_7 whereas; the minimum fruit length (56.25 mm) was recorded in T_5. The maximum fruit width (75.70 mm) was noticed in T_2 which was statistically at par with T_7 and T_1, whereas, minimum fruit width (66.98 mm) was recorded in T_5. The juice percent (49.23 %) was recorded maximum under T_1, whereas the minimum juice percent (41.27 %) was recorded in T_5.The choice of consumers usually depends upon the physical parameters of fruit. Presence of nitrogen, phosphate and potash has been observed to be essential for better action of all the nutrients and consequently causing the fruit to grow more in size and volume with increased juice content [7]. The TSS content was recorded maximum (10.21 °Brix) under the treatment T_7, which was found at par with T_1 (9.64 °Brix) and minimum TSS content (8.52°Brix) was recorded in the treatment T_5. The higher TSS in the fruits of treatment T_7might be due to lesser number of fruits in this treatment which leads to more soluble solids synthesis [8]. The total titratable acidity was found in the range of 0.84-1.02% and the treatment T_7 was found to be obtained with maximum acidity (1.02%), whereas, the minimum acidity (0.84%) was recorded under T_1, which might be because of strong link of potassium with the juice acidity *i.e*., potassium level affects the accumulation or degradation of acids in citrus fruit [9]. The highest (11.47) and lowest (9.47) TSS/titratable acidity was found in T_1 and T_6treatments respectively. The reducing sugar content was recorded highest (3.77%) under treatment T_1 followed by 3.61% in T_2 and lowest reducing sugar (2.82%) was recorded in T_4. Whereas, the total sugar content was recorded maximum (7.02%) under the treatment T_1, which is at par with 6.96% in T_2 and the minimum total sugar content (5.49%) was recorded in T_3. The occurrence of such results might be due to the fact that application of higher NPK fertilization results in higher sugars accumulation in fruits [10]. The maximum fruit yield of 32.07 t/ha. (24.62 kg/ plant) was recorded in T_1 and found significantly higher than rest of the treatments. Whereas, lowest yield *i.e.* 11.58 t/ha (8.69kg/ plant) was recorded in T_7.The confirmatory finding in relation to physico-chemical attributes was also recorded in citrus fruit [2, 11-14].

Leaf nutrient status

The effect of NPK fertigation with different treatments on leaf nutrient status and nutrient up-take was monitored with leaf analysis. The data under different treatments are presented in **Table 2**. The highest leaf nitrogen content (2.28 %)

was recorded in T_6followed by 2.26 % in T_2, whereas, the lowest nitrogen (1.79%) was noticed in T_5. The range of leaf phosphorus content varies from 0.12 to 0.14% and it was non - significant. There was statistically non-significant variation observed due to different fertigation level in relation to potassium content of leaf. Higher dose of nitrogen in T_1 and T_2might be one of the reasons for high leaf nitrogen content because nitrogen is quite mobile element both in plant and soil and thus, supplied nutrients through fertigation, improved the physical properties of soil coupled with well-developed root system resulting into better absorption of water and nutrientsin grape, apple and mandarin respectively [15-17]. The fertigation treatment T_4 recorded the highest concentration of micronutrients, Fe (270.10 ppm) and B (45.67 ppm) followed by T_6 as compared to rest of the treatments. Whereas, the lowest leaf nutrient levelsof Fe(220.90 ppm) and B (39.00 ppm) were observed in T_6 and T_3 respectively. The highest content of leaf Zn (29.30 ppm) and Mn (70.76 ppm) was recorded under $T_7$and T_3 respectively. The Cu content in leaves was found highest (8.12 ppm) under T_3. The possible reason behind an increased micro-nutrient concentration with higher dose of fertigation treatments may be ascribed as the effect of higher and frequent supply of NPK fertigation throughout the growing season resulted in maintaining the adequatemoisture and nutrient content in the soil [2, 13-14].

Table 2 Effect of fertigation on leaf nutrient status of *Citrus reticulata* Blancocv. Kinnow

Treatments	Nitrogen (%)	Phosphorus (%)	Potassium (%)	Zn (ppm)	Cu (ppm)	Fe (ppm)	Mn (ppm)	B (ppm)
120 % RDF (T_1)	1.81	0.14	0.95	33.67	5.66	206.03	76.67	45.67
100 % RDF (T_2)	2.26	0.13	0.98	34.33	5.52	201.23	69.33	43.00
80 % RDF (T_3)	1.83	0.14	0.96	36.67	8.12	195.20	63.67	39.00
60 % RDF (T_4)	1.92	0.13	0.89	29.00	6.32	177.17	78.67	41.33
40 % RDF (T_5)	1.79	0.13	0.88	33.33	5.03	167.40	39.67	42.33
100 % RDF with drip irrigation (T_6)	2.28	0.12	0.99	42.00	7.10	204.03	83.33	43.67
100 % RDF without drip irrigation (T_7)	1.85	0.12	0.95	34.33	6.04	156.03	81.33	40.67
C.D. at 5%	0.21	NS	NS	3.78	0.63	21.91	7.07	4.21
C.V. (%)	6.12	6.70	6.98	6.12	5.67	6.60	5.65	5.60

Table 3 Native soil status of experimental orchard prior to treatments

Soil depth (cm)	0-15	15-30
pH (1:2.5)	7.28	7.16
EC (ds/ m)	0.41	0.40
Organic C (%)	0.55	0.47
N (Kg/ ha)	215.00	199.35
P_2O_5 (Kg/ ha)	29.15	26.50
K_2O (Kg/ ha)	155.35	125.68

Conclusion

The present study has revealed that fertigation with NPK results in proper uptake of nutrient from soil and hence resulted in increased physico-chemical and leaf nutrient parameters of Kinnow fruit tested under high density orchard condition. Hence, treatment T_1*i.e.*, 120% RDF followed by 100% RDF is recommended for the qualitative and quantitativeproduction of *Citrus reticulata* Blanco cv. Kinnowunder Sabour, Bihar, agro-climatic conditions.

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Publication History
Received 14th June 2017
Revised 04th July 2017
Accepted 10th July 2017
Online 30th July 2017