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Significance of Organic and Inorganic nutrients application on Fruit and Quality of Lemon cv. Assam Lemon under the foothills of Arunachal Pradesh

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Abstract

A randomized block designed experiment was taken up with seven treatments of three replications consisting recommended dose of fertilizers (RDF) and RDF in combine with Organic manures and Vermicompost at different concentration during the year 2019. The experimental data revealed that the application of different treatments had positive influence on fruit physio-biochemical characteristics of lemon where, highest fruit length (9.15 cm), fruit diameter (5.33 cm) and fruit fresh weight (211.67 g), thickest peel (3.55 mm), maximum juice content (74 ml), TSS (6.4 °B), ascorbic acid (48 mg), total sugar (6.4%), reducing sugar (3.96%), non-reducing sugar (2.23%), free radical scavenging activity (%) (DPPH) (52.49%), were recorded in treatment T₄ - 60% N of RDF + 40% N from FYM.

Keywords: Organic, quality, significance, vermicompost

Introduction

Lemon is one among popular fruits under citrus group. With regards to its ability of bearing fruits in more than two flushes improvising its availability whole round the year, *Citrus limon* cv. Assam lemon has the advantageous character over other citrus fruits. Accordingly, to obtain the best quality fruits and produce maximum yield, it is necessary to maintain the nutrition status of the soil at peak level from where the plant receive nutrients. Hence, proper application of fertilizers and manuring should be practiced to enhance the healthy and sturdy growth of plants on which the yield and quality fruit production solely depends. The fertilizers in combination from organic and inorganic nutrient sources would not only help to overcome the deficits of these vital nutrients in soil and plants, however, it would as well help in enhancing the integrated plant nutrient management programme. To stipulate viable alternative solution for long term basis of sustainable plant nutrient system, Verma and Chauhan in 2013, advocate that there is an urgent necessity to evaluate different nutrient systems being followed at present in fruit plants to mitigate nutritional deficiencies along with appropriate combination of urea, single super phosphate, muriate of potash, vermicompost and farm yard manure which will eventually help in fulfilling nutrition needs of the tree for economically profitable production of citrus fruit. Thus, the optimized standards of fertilizer application are of great importance to get good growth. Therefore, the present study were undertaken to find out the best possible combination of organic and inorganic fertilizers which can stimulate the lemon production without adversely affecting the quality of soils.

Material and Methods

The investigation was executed with the aim of evaluating and standardizing the significant effect of organic and inorganic nutrient sources on fruit physical characteristics and quality of Assam lemon. The work of research was conducted during the year 2019 on three years old Assam lemon, a cultivar of lemon which is dwarf and spreading type planted in 3x3m spacing at citrus orchard, Department of Fruit Science, College of Horticulture and Forestry, CAU, Pasighat, Arunachal Pradesh. The experimental design was laid out in Randomized block design with seven treatments, each replicated three times. Nitrogenous fertilizer was applied in two split doses. Firstly, half dose of nitrogen and full dose of phosphorus, potassium, FYM and vermicompost were applied in first week of February, 2019 and rest half of nitrogen was applied in second week of April, 2019 to boost up the growth of the developing fruits. Organic nutrient sources viz. Farm Yard Manure (FYM) and Vermicompost (VC) and all the inorganic

Nutrient sources like urea, MOP and SSP were applied separately and in combination in the rings of 25 cm width and 30 cm depth beneath the plant canopy leaving 60 cm from the trunk made around each of the tree by mixing with 20 cm of top soil. Then these were covered with soil followed by light irrigation. The recommended dose of fertilizer (RDF) for Assam Lemon at 210:140:210 g/plant/year (Kumar *et al.*, 2012)^[8] was also applied as control treatment.

Fruits physical parameters such as, fruit length (cm), fruit diameter (cm) and Peel thickness (mm) were measured by using a digital Vernier Caliper and fruit fresh weight (g) with the help of electronic balance. The juice extracted from ten randomly selected representative fruit samples were measured in a measuring cylinder. The average of the ten samples was then expressed in milliliter (ml).

Quality parameters evaluated includes total soluble solids ($^{\circ}$ Brix) by using digital refractometer, titratable acidity (%), Ascorbic acid content (mg/100 g) content of fruits was determined by the method described by Ranganna (1986)^[14]. Total sugar content was estimated by Anthrone method as described by Hodge and Hofreiter (1962)^[5]. Reducing sugar content was estimated by Spectrophotometric method of Somogyi (1952)^[18]. Titratable acidity estimation was done by following the standard procedures described by AOAC (1995). Free radical scavenging activity was determined as per the method of Aoshima *et al.* (2004)^[1]. Total free amino acid content was determined by the method described by Moore and Stein (1948)^[11]. Laboratory analysis of the aforementioned quality parameters were done in Basic Science Laboratory, College of Horticulture and Forestry, Pasighat, Arunachal Pradesh.

The experimental observations recorded during the study were subjected to the statistical analysis of variance for RBD. Significance and non-significance of the variance due to diverse treatments applied were determined by calculating the respective 'F' values as per the method of Gomez and Gomez (2010)^[4].

Treatment details

The treatments incorporated consist of the following combinations

- T₁ : Control (RDF from inorganic sources) (N:P:K=210:140:210 g/plant)
- T₂ : 75% N of RDF + 25% N from FYM
- T₃ : 75% N of RDF + 25% N from Vermicompost
- T₄ : 60% N of RDF + 40% N from FYM
- T₅ : 60% N of RDF + 40% N from Vermicompost
- T₆ : 50% N of RDF + 50% N from FYM
- T₇ : 50% N of RDF + 50% N from Vermicompost

Where, N is Nitrogen and in all the treatments, Phosphorous (P) and Potassium (K) will be applied through inorganic sources at the same rate as mentioned in Control.

Results and Discussion

Data presented in Table 1 and Figure 1 with regards to physical parameters of fruits showed huge variance before application and after application of the nutrients. The fruit fresh weight was found highest (211.67 g) in T₄. The fruit length was observed highest (9.15 cm) in treatment T₄ and minimum length of the fruit (7.24 cm) was recorded in T₁. The highest fruit diameter (5.33 cm) was seen in treatment T₄ and least (4.26 cm) in T₁. The treatment T₄ exhibited the thickest peel (5.79 mm) and the thinnest peel (3.55 mm) was

observed in T₁. The juice content per fruit in treatment T₄ was found highest (74 ml). Treatment T₅ exhibited the lowest juice content (32.83 ml) per fruit.

This notable influence might be the result of improved physical and chemical properties as well as nutritional status of the soil caused due to the organic manures addition eventually helping the plant in better uptake of minerals, water and nutrients, resulting in its increased rate of growth. Nitrogen too has an obvious effect on increase in growth. Nitrogen improves the metabolic process of the plants that encourages plant growth and thus increase weight and fruit size which leads to increased average weight, length, and diameter of lemon fruits. High dose of Nitrogen resulted in reduction of juice content might be probably because of peel thickness (Sharma and Chopra, 2000)^[17].

Organic and inorganic fertilizer in combined application led to maximal increase over the initial one as observed in plant height, canopy spread and trunk growth. The reason behind this effect could be due to enhancement in expansion of leaf and its dark green colour by the combined application of organic and inorganic fertilizer which subsequently improves respiration and photosynthesis of the plant; thus, it is clear that nitrogen from inorganic source and FYM balanced the nutrition and enhanced the growth of the plant. FYM improves physico-chemical properties of soil, which provides better conditions for plant growth and development. Dudi *et al.*, 2003; Kaul and Bhatanagar, 2006^[3, 7] obtained the results in Kinnow which are in line with the present results. The same findings had also been reported in acid lime by Lal and Dayal, (2014)^[9] in which the use of organic and inorganic nutrients in combination improved the soil texture and porosity, causing plant root development, nutrient uptake which resulted in faster cell elongation and consequently enhanced plant height. Rise in juice content might be the result of the fact that fraction of humic acid and folic acid of organic matter present in the soil assisted by the organic sources (vermicompost) would perhaps formed micronutrient soluble in water, thereby improving their presence and uptake leading to better quality.

The data in Table 2 and Figure 2 with respect to biochemical properties of lemon fruits showed significant variation due to application of organic and inorganic nutrients and in combination of the two. The highest TSS (6.4 $^{\circ}$ B) was observed in treatment T₄. The treatment, T₇ gave the highest titratable acidity (3.53%) and was at par with T₂, T₃ and T₆ but the lowest titratable acidity (2.71%) was recorded in T₄. Total sugar content was highest (6.4%) in T₄ having parity with T₃ whereas T₇ recorded the lowest total sugar content (5.07%). The maximum reducing sugars (3.96%) was obtained from treatment T₄ which showed statistical parity with T₃. The least reducing sugar content (2.63%) was obtained from treatment T₇. The lowest non reducing sugar (1.19%) was recorded in T₇ and the maximum (2.23%) was recorded in T₄ which showed statistical parity with T₃. The treatment T₄ exhibited the maximum ascorbic acid content (48 mg) and the lowest (32.64 mg) was observed in T₇. The highest Free Radical Scavenging Activity (52.49%) was obtained from T₄, while, the lowest free Radical Scavenging Activity (45.1%) was observed in T₁. The significantly maximum free amino acid content (62 mg) of Assam lemon fruit was recorded in treatment T₆ while the minimum (32.67 mg) was recorded in T₂ as depicted in Table 2 and Fig. 2.

Increase in TSS might be obtained due to the fact that desired

NPK dose stimulates enzymes functioning in physiological process of fruits. NPK when applied in excessive doses, it leads to falls in the contents of TSS, ascorbic acid and sugars and alike because on reaching the toxicity level, it inhibits nutrient molecules and other enzymes which catalyze the synthesis of most of the quality attributes. These outcomes are in line with the obtained result of Kashyap *et al.*, (2012)^[6] in mandarin, Kaul and Bhatnagar (2006)^[7] in kinnow and Prasad and Mali (2000)^[12] in lemon. The highest titratable acidity (3.48%) of fruit juice was obtained in T₇, which might be the adverse effect of highest dose of nitrogen application. Prasad and Mali (2000)^[12] in lemon stated that increase in synthesis of organic acids and its translocation in the fruits caused higher acidity. Sharma *et al.*, (2013)^[16] had also reported the same findings. Citrus fruits are rich in free radical scavenging property due to the overall biochemical components of the fruits. Henceforth, with the improvement of the biochemical properties of the fruits, the anti-oxidant properties of the fruit is increased.

As per results given by Mahendra *et al.* (2009)^[10], citrus fruit quality improvement might be gain of efficient nutrients supply and growth hormones induction stimulating cell

division and elongation that leads to increase in weight and number of fruits, improved water translocation and nutrients deposition. Perhaps, this could be accredited to the efficient use of fertilizer with organic source nutrient application (Ram *et al.*, 2007^[13] and Ranjan and Gosh, 2006)^[15] in sweet orange.

Table 1: Effect of organic and inorganic nutrient sources on physical characteristics of Assam lemon fruits

Treatments	Fruit Fresh weight (g)	Fruit length (cm)	Fruit diameter (cm)	Peel thickness (mm)	Juice content (ml)
T1	141.08	7.24	4.26	3.55	32.83
T2	178.67	8.46	4.63	4.29	46.11
T3	198.85	8.71	4.88	4.30	60
T4	211.67	9.15	5.33	5.79	68.83
T5	159.45	7.62	4.46	3.80	40.29
T6	174.83	8.12	4.61	3.88	45.91
T7	163.34	7.74	4.47	3.86	43.89
C.D.(0.05)	5.53	0.93	0.45	0.43	5.85
SE(m)	1.78	0.30	0.14	0.14	1.88

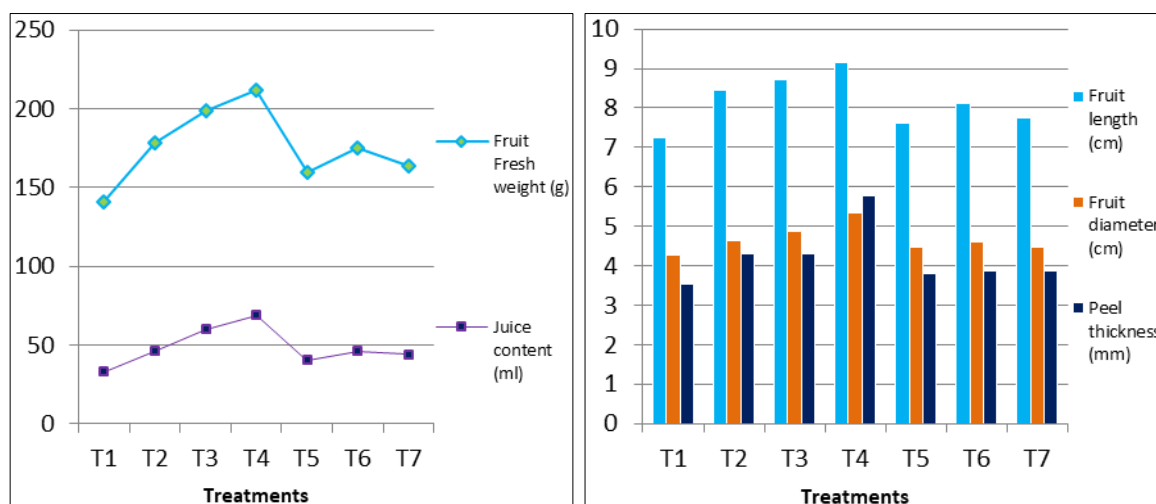


Fig 1: Effect of organic and inorganic nutrient sources on physical characteristics of Assam lemon fruits

Table 2: Effect of organic and inorganic nutrient sources on fruit quality of Assam lemon

Treatments	TSS (°Brix)	Titratable Acidity (%)	Total Sugar (%)	Red. Sugar (%)	Non Red sugar (%)	Ascorbic acid (mg/100g)	Free Radical Scavenging Activity (%)	Free Amino acid(mg/100g)
T1	5.27	3.13	5.30	3.4	1.9	39.04	45.1	38.7
T2	5.3	3.46	5.07	3.26	1.81	38.4	48.42	32.67
T3	5.8	3.48	5.91	3.78	2.12	44.8	50.68	38.67
T4	6.4	2.71	6.20	3.96	2.23	48	52.49	44
T5	6.28	2.98	4.88	3.10	1.78	33.28	49.91	56
T6	5.73	3.31	4.53	3.19	1.34	37.76	50.08	62.33
T7	5.07	3.53	3.83	2.63	1.19	32.64	47.66	57.33
C.D. (0.05)	0.811	0.416	0.55	0.59	0.65	1.21	0.99	1.02
SE(m)	0.26	0.133	0.18	0.19	0.21	0.39	0.32	0.33

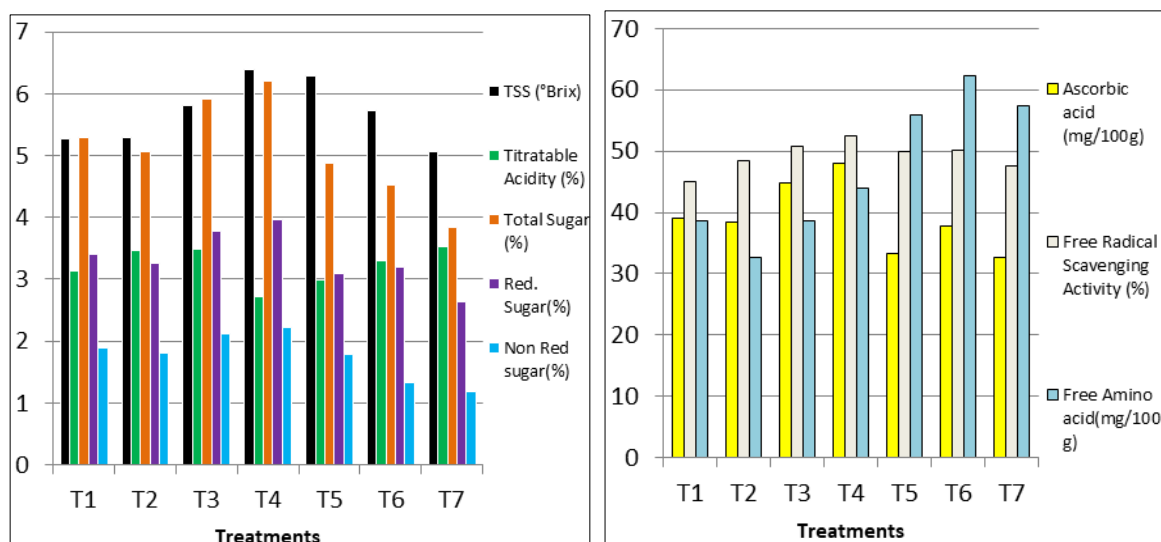


Fig 2: Effect of organic and inorganic nutrient sources on fruit quality of Assam lemon

Conclusion

As per the experimental result of the present work of research, it was cleared that the treatment T₄ [60% N of RDF + 40% N from FYM] furnished the best outcome with respect to almost all the parameters observed *viz.* fruit fresh weight, fruit length, fruit diameter, peel thickness, fruit juice content and biochemical properties like TSS, total sugar, reducing sugar, non-reducing sugar and free radical scavenging activity of Assam lemon fruits. Thus, it can be assured that integrated use of organic and inorganic nutrient sources offered better outcome rather than sole application of organic or inorganic fertilizers.

Henceforth, it can be concluded that the treatment T₄ [60% N of RDF + 40% N from FYM] may be recommended for better fruit and its quality as well as sustaining the soil health which has been continuously degraded by sole use of chemical fertilizers.

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