IJNRD.ORG ISSN : 2456-4184
INTERNATIONAL JOURNAL OF NOVEL RESEARCH AND DEVELOPMENT (IJNRD) | IJNRD.ORG
An International Open Access, Peer-reviewed, Refereed Journal

Soil Characterization and Leaf Nutritional Status of Acid Lime Orchard in TIAC Farm

Renjith S[1], Wesly Pravin Raja K[1], Pon Esakki M[1], Anshiya D[1], Rithika Devi S[1], Vinothraj J[2*] and Senthilkumar A[2]

[1]UG Students, The Indian Agriculture College, Radhapuram, Tamil Nadu

[2] Assistant Professor, Department of Soils Science, The Indian Agriculture College, Radhapuram, Tamil Nadu

***Corresponding author**: vinutnau312@gmail.com

ABSTRACT

In 2025, the current study on the "Soil Characterization and Leaf Nutritional Status of Acid lime Orchard in TIAC Farm" was started. Based on visual observations and yield performance, one healthy citrus grove was chosen from five different locations on the TIAC farm. The study was intended to analyze the soil properties and leaf nutritional status. Ten soil samples were taken from randomly chosen citrus orchards at depths of 0–30 and 30–60 cm. In a similar manner, leaf samples were gathered and their quality criteria examined. With a pH range of 7.35 to 8.14 and an EC range of 0.23 to 0.32 dS m^1, the results showed that the soil reaction was neutral to slightly alkaline, demonstrating the non-saline nature of these soils. The range of free calcium carbonate was 5.63 to 9.42%, Organic carbon showed decreasing trend with soil depth and having medium to moderately high in organic carbon. The available nitrogen was found to be low to medium, phosphorus was low, potassium was high to very high and sulphur was low to moderate. The leaf nutrient status was found to be low to optimum in total nitrogen, phosphorus and optimum to high in potassium. Since, the correlations obtained in the present studies did not show any consistent trend.

INTRODUCTION

The acid lime (*Citrus aurantifolia Swingle*), a native of India and a member of the Rutaceae family, is the third most important citrus fruit crop in the country after sweet orange and mandarin. In the lowlands and up to 1200 meters above sea level, it is typically grown in both tropical and subtropical climates. With a total production of 112.8 million tonnes (Mt), citrus is one of the most important fruit crops in the world. Asia produces the most, at 32.6 Mt, followed by South America with 25.8 Mt [1]. With a total production of 19.9 Mt, Brazil leads the pack, followed by the United States and India (Srivastava and Singh, 2008).Soils belonging to the Alfisol, Ultisol, Entisol, and Inceptisol orders produce the most citrus worldwide [2,3,4].

Citrus is cultivated on 5.63 lakh hectares of land in India, yielding 56.8 lakh tons of total production and 10.1 tons of productivity per hectare [5]. Citrus is regarded as a crop that responds very well to nutrients. Citrus nutritional responsiveness is assessed using nutrient diagnostics, which is based on enzyme function, leaf, soil, and juice analysis as well as symptoms of deficiencies. Despite having little real-world impact on the operation of the orchard, the deficiency symptom is the most commonly employed of them. If deficient symptoms are not accompanied by data from soil and leaf analyses, it will be too late to diagnose nutrient restrictions in a timely manner. Multiple nutritional shortages might occur, making the process of correcting them extremely complicated. Compared to traditional

fertilization response research, certain nutrient management studies are given more weight. Using fertigation and integrated nutrient management (INM) with the sensible use of organic manures supplemented with microbial consortiums, as well as applying macronutrients (NPKS) to the soil and micronutrients (Fe, Mn, Zn, and B) on the leaves, all at the same time. Inorganic fertilizers and the integration of microbial cultures through the isolation and characterization of native and dual-purpose microorganisms have yielded positive results to enhance production dividends, supporting their indisputable usefulness [6]. One of the main concerns for optimizing yields is keeping orchards with trees at the ideal concentrations of leaf nutrients [7].

The current study has been attempted in light of the significance of plant nutrition in determining the production of acid lime as well as the dearth of knowledge regarding the ideal range of nutrients in soil, especially for preserving the yield potential of high-quality acid lime fruits.

MATERIALS AND METHODS

The current investigation's study area is 8.267795 o North Latitude and 77.655001 o East Longitude, spanning an area of 737.09 square kilometers in TIAC farm of Tirunelveli district. Fig. 1 shows the study area's location map. The study area is in a subtropical, dry sub-humid climate with hyperthemic soil temperature and a ustic soil moisture regime. The south-west monsoon is mostly responsible for the 736 mm of rainfall that occurs on average. For this investigation, one acid lime orchard was chosen. Samples of soil were taken at 0–30 and 30–60 cm depth in each of the ten orchards. Standard techniques were used to analyze the soil samples that were collected [8,9,10]. In the same way about fifty leaves from flushes that were 4–7 months old and from non-fruiting terminals—ideally the second, third, and fourth leaves—that were 1.5–1.8 meters above the ground were randomly selected from all plant sides. [2]. Standard protocols were used to analyze the leaf nutritional characteristics of the collected samples in their entirety [11,9,12]. In contrast, Lacey's standard protocols were used to analyze the physical and chemical properties of fruit [13]. The regression equations and the coefficient of correlation between the dependent and independent soil variables were calculated using the methodology outlined by Gomez and Gomez [14].

Fig 1. Location of the study area at TIAC farm

RESULTS AND DISCUSSION

Chemical Properties of Soil

The soil reaction was neutral to slightly alkaline with pH value varied from7.35 to 8.41, presented in (Table 1). it slightly increased with depth and varied from 7.53 to 8.14 at 30-60 cm depth. Electrical conductivity ranges from 0.23 to 0.32 dS m^{-1} indicating the non-saline nature of these soils [11]. The free calcium carbonate varied from 5.63 to 9.42 % which qualify them to class as moderately calcareous to calcareous calcium. Carbonate content below 10 percent is supposed to be safe for cultivation of lime [6]. Similar result were closely pointed out by Punekar et al. [15]. The organic carbon has a strong cascading effect on most of the soil physico-chemical properties [2]. The organic carbon content in soils of healthy acid lime orchards varied from 4.4 to 6.8 g kg^{-1}. Whereas, it has shown decreasing trend with soil depth These soil profiles displayed a medium to moderate soil organic carbon content, especially in their rhizosphere soil. The results were in conformity with the findings of Punekar et al. [15].

Table 1. Chemical properties of soils of acid lime orchard

Sample No.	Depth(cm)	pH	EC (dSm^{-1})	$CaCO_3$ (%)	Org.C ($g\ kg^{-1}$)
Location: TIAC Farm					
Location 1	0-30	7.89	0.258	7.65	5.3
	30-60	7.92	0.274	8.28	4.4
Location 2	0-30	7.45	0.298	7.39	6.1
	30-60	7.53	0.324	8.71	5.9
Location 3	0-30	8.01	0.274	7.96	5.6
	30-60	8.12	0.302	8.54	4.2
Location 4	0-30	7.69	0.276	6.14	4.6
	30-60	7.74	0.298	7.65	4.2
Location 5	0-30	7.35	0.286	7.02	6.8
	30-60	7.41	0.312	8.32	5.0

Soil Nutrient Status of Acid Lime Orchards

The collected soil samples were analyzed for various nutrients and the generated results are placed in (Tables 2). It was observed that the available nitrogen in surface soils varied from 198.91 to 291.68 kg ha^{-1} in acid lime orchard. Whereas, it varied from 179.29 to 264.47 kg ha^{-1} with different depth. From the data it is indicated that, the available nitrogen content was decreasing with depth in all the soil profile. Similar findings were reported by Kuchanwar *et al.*[16].While available phosphorus varied from 18.12 to 22.85 kg ha^{-1}.The available phosphorus content showed a decreasing trend with depth in all the soil profile. Similar observations was also recorded by Srivastava and Singh [3] and Rahman *et al.* [17] The available potassium in surface soils of acid

lime orchard ranged from 330.28 to 394.45 kg ha^{-1}. All soils of acid lime orchards were under high to very high in available potassium content. Similar result was reported by Kuchanwar *et al.* [16]. The available sulphur in surface soils of acid lime orchards ranged from 10.14 to 12.87 mg kg^{-1}.The result showed that the distribution of sulphur was not uneven with depth of the soil.

Table 2.Soil nutrient status of acid lime orchards

Sample No.	Depth(cm)	N ($kgha^{-1}$)	P ($kgha^{-1}$)	K ($kgha^{-1}$)	S ($mgkg^{-1}$)
Location: TIAC Farm					
Location 1	0-30	236.82	22.85	394.45	11.22
	30-60	197.13	21.62	352.84	9.92
Location 2	0-30	272.95	20.63	365.41	12.62
	30-60	264.47	18.14	320.02	9.24
Location 3	0-30	251.54	21.25	354.32	11.84
	30-60	188.21	20.52	321.22	8.95
Location 4	0-30	207.39	21.21	371.65	11.28
	30-60	188.65	20.12	322.52	9.12
Location 5	0-30	291.68	19.38	360.82	12.22
	30-60	223.89	18.14	302.02	11.01

Leaf Nutrient Status of Acid Lime Orchards

The leaf assessment was also followed during the investigation. The generated data is placed in (Table 3). The nitrogen content in leaves of acid lime ranged from 2.21 to 2.41%, the similar variation of nitrogen content in kagzi lime was also observed by Shrivastava and Singh (2001). Similar findings were also reported by Kuchanwar et al. [16] who reported that nitrogen content in leaves of mandarin orchards in Warud tahsil of Amravati district were ranged from 2.22 to 2.43% with a mean value of 2.29%. The total phosphorus

concentration in the leaves of acid lime orchards ranged from 0.09 to 0.16%.The low concentration of phosphorus might be due to low available phosphorus status in soil and inadequate use of phosphatic fertilizers. Similar findings were also reported by Kuchanwar et al. [16]. Total potassium content in the leaves of acid lime orchards varied from 0.79 to 1.96%.

Table 3.Leaf nutrient status of acid lime orchards

Sample No.	N (%)	P (%)	K (%)
Location: TIAC			
Location 1	2.35	0.12	1.15
Location 2	2.38	0.16	1.43
Location 3	2.40	0.13	1.09
Location 4	2.29	0.11	1.24
Location 5	2.30	0.11	1.32

Correlation Co-efficient between Soil Properties and Leaf Nutrient Status

The correlation between different soil properties with nutrient content in leaves is placed in (Table 4). It observed that, the significant positive correlations between soil organic carbon with leaf nitrogen (r=0.421**), and phosphorous (r=0.435**). Similarly, significant positive correlations of available nitrogen with leaf nitrogen (r=0.504**) and phosphorous (r=0.328*). This indicates that the optimum availability of nitrogen in soil increases uptake of other nutrients. Significant positive correlations of available P with leaf nitrogen (r=0.496**), phosphorous (r=0.361*).

Table 4.Correlation co-efficient between soil properties and leaf nutrient status

Correlation co-efficient between soil properties and leaf nutrient status			
Soil properties	**Leaf nutrient content**		
	N	**P**	**K**
pH	0.044	0.014	-0.093
EC	-0.377	-0.132	0.081
$CaCO_3$	-0.188	-0.047	-0.381
OC	0.421**	0.435**	0.197
N	0.504**	0.328*	-0.073
P	0.496**	0.361*	0.296
K	0.007	0.357	0.385
S	-0.050	0.320	0.427

CONCLUSION

It can be concluded that fertility of soils is a result of presence of essential plant nutrients in adequate amounts and in available forms to the plant. The present result thus, reflects that the soils of the region are suitable for acid lime. There is a need to increase in the content of organic carbon, available nitrogen, available phosphorus, which increases the content of nutrients in leaves which turns into yield of acid lime orchards. The studies further confirm that the soil analysis in conjunction with leaf analysis can be effective in predicting the nutrient status as well as the effects on yields in citrus, since the correlations obtained in the present studies do not show any consistent trends.

REFERENCES

1. Srivastava AK, Rajeev PC, Solanke MSS, Nagaraju J, Prasad RA, Nasre DS,Mohekar and Barthwal AK. Status of available micronutrient cations and their relationship with soil properties in Nagpur district, Maharashtra. Indian Journal of Dryland Agricultural Research And Development. 2014;29(1):68-72.
2. Srivastava AK, Singh S. Soil plant nutrient limits in relation to optimum fruit yield of sweet orange (*Citrus sinensis*) cultivar 'Mosambi'. Indian Journal of Agricultural Science. 2003;73(4): 209-211.
3. Srivastava AK, Singh S. Leaf and soil nutrient guide in citrus - A review, Agricultural Reviews. 2004;25(4):235-251.
4. Srivastava AK, Singh. Soil analysis based diagnostic norms for Indian citrus cultivar. Journal of Communications in Soil Science and Plant Analysis. 2002;33(11&12):1689-1706.
5. Srivastava AK, Singh S. Citrus decline: Soil fertility and plant nutrition. Journal of Plant Nutrition. 2009; 32:197–245.
6. Srivastava AK.Nutrient management in Nagpur mandarin: Frontier developments Sci. J. Agri. 2013;2(1)1-14.
7. Raveh E. Citrus leaf nutrient status: a critical evaluation of guidelines for optimal yield in Israel. Journal of Plant Nutrition and Soil Science. 2013;176(3):420-428.
8. Black CA. Methods of Soil Analysis, Part I&2 American Society of Agronomy, Madison, Wisconsin USA; 1965.
9. Jackson ML. Soil chemical analysis, Prentice Hall India Pvt. Ltd., New Delhi; 1967.
10. Lindsay WL, Norvell WA. Development of DTPA soil test for Zinc, Iron, Manganese and Copper. Soil Science Socity of American Journal. 1978;42:421- 428.
11. Issac RA, Kerber JD. Atomic absorption and flame photometry; Techniques and uses in soil, plant and water analysis. Instrumental Methods for Analysis of Soil and plant tissue, *Soil Science Society America*, Madison, Wisconsin. 1971;17-37.
12. Piper CS. Soil and Plant analysis Adelaide, Australia; 1966.
13. Lacey WJ. Measuring maturity of citrus; 2009.[ISSN: 0726-934X 1-4]
14. Gomez KA, Gomez AA. Statistical procedures for agriculture research. John Willey and Sons, New York; 1983.
15. Punekar SB, Kuchanwar OD, Chopde NK, Deshmukh S. Characterization of Nagpur mandarin (Citrus reticulata) growing soils in central India. Current Horticulture.2017;5(2):15–21.
16. Kuchanwar OD, Chopde N, Deshmukh S. Soil fertility and plant nutrional factors contributing towards citrus decline in central India. Annals of plant and soil Research. 2017;19(3):319-323.
17. Rahman H, Amanullah BJ, Shafi M. Survey of citrus orchards for micronutrients deficiency in swat Valley of North Western Pakistan. Pakistan Journal Biotechnology. 2012;44(2):705-710.