International Journal of Agriculture Sciences
ISSN: 0975-3710 & E-ISSN: 0975-9107, Volume 11, Issue 5, 2019, pp.-7996-7998.
Available online at https://www.bioinfopublication.org/jouarchive.php?opt=&jouid=BPJ0000217

Research Article

STUDY OF SOIL NUTRIENT STATUS OF ARECANUT GARDENS OF DAKSHINA KANNADA DISTRICT OF COASTAL KARNATAKA

HARISH SHENOY*
ICAR-Krishi Vigyan Kendra, Dakshina Kannada, Mangaluru, 575002, Karnataka Veterinary Animal and Fisheries Sciences University, Bidar, 575419 Karnataka, India
*Corresponding Author: Email - harish.shenoy1@gmail.com

Received: March 02, 2019; Revised: March 11, 2019; Accepted: March 12, 2019; Published: March 15, 2019

Abstract: Available soil nutrient status was assessed under Arecanut cropping systems for two seasons in Dakshina Kannada district of coastal Karnataka. Data on soil pH indicate that the soils were acidic and non-saline with pH ranging from 4.22 to 6.58 and 4.32 to 6.68 at surface and sub-surface layers respectively with low water-soluble salts. Organic carbon content of the surface soils was higher (0.53% to 0.64%) than that of sub surface soils (0.48% to 0.55%) with decreasing trend over the seasons. Available Nitrogen was higher (180-420 kg/ha) at surface soil than at sub surface soils (175-409 kg/ha) with decreasing trend over the seasons. Majority of the soil samples depicted low 'P' status that ranged from 3.36 to 33.49 and 3.00 to 30.71 kg/ha and available 'K' status of 73 to 237.50 and 68 to 223 kg/ha at surface soil samples and sub-surface soil samples respectively with decreasing trend over the seasons.

Keywords: *Nutrients status, Soil fertility, Arecanut, Seasons, coastal Karnataka*

Citation: Harish Shenoy (2019) Study of Soil Nutrient Status of Arecanut Gardens of Dakshina Kannada District of Coastal Karnataka. International Journal of Agriculture Sciences, ISSN: 0975-3710 & E-ISSN: 0975-9107, Volume 11, Issue 5, pp.- 7996-7998.

Academic Editor / Reviewer: Dr Teena Agrawal, Dr M. Hanumanthapa

Introduction

Arecanut (*Areca catechu* L.) is one of the most important commercial crops grown in parts of Karnataka, Assam, Meghalaya, West Bengal and Andaman and Nicobar Islands. India is the largest producer and Karnataka is the leading state for arecanut with an area of 2.16 lakh ha with an annual production of 3.5 lakh tons [1]. The state has got two distinct tracts *viz*. the Malnad and the Maidan tract. Malnad tract is the traditional belt comprising of coastal plains of Dakshina Kannada and Uttar Kannada district along with Udupi, Shimoga and hilly terrains of Chickmagalur]. The soils of this region comprise of laterites sandy loam and alluvial soil. Since Arecanut is perennial in nature, the soil fertility status of the soil is greatly influenced by the factors like heavy rainfall, altitude and temperature variation. Soil related limitations affecting crop productivity including the nutritional disorders can be determined by evaluating the fertility status of the soils. [2]]. Soil testing provides the information about the nutrient availability of the soil upon which the fertilizer recommendation for maximizing crop yield is made. Soil fertility fluctuates throughout the growing season each year due to alteration in the quantity and availability of mineral nutrients by addition of fertilizers, manure, compost, mulch and lime in addition to leaching. Hence evaluation of fertility status of the soils of an area is an important factor in sustainable agriculture. Organic carbon content in the soils is an index of available nitrogen [3]. Organic matter is one of the important factors to determine quality of soil and serves as source of nutrient for improving the physical and biological properties of soil in addition to productivity. In the present study, an effort has been made to assess the nutrient status under Arecanut cropping system in coastal agro ecosystem for two seasons that would focus on proper nutritional management for higher yield in arecanut.

Materials and Methods

Characterization of surface and sub surface soil for fertility status was studied by taking thirty representative soil samples at random from traditional Arecanut plantation of Chandapady village of Bantwal taluk for two consecutive seasons (Pre-*kharif* and post- *Kharif* of 2014). Soil samples were drawn from two depths 0-30cm and 30-60cm. The collected soil samples were dried under shade. The soils were analyzed for pH, EC, organic carbon, and available NPK. The following standard procedures were adopted for analysis of the nutrients in the laboratory. The pH of the soil was determined by use of digital pH meter. The organic carbon (%) in the soil was determined by wet oxidation method [4]. The Electrical Conductivity is measured by Conductivity Bridge and expressed in millimhos per centimetre. The available Nitrogen(kg/ha) content in soil was determined by adopting alkaline potassium permanganate method [5]. The available phosphorus (kg/ha) was determined by using by Brays extractant and the available potassium(kg/ha) by determined by flame photometer.[6]. During the period of study, total rainfall received was 3460 mm [7] as against normal rainfall of 3912 mm in 2014. The pre-*kharif* rainfall received during the months of January-2014 to May-2014 was 237 mm whereas the *Kharif* rains received in the month of June-2014 to September-2014 was 3285 mm.

Results and Discussion

Soil pH

The soil pH influences the rate of nutrients release through its influence on decomposition, carbon exchange capacity and solubility of the materials. Further soil pH influences plant growth by way of improving the soil physical condition and nutrient availability whereas, high or low pH of the nutrient medium has adverse effect on plant growth. In the study, soil pH over two seasons indicate [Table-1] that the soils under study were acidic with pH ranging from 4.22 to 6.58 and 4.32 to 6.68 over two depths. The variation in pH among different depth of soils may be attributed to variation in rain and management practices [2]. The soils of Arecanut plantation are derived from gneiss and Schist type of parent material revealed that in most of the soil profiles, the soil pH did not show any specific trend with depth [8]. Mean soil pH over the seasons indicate that there was decrease in soil pH with time may be due to the fact that the soil could retain only a limited quantity of

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Table-1 *pH, EC and OC content of soil sample in Arecanut Cropping Systems*

a) Season Pre-kharif (May-2014)

Soil Depth	pH (1:2.5)		EC (milli mhos/cm)		Org. Carbon (%)	
	0-30cm	30-60cm	0-30cm	30-60cm	0-30cm	30-60cm
Range	4.10-6.36	4.25-6.45	0.16-0.091	0.25-0106	0.58-0.70	0.55-0.68
Mean	5.20	5.30	0.125	0.178	0.60	0.50

b) *Season (Post-kharif) (Oct-2014)*

Soil Depth	pH (1:2.5)		EC (milli mhos/cm)		Org. Carbon (%)	
	0-30cm	30-60cm	0-30cm	30-60cm	0-30cm	30-60cm
Range	4.22-6.53	4.32-6.68	0.014-0.072	0.022-0.104	0.53-0.64	0.48-0.55
Mean	5.37	5.50	0.043	0.063	0.58	0.51

Table-2 *Available N, P and K content of Soil samples in Arecanut Cropping system*

a) Season Pre-Kharif (May-2014)

Soil Depth	N (kg/ha)		P_2O_5(kg/ha)		K_2O(kg/ha)	
	0-30cm	30-60cm	0-30cm	30-60cm	0-30cm	30-60cm
Range	180-420	175-490	4.00-56.40	3.95-48.90	73.402	68.378
Mean	300	332.50	30.20	26.42	237.50	223

b) Season Post-*Kharif* (Oct-2014)

Soil Depth	N (kg/ha)		P_2O_5(kg/ha)		K_2O(kg/ha)	
	0-30cm	30-60cm	0-30cm	30-60cm	0-30cm	30-60cm
Range	174-524	166-500	3.36-63.63	3.00-58.42	70-405	64-388
Mean	349	333	33.49	30.71	237.5	226

mineralized nitrogen and significant N lost through leaching due to heavy rains, soil erosion and denitrification in the soils [8,9]. The soils are subjected to high degree of leaching due to *kharif* rain fall of 3285mm received in 2014. High rainfall causes leaching of bases which contribute to acidity was observed by many workers [10].

Electricity Conductivity (EC)

The measure of electricity conductivity shows the total amount of soluble salts present in the soil. It is the most common measure for soil salinity. The variations found in respect of electrical conductivity among the soils over the season were low. The low EC indicate that the soluble salts were leached out of soil due to high rainfall. Consequently, there was low accumulation of soluble salts in these soils and decreased over the seasons [Table-1][11].

Organic Carbon (%)

The level of soil organic matter determines the multiplication of microorganisms and makes the system more dynamic [12]. Organic carbon content of the surface soils was higher than that of sub surface soils. Mean organic carbon content of surface and sub-surface samples ranged from 0.53 to 0.64 and 0.48 to 0.55 percent respectively with decreasing trend over the seasons [Table-1]. In most of the samples the soil organic matter content will be lower in low elevation than high elevation. This is due to slow decomposition of organic residues [13,14]. Organic carbon content was high at the surface than in sub surface. This can be attributed to luxuriant vegetative growth and consequent addition of organic manure to the soil by the farmer every year in these plantations [8]. However, the nutrients stored in solid soil organic matter become available to the soil microbial community and plants as they are processed into smaller units by soil microbial community [15].

Available Nitrogen (N)

Nitrogen is an important factor affecting decomposition [14,17]. The availability of nitrogen is due to the regular addition of plant residues on the soil and decomposition [16]. Available nitrogen contents of the Arecanut plantations soils are generally low to medium and ranged from 174-524 kg/ha and 166-500 Kg/ha. Surface soils contents of Nitrogen were higher than that of sub-surface soils with decreasing trend over the seasons [Table-2]. Exceptionally high nitrogen content of some soils can be attributed to indiscriminate use of fertilizers and direct application of cow dung slurry by the farmers in this area. Low to medium available Nitrogen status may due to the fact that the soil could retain only a limited quantity of mineralized Nitrogen and significant amount of Nitrogen loss through leaching and denitrification in these soils [9].

Available Phosphorus(P_2O_5)

Phosphorus is an essential constituent of protoplasm. It does not move readily through the soil and is not leached by rain or irrigation. Most of the phosphorus is tied up chemically in compound of limited solubility [18]. Available P content in the collected soil samples was in the range of 3.36 to 63.63 and 3.00 to 58.42 Kg/ha. Available phosphorus content of the surface samples was higher than that of sub surface samples [8, 19]. Also, reported similar findings in laterite soils of coastal region. It was observed that low to high available 'P' status had decreased with the depth and seasons [Table-2]. Majority of the soils of study area was having low 'P' status. Since the soils are rich in hydrated as well as amorphous oxides of Fe and Al, the potent source of P immobilization, P content is very low in these soils [[20] Available P content was medium at some sites in the study area where the pH of the soil was near to neutral which had a significant role in enhancing 'P' availability [21].

Available Potassium(K)

The potassium is an activator of dozens of enzymes, starch synthesis, nitrate reduction and also plays a major role in protection against disease by thickening the other cell walls of plant tissue and responsible for energy metabolism. Available Potassium content of the surface and sub-surface samples was observed to be low to high over the seasons [Table-2]. The majority of the area was low in available 'K'. However, the available 'K' content was more at the surface than at the lower depth. Coarse textured and gravelly soils are particularly low in available potassium due to faster and deeper leaching [22]. In highly weathered soils like laterite where strong weathering had reduced the 'K' content of the entire profile to a low level, the surface soil had a higher 'K' content than the sub surface soil [22].

Conclusion

The study revealed that the soils were acidic in nature with low soluble salts. Organic carbon of the surface soil was higher than that of sub surface soils with decreasing trend over the seasons. The available Nitrogen content of the soil was generally low to medium. Majority of the soils of the study area depicted low in P and K status. Hence, integrated nutrient management is the only holistic approach to maintain the sustainability of arecanut production system of the study area.

Application of Research: The study is useful in formulating integrated nutrient management practices for sustained arecanut production

Research Category: Soil fertility

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Acknowledgement / Funding: Author is thankful to ICAR-Krishi Vigyan Kendra, Dakshina Kannada, Mangaluru, 575002, Karnataka Veterinary Animal and Fisheries Sciences University, Bidar, 575419 Karnataka, India and ICAR-Agricultural Technology Application Research Institute, Zone-XI, Bengaluru, Karnataka, India.

***Principal Investigator or Chairperson of research: Harish Shenoy**
University: Karnataka Veterinary Animal and Fisheries Sciences University, Bidar, 575419
Research project name or number: On farm trials on Assessment of split application of potassium in arecanut

Author Contributions: Sole author

Author statement: Author read, reviewed, agreed and approved the final manuscript. Note-Author agreed that- Written informed consent was obtained from all participants prior to publish / enrolment

Study area / Sample Collection: Chandapady village, Bantwal taluk, Dakshina Kannada District, Karnataka

Cultivar / Variety name: Arecanut (*Areca catechu* L.)

Conflict of Interest: None declared

Ethical approval: This article does not contain any studies with human participants or animals performed by any of the authors.
Ethical Committee Approval Number: Nil

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