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Nutrient Use Strategies for Coconut Based Cropping System in Onattukara Sandy Tract, Kerala

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***Abstract**: Onattukara sandy tract is a fluvial and marine sand area of Alappuzha and Kollam districts of Kerala state in India, which covers an area of 67,447 ha. These soils are coarse textured with low nutrient and water retention capacity. Soil fertility status of coconut based cropping system in onattukara was assessed for formulating soil based plant nutrient use strategies to get sustainable crop yields. Composite surface soil samples from 200 locations were collected from twenty soil series of the Onattukara region. The parameters analyzed included pH, electrical conductivity, organic carbon, available phosphorus, potassium, calcium, magnesium, sulphur, iron, copper, zinc, manganese and boron following standard analytical procedures. The soils were extremely acidic to slightly acidic. Liming of acid soils in accordance with soil test results is highly essential. The soil nutrient index value for available nitrogen was medium and that for available phosphorus and potassium were high and low respectively. Extensive soil acidification, excess levels of phosphorus and wide spread deficiencies of calcium, magnesium, boron and zinc are the major limitations to crop production in the region. Excess of available phosphorus in the soil impairs nutrient balance and affects micronutrient absorption by plants. Use of nitrogenous fertilizers should be restricted in accordance with soil test results. Reduction in the use of phosphatic fertilizers to fifty to twenty five per cent of the recommended dose is possible in this region. Application of potassium fertilizers should be done in several splits to minimize the leaching losses. Boron deficiency is indicated in 77 per cent of the soil samples and 85 per cent of samples are deficient in calcium and magnesium. Amelioration of soil acidity and external inputs of secondary and micronutrients along with the major nutrients are essential for enhancing crop productivity in the region. Soil test based nutrient use will enhance crop productivity without deteriorating soil health.*

***Keywords:** Onattukara, Sandy soil, Coconut, Nutrient use.*

I. Introduction

The Onattukara region forms a unique agro ecological region of Kerala in India, distributed between 8°55’44” to 9°21’09” N latitude and 76°23’13” to 76°41’16” E longitude and covers an area of 67,447 ha.The soils of the Onattukara region exhibit wide spatial variability in their properties. The major soils occur as marine deposits extending to the interior up to the lateritic belt in the midland region. These soils are in general coarse textured with immature profiles. They are acidic in reaction and extremely deficient in all major plant nutrients. The CEC is also poor. Onattukara soil is coarse textured with low nutrient and water retention capacity. The major cropping system prevailing in the upland is coconut based cropping system. In older days this region was considered as a region of agricultural prosperity, but now it has become an area of low productivity with many constraints like water and nutrient stress (Premachandran, 1998).

In order to maintain soil productivity, removal of nutrients from the soil must be restored by the application of manures and fertilizers. The selection of the right kind of nutrient to be so replenished and the proper quantity to be applied is based on the nutrient requirement of crop and the nutrient supplying capacity of the soil. The assessment of nutrient supplying capacity of a soil is nothing but soil fertility evaluation. Hence present study was undertaken at College of Agriculture, Vellayani, Kerala Agricultural University, to develop the nutrient management strategies for coconut based cropping system in Onattukara region of Kerala. As part of this project soil samples were collected from onattukara region and analyzed and the soil test information obtained was compiled and nutrient management strategies for the region was also prepared.

II. Materials And Methods

A total of 200 soil samples from coconut based cropping system were collected from 20 soil series of the Onattukara region of Kerala. The parameters analyzed included pH, EC, oxidisable organic carbon, available phosphorus, potassium, calcium, magnesium, sulphur, iron, copper, zinc, manganese and boron following standard analytical procedures (Jackson, 1973). The data generated for individual farmers of each series was interpreted under different systems of classification. The soils were classified in to six groups based on soil reaction as ultra acid, extremely acid, very strongly acid, strongly acid, moderately acid and slightly acid. Based on the soil test values for different nutrients, the soil samples were classified into three categories viz. low, medium and high as per the ratings suggested by Dev (1997).

Soil Nutrient index value

The Soil Nutrient Index(SNI) concept is useful in formulating area wise fertilizer recommendation and comparing fertility levels of different areas.SNI was calculated by giving separate weightages to the number of samples falling in low, medium and high soil fertility classes. Separate indices were calculated for different nutrients. SNI values less than 1.5 were rated as low, between 1.5-2.5 as medium as and more than 2.5 as high. The data were interpreted and fertilizers recommendations for the different crops were arrived at taking in to account the existing package of practice recommendations (KAU, 2011).

III. Results And Discussions

The soil test results for each parameter based on different classifications systems along with the suggested nutrient management strategy are discussed below. Range and mean value of various parameters have been given in Table 1.The content of soluble salts in the soil was negligible and no deficiency of micronutrients iron and manganese was recorded in any of the analyzed samples. Hence analysis and interpretation of the data pertaining to the said parameters are not included.

Table 1. Range and Mean of various parameters

Sl.No	Parameter	Range	Mean	SD*
1	pH	4.04 - 6.50	5.13	0.51
2	Electrical Conductivity (dS/m)	0.01 - 0.15	0.05	0.02
3	Organic Carbon (%)	0.04 - 2.11	0.62	0.26
4	Available Phosphorus(kg/ha)	9.5 - 62.0	30.53	7.63
5	Available Potassium(kg/ha)	13 -356.6	134.70	73.96
6	Available Calcium(mg/kg)	24.33 -390.9	106.59	92.47
7	Available Magnesium(mg/kg)	14.30 -183.7	33.82	33.77
8	Available Sulphur(mg/kg)	3.29 -19.38	7.01	2.66
9	Available Iron(mg/kg)	6.05-45.66	14.70	8.34
10	Available Manganese(mg/kg)	2.62-17.48	13.07	0.42
11	Available Zinc(mg/kg)	0.21-1.94	0.64	0.41
12	Available Copper(mg/kg)	0.20-1.93	0.76	4.59
13	Available Boron(mg/kg)	0.13-0.93	0.29	0.14

SD* - Standard deviation

Soil Reaction

The pH of the soils ranged from extremely acid (<4.5) to neutral to slighyly alkaline (<6.5) with mean value of 5.13. However the major share of soil comes under strongly acidic (5.1-5.5) followed by very strongly acidic (4.5-5.0) (Fig.1). Acidification of soils is a serious constraint to crop production in the region. About 94 per cent of soils are acidic in reaction and 77per cent strongly to extremely acidic. The problem of acidity has aggravated to extreme levels in soils due to heavy inputs of acid producing fertilizers, without regular application of lime to neutralize the acidity generated. Application of lime based on soil test has to be followed. Liming is essential for favourable soil reaction and to ensure availability of essential nutrients.

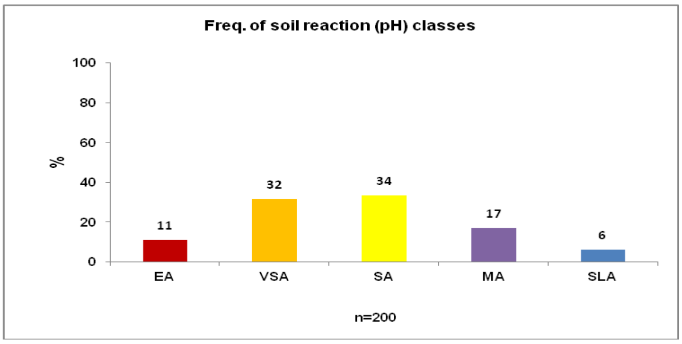

Fig.1.Frequency of soil reaction classes: EA- Extremely acid (pH<4.5), VSA-Very strongly acid (pH 4.5- 5.0), SA- Strongly acid (pH 5.1- 5.5), MA- Moderately acid (pH 5.6- 6.0), SLA-Slightly acid (pH 6.1- 6.5)

Plant available nitrogen in soils

Content of oxidisable organic cabon in the soil is taken as the index for available nitrogen status of the soil. The available nitrogen status of the soils of this region reveals that 54 percent of the samples were deficient in available nitrogen(Fig.2). Forty seven per cent of samples have indicated medium to high levels of organic carbon. The soil nutrient index value worked out was 1.78, which was medium with a mean organic carbon content of 0.62 per cent. Sustained crop productivity can be ensured with the use of recommended levels of organic manures and nitrogenous fertilizers. High levels of organic matter not only provide part of the nitrogen requirement of the crop plants, but also improve physico-chemical and biological properties of the soil. Correction of soil acidity can lead to better microbial activity and consequently to better utilization of applied nitrogen fertilizer and possibly reduction in their use.

Plant available phosphorus in soils

The available phosphorus status of the soils was found to be medium to high. As per the general classification, it was seen that 36 per cent and 62 per cent of the samples were having the medium and high content of phosphorus respectively (Fig. 2). The soil nutrient index for P was worked out as 2.60, which was high with a mean phosphorus content of 30.53 kg/ha. The high proportion of soil samples with high level of phosphorus suggest considerable build up of the nutrient. Heavy inputs of phosphatic fertilizers lead to build up of very high levels of the nutrient in soils. The result of the study points to the possibility for reduction in the use of the costly phosphatic fertilizers. Correction of soil acidity through liming can lead to release of phosphorus fixed by soil constituents into the available pool. Hence it is recommended to get the soil tested regularly and apply fertilizers accordingly. In the absence of soil test results apply only fifty percent of the dose fixed for crops. High levels of available phosphorus can have negative influence of uptake of other nutrients especially zinc and boron. Use of phosphatic fertilizers should be restricted in these production systems to the extent of fifty to twenty five percent.

Plant available potassium in soils

In the case of available potassium, 62 percent of the samples in the region were found to be in the low category (Fig. 2). Possible reason may be the intensive leaching condition brought in by irrigation or rain and the very strong acid condition which does not permit any retention and rapid leaching loss of the element. The soil nutrient index for K was worked out as 1.48, which was low. The results of the study points to the need for regular application of potassium fertilizers in specified doses in as many splits as feasible to reduce the leaching losses.

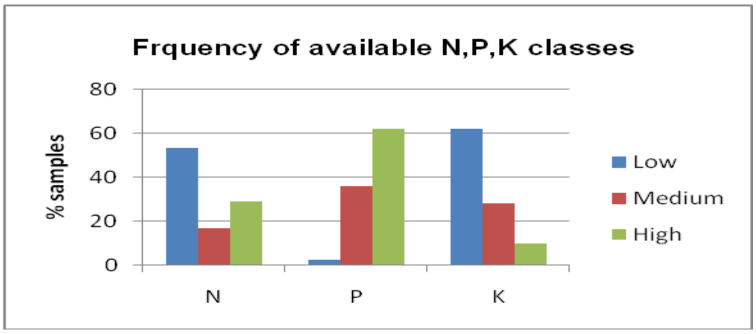

Fig.2. Frequency of available nitrogen,phosphorous and potassium classes

Plant available calcium in soil

In the case of available calcium status, only 12% of the samples were sufficient and the remaining deficient (Fig. 3). The deficiency is more pronounced in areas with strongly acidic soil reaction. Use of required quantity of lime for regulation of soil reaction can take care of calcium nutrition as well.

Plant available magnesium in soils

Magnesium deficiency was indicated in 89 per cent of the soil samples (Fig. 3). This indicates chronic deficiency of this nutrient in the region. Similar trend was observed for the samples drawn from different crop production systems, except for vegetable growing areas, wherein almost all the samples were very low in available calcium .Deficiency of calcium and magnesium seriously affect cellular functions of the plants. It is necessary to apply magnesium sulphate regularly in accordance with soil test results or in its absence at the rate of 80 kg per hectare. Application of a quarter of the lime requirement as dolomite is also equally effective.

Plant available sulphur in soils

Sulphur deficiency was observed in eighteen per cent of the soil samples (Fig. 3). The possible reason for this may be the low retention capacity of the soil. Phosphatic fertilizers mostly in use in the region contain sulphur as an additional constituent and that may be responsible for satisfactory levels in soils of high input crop production systems like vegetable. Application of the magnesium sulphate can take care of sulphur requirement of the crops.

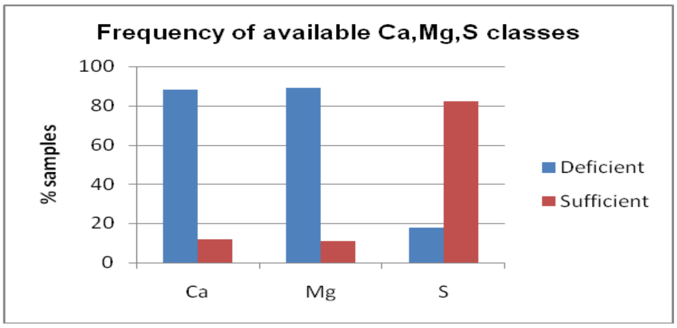

Fig. 3.Frequency of available calcium,magnesium and sulphur classes

Plant available zinc in soils

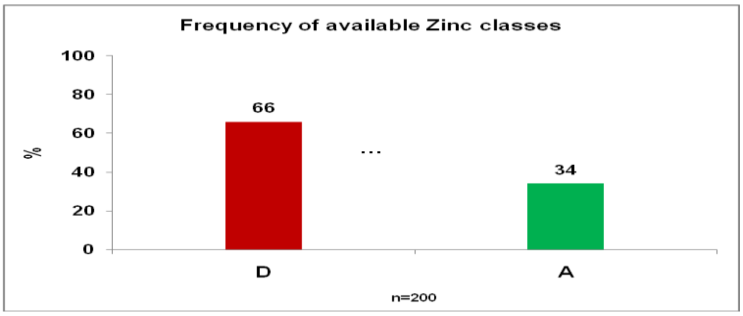

Fig.4. Frequency of available zinc classes: D-Deficient, A- adequate.

Zinc is a micronutrient required by the plant in very small quantities. Zinc deficiency was recorded in 66 per cent soil samples in the region (Fig. 4). Zinc sulphate@ 20 kg/ha or as foliar spray (0.2 % solution of zinc sulphate) in zinc deficient areas is to be used to cater crop need of zinc.

Plant available copper in soils

Copper deficiency was noticed in 53 per cent of the soil samples in the region(Fig. 5). Application of copper sulphate @1.5kg per hectare can be done to combat deficiency. The micronutrient copper need to be applied only on the basis of soil test results indicating deficiency.

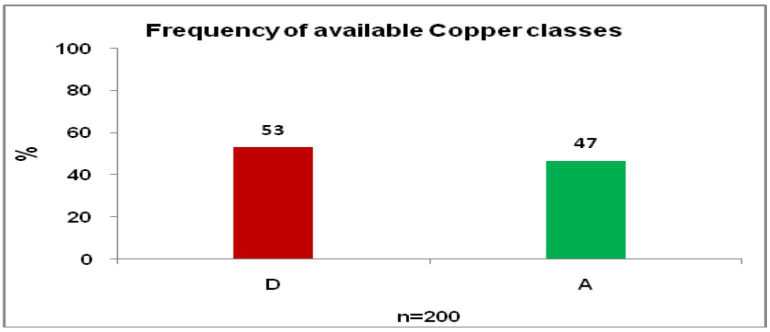

Fig.5. Frequency of available copper classes: D-Deficient, A- adequate

Plant available Boron in soils

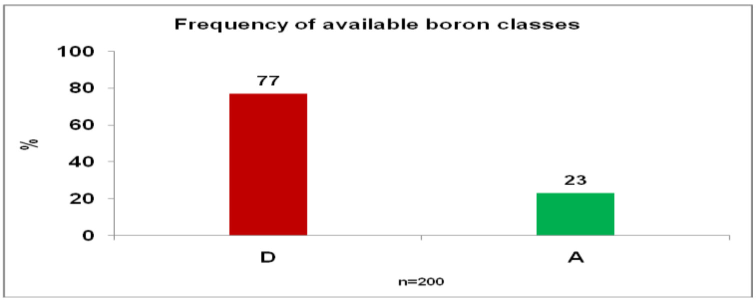

Fig.6. Frequency of available boron classes: D-Deficient, A- adequate

Boron is another essential micronutrient required only in very small quantities by the plants. Boron deficiency is indicated in 77 per cent of soil samples tested in the region (Fig. 6). More than 80 per cent of the samples from vegetable and banana growing areas were deficient in boron. Deficiency of boron seriously affects fruit and seed development in the plants. Application of borax @ 10kg /ha is recommended. However, in the light of very high levels of phosphorus in soils, soil application may not ensure plant uptake of boron. Foliar application of 0.2 per cent solution of borax is better.

IV. Conclusion

Extensive soil acidity, very high level of phosphorus and wide spread deficiencies of calcium, magnesium, boron and zinc are the major limitations to crop production in the region. Amelioration of soil acidity and external inputs of secondary and micronutrients along with the major nutrients are essential for enhancing crop productivity in the onattukara region. Soil test based fertilizer application will lead to saving of fertilizers to the extent of 50-90 per cent. This will enhance the benefit-cost ratio and also sustain soil health. There is a need to use plant nutrients in an integrated way so as to achieve sustainable crop production through management of soil fertility.

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