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Research Article

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Soil based nutrient management plan for Onattukara sandy tract of Kerala

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Summary

The present investigation was carried out at College of Agriculture, Vellayani, Kerala Agricultural University, Kerala to develop the nutrient management strategies for Onattukara sandy tract of Kerala. The overall fertility status of this region indicated that the soil was strongly acidic with high level of phosphorus and low organic carbon and potassium. Excess levels of phosphorus and wide spread deficiencies of calcium, magnesium boron and zinc are the major limitations to crop production in this region. Management of soil acidity is essential for successful crop production in the region. Liming of acid soils in accordance with soil test results is highly essential. Regular application of organic matter or recycling of organic matter is essential to maintain favourable physico-chemical and biological environment in the soils and retention of applied plant nutrients. Restrict the use of nitrogenous (N) fertilizers in accordance with soil test results or as recommended in the package of practices of Kerala Agricultural University. Reduction in the use of phosphatic (P) fertilizers to the tune of fifty per cent of the recommended dose is possible. Apply potassium (K) fertilizers in doses specified, but in several splits to minimize the leaching losses. Amelioration of soil acidity and external inputs of secondary and micronutrients along with the NPK nutrients are essential for enhancing crop productivity in the region.

Key words : Coconut, Cropping system, Nutrient management plan, Onattukara, Sandy tract

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Introduction

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. The region lies between 8°55'44" to 9°21'09" N latitude and 76°23'13" to 76°41'16" E longitude. The soils of the Onattukara region exhibit marked variance in their properties. The major soils occur as marine deposits along the coastal region extending to the interior upto 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 (Premachandran, 1998). Onattukara soil is coarse textured with low nutrient and water retention capacity. Now problems due to micronutrient deficiencies have been reported from many parts of this region. The supplementation of micronutrients under such situation becomes more important to provide balanced nutrition to crops. Supplementation of micronutrients helps in correction of hidden hunger and better utilization of major nutrients resulting in better crop growth and yield (Mathew, 2007). Micro nutrient recommendations are not included in the general crop husbandry practices of Kerala, based on the generalization that acid soils are not deficient in micronutrients. Recent studies in Kerala Agricultural University report response to application of micronutrients in many crops as well as deficiency of micro nutrients especially B, Cu and Zn. The beneficial effect on use of micronutrient fertilizers of B and Zn have been reported in tomato (Jyolsna and Mathew, 2008) sesame (Mathew, 2009) and in fodder maize (Thankamoni, 2010).

The land resources of this region suffer from serious land degradation due to anthropogenic and natural causes. This situation evoked the need for conservation and rejuvenation of the resource trinity *i.e.,* soil, water and biomass. Hence, present study was undertaken at College of Agriculture, Vellayani, Kerala Agricultural University, Kerala 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 all series of onattukara region and analyzed and the soil test information obtained was interpreted and nutrient management plan for the region was prepared.

Resource and Research Methods

To characterize the fertility status of soils, composite surface soil samples were collected from farmers' fields spread all over the onattukara region. Total of 200 georeferenced soil samples were drawn at random from twenty soil series of the onattukara region representing different crop production systems and analysed for 13 soil fertility parameters: soil reaction, soluble salts, oxidisable organic carbon and available phosphorus, potassium, calcium, magnesium, sulphur, iron, manganese, copper, zinc and boron following standard analytical procedures (Jackson, 1973). The data generated were used for assessing soil fertility status and preparing plant nutrient management plan for the region based on the existing package of practice recommendations (KAU, 2011).

Research Findings and Discussion

The content of soluble salts in the soil was normal for all crops and no deficiency of micronutrients iron and manganese was recorded in any of the analysed samples. Hence, analysis and interpretation of the data pertaining to the said parameters are not included. Based on the soil test values for oxidisable organic C, available, P , K, Ca, Mg, S, Fe, Cu, Mn , Zn and B the soil samples were classified into three categories *viz.,* low, medium and high as per the ratings suggested by Dev (1997). Range and mean value of various soil test parameters in the region is given in Table 1.

Soil reaction :

Acidification of soils is a serious constraint to crop production in the region. About 94 per cent of soils are acidic in reaction and 77 per cent strongly to extremely acidic (Fig. 1). 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. When the data sets were analysed for samples drawn from specific crop

Table 1 : Range and mean of soil fertility parameters

Sr. No.	Parameters	Range	Mean	Standard deviation
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

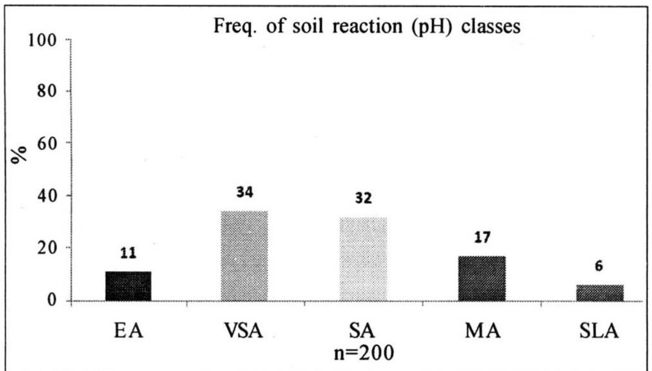

Fig. 1 : Frequency of soil reaction classes: EA- extremely acid (pH<4.5), VSA- very strongly acid (pH 4.5- 5.5), SA- strongly acid (pH 5.1- 5.5), MA- moderately acid (pH 5.6- 6.5), SLA- (pH < 6.5)

production systems, 90 per cent of the samples from banana and paddy were very strongly to strongly acidic.

Liming is essential for favourable soil reaction and to ensure availability of essential nutrients. Liming is also required to reduce the inoculum load of harmful microbes especially *Phytophthora* in soils. Application of lime based on soil test has to be followed.

Primary nutrients :

Oxidisableo organic carbon content of the soil is taken as an index for available nitrogen status in the soil. The available nitrogen status of the soils of this region reveals that 54 per cent of the samples were deficient in available nitrogen. Forty seven per cent of samples have indicated medium to high levels of oxidisable organic carbon (Fig. 2). Sustained crop productivity can be ensured with the use of recommended levels of organic manures and nitrogenous fertilizers. Optimum levels of organic matter not only serve as a slow release source of plant nutrients, 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 is high in 62 per cent of the soil samples tested (Fig. 2) .A greater proportion of soil samples with high level of available 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 per cent of the dose fixed for crops. The data sets on available phosphorus did not reveal significant variation among samples drawn from different cropping systems. More than 70 per cent of the samples drawn from all the production systems tested very high in available phosphorus. 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 to the tune of 25-30 per cent of POP recommendations in these production systems.

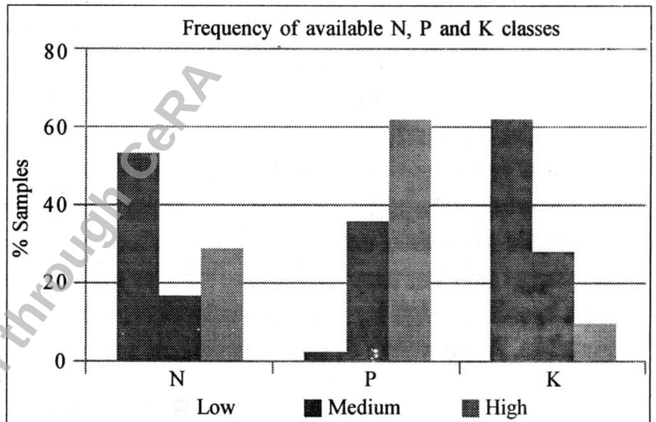

Fig. 2 : Frequency of available nitrogen, phosphorus and potassium classes

Among the major nutrients, potassium has significant role in both crop productions as well in contributing to produce quality. In general, the potassium status of Kerala soils is found to be low and the reason can be attributed to the tropical climate of our state and predominance of kaolinitic clay mineral characterized by low K.

The available potassium status of the region varied from very low to high. A major part (62 %) of the soils of onattukara belonged to the low potassium status (Fig. 2). About thirty nine per cent samples have shown medium to high levels. Same trend was noticed for soil samples drawn from different cropping systems. Possible reason may be the intensive leaching condition brought in by irrigation and the very strong acid condition and low CEC which do not permit any retention and rapid leaching loss of the element.

Secondary nutrients :

In the case of available calcium status, only 12 per cent of the samples were sufficient and the remaining deficient (Fig. 3). Similar trend was observed for the samples in different crop production systems. 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. Magnesium deficiency was indicated in 89 per cent of the soil samples (Fig. 3). More than 90 per cent samples in rice and coconut and more than seventy five per cent samples in coffee, pepper and arecanut have shown low magnesium status. In vegetable growing areas all the samples were deficient. This indicates chronic deficiency of this nutrient in the district. Sulphur deficiency was observed in eighteen per cent of the soil samples (Fig. 3). The possible reason for this may be due to low retention capacity and organic matter status of the soil. No significant variation was observed among the different cropping systems, except for vegetable growing areas, where almost all the samples were having adequate level of the nutrient. Most phosphatic fertilizers 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.

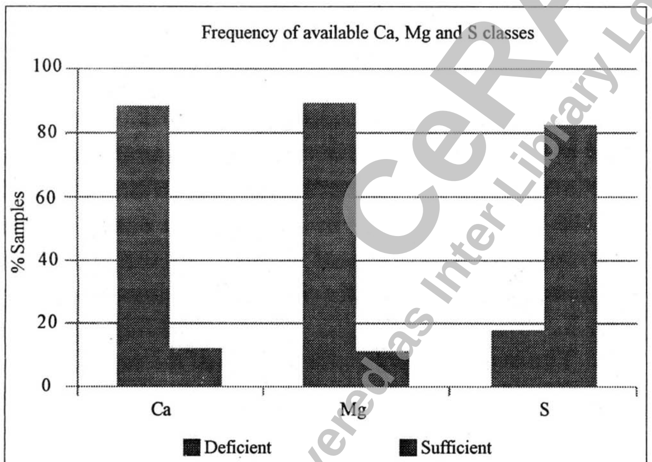

Fig. 3 : Frequency of available calcium, magnesium and sulphur classes

Micronutrients :

There was no deficiency of iron and manganese in any of the samples. Zinc is a micronutrient required by the plant in very small quantities. Zinc deficiency was recorded in 76 per cent soil samples in the region (Fig. 4). Zinc deficiency is more pronounced in rice followed by coconut and banana growing areas. In vegetable growing areas 80 per cent of the samples were having adequate level of available zinc in the soil. High input of phosphatic fertilizers might have ensured adequate level of zinc in these soils, since zinc occurs as a contaminant in phosphatic fertilizers (Nair *et al.*, 2013).Copper deficiency was noticed in 53 per cent of the soil samples in the region (Fig. 4). Deficiency is more pronounced in coconut, rice and cassava growing areas. The micronutrient copper need to be applied only on the basis of soil test results indicating deficiency.

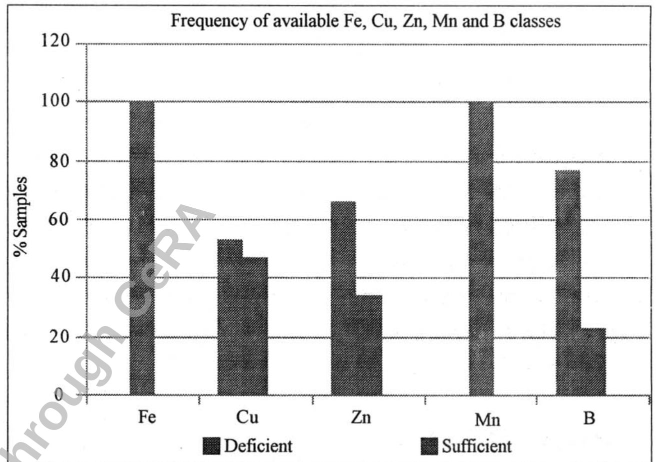

Fig. 4 : Frequency of available Fe, Cu, Zn, Mn and B classes

Boron is another essential micronutrient required only in very small quantities by the plants. Boron deficiency was indicated in 85 per cent of soil samples tested in the region (Fig. 4). About 90 per cent samples from rice growing area have recorded boron deficiency, which indicates the urgent need for boron fertilization in rice for enhancing productivity of rice. About 82 per cent samples in banana growing areas and 80 per cent samples tested from vegetable growing areas were deficient in available boron. Dutta and Sangtam (2014). Worked on integrated nutrient management and continuous cropping for a decade on soil properties in a terraced land.

Recommendations for nutrient management :

– Management of soil acidity is essential for successful crop production in the region. Liming of acid soils in accordance with soil test results is highly essential.
– Regular application of organic matter or recycling of organic matter is essential to maintain favourable physico-chemical and biological environment in the soils and retention

of applied plant nutrients.

- Restrict the use of nitrogenous fertilizers in accordance with soil test results or as recommended in the package of practices of Kerala Agricultural University.
- Reduction in the use of phosphatic fertilizers to the tune of fifty per cent of the recommended dose is possible.
- Apply potassium fertilizers in doses specified, but in several splits to minimize the leaching losses.
- Apply magnesium sulphate @ 80 kg per hectare to ensure adequate levels of magnesium and sulphur to crops.
- Apply zinc as foliar spray (0.2 % solution of zinc sulphate) in zinc deficient areas.
- Apply copper sulphate @1.5 kg per hectare to correct copper deficiency.
- Apply borax @ 10 kg/ha in soil or foliar spray of 0.2 per cent solution of borax.

Conclusion :

Extensive soil acidification, excess levels of phosphorus and wide spread deficiencies of calcium, magnesium, boron and zinc were the major limitations to crop production in the district. The problem of soil acidity has aggravated to extreme levels due to heavy inputs of acid producing fertilizers and the practice of liming to ameliorate soil acidity is either non-existent or ineffective. Very high levels of phosphorus in soils impair nutrient balance and affects micronutrient absorption by plants even when they are present in adequate levels in soils. Possible leaching of phosphorus into water bodies will lead to gradual build up in sediments and eventual eutrophication of water bodies. Deficiency of calcium and magnesium seriously impair plant growth and productivity by affecting absorption of other nutrients and its effect on cellular functions. Deficiency of boron seriously affects fruit and seed development in the plants. 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.

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