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SOIL NUTRIENT STATUS OF BIG ONION GROWING AREAS IN ANURADHAPURA DISTRICT OF SRI LANKA

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ABSTRACT

An investigation on nutrient status of Reddish Brown Earths soil in big onion growing areas in Ipalogama agrarian service division of Anuradhapura District in Sri Lanka was carried out during 2014 and 2015. Forty five samples were tested to identify nutrient status of soil. Results showed that pH and EC of the soils were varied 4.5 -8 and 0.03 to 0.72 (dS/m), respectively. All tested locations had organic matter levels less than 3%. Exchangeable potassium contents of 31% of the samples were higher than 160 ppm. Available phosphorus level in 46% of the samples was higher than the 30ppm. Available Cu and Zn levels of the soils were varied 0.96 – 5.3 mg/kg and 1 – 3.6 mg/kg, respectively. Results revealed that location to location soil nutrient status was varied and some nutrients were very high in some soils. Hence, soil test based fertilizer recommendations are important for balance fertilizer application.

Key words: Big onion, Nutrient status, Soil fertility, Reddish Brown Earths Soil

INTRODUCTION

After green revolution, use of chemical fertilizer was increased with alarming rate. Annual chemical fertilizer usage in Sri Lanka is 879,900 tones (AgStat, 2016). This amount is used for rice other field crops, vegetable, fruits and plantation crops. Different crops have different fertilizer recommendations, but some farmers do not adopt recommendations. They use fertilizer levels higher than the recommendations. It is common for cash crops. Nutrient status of the soil is mainly changed by fertilizer application. However, imbalance chemical fertilizer application leads to problems in the soil (Vindo *et al*., 2012). It also affects the health of the soil (Bijay and John, 2015).

Big onion is one of the cash crops grown in Sri Lanka (HARTI newsletter, 2009). It is mainly cultivated in Anuradhapura, Matale and Hambanthota districts. Cultivating extent is 6,827 ha (AgStat, 2016). Due to high economical value of big onion, farmers apply different rates and type of chemical fertilizers expecting higher yields. However, farmers get low yield than the potential yield (Lesly *et al*., 2002). Imbalance nutrient application leads to different nutritional problems of the crop and low yield (Upinder *et al*., 2014). Soil nutritional problems can be identified by analysis of soil chemical properties. Hence, this experiment was done to identify the nutrient status of onion growing soil in Anuradhapura district.

MATERIAL AND METHODS

Soil samples were collected from Ipalogama Agrarian service division which is one of the onion growing areas in Anuradhapura District in Sri Lanka. 45 Samples were collected from different farmers, field. Sampling area was located at Dry zone Low Country (DL_{1b}) agro ecological region and Reddish Brown Earth soil is the predominant great soil group (Panabokke, 1996). Soil samples were collected after harvesting the onion crop in 2014. Samples were taken from 0 - 15 cm depth of soil. In each field, sub samples were taken from the field and composite samples were made. Composite samples were reduced up to 1kg and it was used to analysis. Air dried and sieved through 2mm mesh samples were analyzed for pH, electrical conductivity (EC), exchangeable potassium, available phosphorus, organic matter % and available Cu and Zn. Soil pH was determined by using 1:2 soils: water suspension with the calibrated pH meter by following the method given by Dharmakeerthi *et al.* (2007). Electrical Conductivity was determined by using 1:5 soils: water suspension with the calibrated conductivity meter by following the method given by. Dharmakeerthi *et al.* (2007). Available phosphorus was estimated using the Olson method (Olson *et al*., 1954) organic carbon was determined by the Walkley and Black method (Nelson and Sommers, 1982) and organic matter % was calculated (organic carbon % x 2). Exchangeable potassium, available Cu, available Zn were determined according to the methods given in Dharmakeerthi *et al.* (2007).

RESULTS AND DISCUSSION

pH and Electrical Conductivity (EC)

The levels of soil pH were between 4.5 -7.9, mean value was 6.4 and standard deviation was 0.82. 64 % of the tested samples had optimum pH level (6 -7.5) for onion cultivation (Table 1).

Table 1. Percentage of soil samples at different pH levels

pH range	Status	Tested soil samples %
4.0- 5.5	acidic soil	27
6.0 -7.5	Most productive soil	64
8 - 9	basic soil	9

The values of electrical conductivity were between 0.03 - 0.72 ds/m, mean value was 0.14 and standard deviation was 0.12. Electrical conductivity of 38 % of the tested samples was higher than the 0.15 dS/m (Table 2). If EC value of the soil is 0.15 dS/m, salinity is developed. Therefore, pH and EC of some soils were not in the optimum level for onion cultivation.

Table 2. Percentage of soil samples at different EC levels.

Salinity level	Status	Tested soil samples %
Very low	> 0.15	6
Low	0.15 - 0.4	36
Medium	0.4 - 0.8	2
High	0.8 - 2	-
Very high	>2	-

Organic Matter (%)

The levels of soil organic matter (%) were between 0.5 - 3.1, mean value was 1.76 and standard deviation was 0.61. Most of productive agricultural soils have between 3% and 6% organic matter (http://franklin.cce.cornell.edu, 2008). Organic matter level in 97 % of the tested soil samples were less than 3%. Organic matter levels of the soils were not in an adequate level. Hence, organic manure should be incorporated to the soil for good yield.

Exchangeable potassium

The level of soil exchangeable potassium are between 43 - 365 mg/kg, mean value is 143.2 and standard deviation is 79.8 (Table 4) According to the classification of Darmakeerthi *et al*. (2007) more than 50% of the soil samples contained very high level of exchangeable K (Table 3). If soil has more than 160 ppm exchangeable K potassium containing fertilizers should not be applied for onion cultivation (Fertilizer recommendation, 1997). When soil has very high level of potassium it has a negative impact on nitrogen, calcium and magnesium uptake by the plant (Svend and Jakobsen., 1993).

Available Phosphorus

The level of soil available phosphorus are between 4.3 - 100 mg/kg, mean value is 38.4 and standard deviation is 26.1 (Table 4). If soil P level is more than 30 ppm it's classified as very high P containing soil (Dharmakirthi *et al*., 2007). Therefore, 46.7% of tested samples had more than 30 ppm P (Table 5). These soils need not be applied with P containing fertilizer for the next crop. Excess amount of P negatively affect the uptake of Zn, Cu, and Fe (Kuntal *et al*., 2005).

Table 3. Percentage of soil samples at different potassium levels.

K level (mg/kg)	Status	% of tested samples
< 39	Very low	0
39 – 58.5	(Low	8.9
58.5 -78	Fairly low	13.3
78 -97.5	Medium	11.1
97.5 - 117	High	13.4
> 117	Very high	53.3

Table 4. Statistic of distribution nutrient in the soil.

Parameter	Exchangeable K	Available P	Available Cu	Available Zn
Minimum (mg/kg)	43	4.3	0.96	1
Maximum (mg/kg)	365	100	5.3	3.6
Mean (mg/kg)	143.2	38.4	3.15	1.82
Standard Deviation	79.8	26.1	1.06	0.72

Table 5. Percentage of soil samples at different phosphorus levels.

Available P level (ppm)	Status	% of tested samples
< 2.5	Very low	0
2.5 -7.5	Low	4.4
7.5 – 15	Fairly low	13.3
15 -22.5	Medium	15.6
22.5 -30	High	20
> 30	Very high	46.7

Available Cu and Zn

The Tested samples had 0.96 mg/kg to 5.3 mg/kg available Cu, mean value is 3.15 mg/kg and standard deviation is 1.06. The level of soil available Zn are between 1 mg/kg to 3.6 mg/kg, mean value is 1.82 mg/kg and standard deviation is 0.72 (Table 4). Critical soil available Cu and Zn level for crops are 1- 2 mg/kg and 0.7 -1 mg/kg, respectively (Dharmakirthi *et al.,* 2007). However, available Cu level was more than 2mg /kg in 78% of the samples and available Zn level was higher than the 1 mg/kg in 92% of the tested samples (Table 6).

Table 6. Percentage of soil samples at different Zn and Cu levels.

Nutrient	Nutrient level	% of tested samples
Cu	> 2mg/kg	78
	< 2mg/kg	22
Zn	> 1mg/kg	92
	< 1mg/kg	8

CONCLUSION

More than 95% of the samples had less than 2.5% of organic matter. Organic manure application is needed for these soils to improve fertility status. Exchangeable potassium levels in 31% of the samples were higher than 160 ppm. For such soil, K fertilizer application should not be done for the next crop. Also, available P level in 46 % of the soils had more than 30 ppm. Available Zn level in 78% of the samples and available Cu level of 92% of the

samples were higher than critical levels. Hence, those soils have enough Zn and Cu for the next crop. Therefore, these results indicate that the blanket recommendation for onion is not a suitable approach and site specific fertilizer recommendations are needed for better crop productivity. Otherwise long term fertilizer application without considering the soil test results may create many problems for the crop and the environment as a whole.

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