Nutrient budget in fertilised and unfertilised taro (Colocasia esculenta) with legume and non-legume mulches

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Introduction

Nutrient budget is perceived as a powerful tool for the valuation of critical components for sustainability in agricultural production (Wijnhoud et al., 2003). It has been studied in many places with different type of crops (Top et al., 2003). It provides an early indication of potential problem arising from (i) nutrient surplus (inputs>outputs) which may lead to nutrient loss and (ii) nutrient deficit (outputs>inputs) which may cause nutrient deficiency and lower crop yield. Nutrient budgeting is a technique used to quantify or predict nutrient deficit or surplus, which is an attempt to improve nutrient use efficiency and reduce nutrient loss. Morrison et al (2016) suggested that soil and farm nutrient budget have to be developed to assist farmers in their management decisions. Samoa soils are formed from volcanic activity, resulting in high organic matter hence it is fertile, however it is highly porous and tend to be erodible on slopes. High temperature and rainfall makes Samoa prone to leaching losses of nutrients, leading to decline in soil fertility which lowers crop yield, resulting in low crop productivity. Crop uptake is a major component in nutrient budgeting. Taro (*Colocasia esculenta*) is one of the major cultivated root crops in the PICs and ranked as the second export crop commodity in Samoa. With increased demand for taro in the urban and export markets, production has intensified. Intensification of taro production and farmers failure to replenish soil nutrients and organic matter with continuous use of soil resources unsustainably leads to decline in soil fertility. Declining soil fertility is thought to present a major threat to sustainable agricultural development in the PICs. Mulching could be an option that may reduce nutrient loss with water runoff and leachate. The effect of legume mulching on taro yield has been studied for past years, however, its influence on nutrient loss was not analysed. There has never been any work done on comprehensive nutrient budgeting in the Pacific. Therefore, this research will be conducted to quantify the nutrient balance of fertilised and unfertilised taro under legume and non-legume mulch, the effect of legume and non-legume mulch on taro yield and its influence on nutrient loss

Methodology

This research work will be conducted at the University of South Pacific, Alafua Crops Research Field in Samoa on Typic Humitropept soil. The location experiences a humid tropical climate with an annual rainfall of 2,500 to 3,500mm and an annual temperature ranging from 20-33^{0}C. The experiment will be laid out in a Factorial Randomized Complete Block Design (RCBD) with three replications and treatments comprised: two Fertilizer- No fertilizer and fertilizer (NPK) and three mulches- No mulch, legume mulch (*Macuna sp*) and non-legume mulch (grasses). Test crop will be taro (Samoa 2). Land will be ploughed and soften by tractor and taro will be planted at 1m x 1m distance in a hole of approximately 15cm depth. Weed control will be throughout growing season to ensure good crop growth. Fertilizer rate to be applied is 135kg/ha N, 70kg/ha P and 110kg/ha K, based on the soil analysis of the trial site. Nitrogen will be applied in split applications (5, 10 and 15 week after planting (WAP)), phosphorus will be applied at planting while potassium will be applied twice (half at planting and half 10WAP). Mulching treatment will be applied at planting. Soil samples will be collected from 3 depths, 0-20cm, 20-40cm and 40-60cm respectively before planting and at harvest for chemical and physical analysis viz. bulk density, moisture factor, soil pH, Total N, Total C, Olsen P and Exchangeable bases (Ca, Mg, K). Plant parameters (leaf colour, height, corm yield biomass etc…) and nutrient uptake will be measured on destructive sampling every month till harvest. Soil solution will be collected at 30cm and 60cm depth respectively to be analysed for leaching loss of nutrients (N, P, K, S and Mg). Nutrient budget will be calculated by the difference between the Nutrient Inputs (rainfall, fertilizer, mulch, Biological N fixation) and the Nutrient Outputs (soil runoff, leaching and crop uptake). Soil surface runoff will be measured using the Universal Soil Loss Equation (USLE). Biological N fixation will not be measured in this research study and will be used literature value.

Results and discussion

N/A – This research work is yet to commence hence results will be available by November.

Expected outcomes

Comprehensive nutrient budgeting is of utter importance for improved soil fertility. Lack of soil knowledge limits production knowledge hence potential skill of local farmers. Therefore, upon completion of this study, it will:

- Assist farmers, extension officers, policy makers in identifying proper nutrient management practices that will boost taro production system in a cost effective manner
- Improve the knowledge of soil nutrient management that will lead to increase in yield
- Improve understanding of the flow of nutrients within the taro production system and indicating consequences of farm management decisions on nutrient cycling process
- Provide knowledge of nutrient budgeting on the application of legume and non-legume mulches in taro with or without fertilizer application

Conclusions

The quality of organic materials as well as soil itself have a large influence on the changes of pH, Eh and nutrient releases during anaerobic incubation. The reduction potential (Eh) of the studied soil showed a significant variation among the treatments depending on the chemical composition and quality of organic matter used for soil amendments. Soil pH was increased by the lime content of the applied organic materials while the Eh was decreased by the liability of applied organic materials. Based on the present study, it may be concluded that application of bioslurry in soil had better performance on release of N, P, S, and the use of manure in soil not only accelerated the release of nutrients but may also maintain soil pH and soil Eh. The results suggest that soil should be amended with bioslurry of poultry manure or cowdung to improve fertility rather than decomposed manure or dung.

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