

## Evaluation of different local lime sources on soil properties and yield of Irish potatoes (*Solanum tuberosum* L.) in Burera District, Rwanda

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### ABSTRACT

*Background and objective:* Agriculture is the most important sector of the Rwandan economy. Irish potato (*Solanum tuberosum*.L) underpins Rwanda's food security but its production is threatened by widespread acidity in many parts of Rwanda. The problems of acid soils (pH less than 5) is widespread in the country occupying approximately 45% of the total arable land or covering about 60% of the highland areas (Beenart, 1999), which are the major growing areas of Irish potatoes.

Potato requires a considerable amount of Nitrogen, and the continuous widespread use of Ammonium or urea based N fertilizers in a high rainfall environment contributes to acceleration of soil acidification (Brett et al., 2005). Acidity limits the fertility of soils through nutrient deficiencies (P, Ca and Mg) and the presence of phytotoxic nutrients such as soluble Al and Mn (Awad et al., 1976). Application of lime has been shown to



reduce Al toxicity, improve pH, Ca, Mg and increase both P uptake in high P fixing soil and plant rooting system (Black, 1993).

The use of liming materials in Rwanda (Yamoah et al., 1992) demonstrate that even small locally produced travertine and liming materials can be used to increase crop production on acidic soils. In some areas of Rwanda, the use of 2-4 tonnes per hectare of local limestone or dolomite resources has proved to be agronomically effective, significantly enhancing the yield of wheat, beans and potatoes (Yamoah et al. 1992). Locally available carbonates are relatively common in many countries of sub-Saharan Africa and are well suited for small-scale mining and processing. There are several good sources of lime in Rwanda and some local production of this lime is currently done using artisanal technologies.

Despite this potential, there is limited use of these alternatives by smallholder farmers. However, the serious limiting factor to the widespread use of lime in Rwanda is the lack of awareness among farmers and the lack of appropriate recommended application rates. The efficiency of lime utilization for acid soils amelioration depends on its chemical interactions with soil particles and therefore its solubility (Huang et al., 2007). In Rwanda not much work has been done to characterize the solubility of these lime sources. This information is vital for lime selection and uses recommendations, and would spur farmer uptake of the liming technology. This research therefore aims to fill this gap and will focus on the evaluation of different local lime sources for improved productivity of the acid soils and Irish potatoes in Burera district, Rwanda. The specific objectives of the study are: (i) to determine the effects of three local lime sources (Musanze travertine, Karongi travertine and Rusizi travertine) on



soil properties and yield of Irish potatoes; (ii) to determine and compare the solubility of three main local lime sources with the recommended agricultural lime in Rwanda; (iii) to determine the appropriate rate of different local lime for increased Irish potato production and soil properties improvement in acidic soils.

*Methodology:* The study will analyze local lime and soil samples, and evaluate their effect on yield of Irish potato. The experiment is designed as an RCBD with 48 treatments and two factors; the first factor is lime from four sources (Musanze travertine, Karongi travertine and Rusizi travertine and control), while the second factor is lime rate at four levels (0, 1.5, 3 and 4.5 tons/ha).

The study is being carried out in Burera district, one of the Irish potatoes producing area of Rwanda. Burera district lies in the northern region of Rwanda where farming is done continuously on the hills and mountains; this region also has high rainfall and high rate of erosion. The average annual rainfall in Burera district is estimated at 1200 mm, mean monthly temperature is 13 °C, but temperatures as low as 5 °C is possible. The soils are classified in the USDA system as Oxisols (Franzel et al., 1985). Soils of the experimental station are typically acidic with the following characteristics: pH=4.7; exchangeable aluminum (Al) =2.9 meq/100g, effective cation exchange capacity (CEC) =7.1 meq/100 g and Bray 1 Phosphorous (P) = 5.2 ppm.

The soil chemical and physical properties changes will be analyzed and Irish potato yield evaluated. The soil chemical analyses (soil pH changes, soil organic C, total N, and available P, Ca and Mg content changes in soil solution, Fe and Al variability in soil solution, Mo and Zn availability in the soil, soil CEC, Exchangeable acidity ( $H^+$  and  $Al^{3+}$ ) and base saturation ( $Ca^{2+}$ ,  $Mg^{2+}$ ,  $K^+$  and  $Na^+$ ) and physical properties (soil moisture



content, soil aggregate and soil texture), will be assayed by conventional methods. Data will be analyzed appropriately.

*Application of expected results:* The results from this study will be helpful to the smallholder potato farmers who possess small land parcels; lack adequate cash to afford inputs and face difficulties in managing soil fertility to carry out agricultural production sustainability. In addition, information generated will be used by the regional agricultural field staff and/or agricultural extension officers to advise farmers on better soil management. The awareness among potatoes farmers on the importance of applying lime and increased usage of the most effective local lime will reduce the production cost and consequently increase the yield and profitability of Irish. This will help to alleviate hunger and poverty among potato farmers in Rwanda.

