

**EFFECTS OF MINJINGU PHOSPHATE ROCK FERTILIZER ON MAIZE
YIELD AND SOIL CHEMICAL COMPOSITION IN ACIDIC SOILS OF
THARAKA-NITHI COUNTY, KENYA**

By

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DECLARATION

This thesis is my original work and has not been presented for a degree in any other University

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ABSTRACT

Soil Phosphorus (P) is a limiting factor to plant growth in acidic soils (pH <5.5 units) and a major cause of decreased yields. As organic inputs used by farmers generate less P since they are grown on P-deficient soils, other P sources, such as inorganic fertilizers, are necessary. However, inorganic fertilizers are ineffective as they are costly in low income settings and not affordable to farmers. Therefore, there is a need to explore the effectiveness of cheaper and readily available organic alternatives such as phosphate rock to replenish P in the soil. In this study, the impact of phosphate rock fertilizer on maize yields and soil chemical composition was assessed when applied; (i) alone or (ii) in combination with *Tithonia diversifolia* and manure as inputs. Further, the cost-effectiveness of the different treatments during the assessment was analyzed. The study was conducted during the Short-rains (SR) 2017 and Long-rains (LR) 2018 seasons in Kigogo - Tharaka-Nithi County, an area with high acidic soils and low income farmers who experience low crop yields. The experiment was set up in a randomized complete block design (RCBD) with plot sizes of 6 m by 4.5 m replicated three times. The treatments were manure, phosphate rock, *Tithonia diversifolia* tested in the following combinations; CAN+TSP, manure+Minjingu phosphate rock, sole manure, Minjingu phosphate rock, *Tithonia diversifolia*+Minjingu phosphate rock and sole *Tithonia diversifolia*. A control where no treatment was added was also included. Soil samples were collected at a depth of 0-20 cm before and at the end of the experiment and analyzed for pH, total N, available P, P-sorption and total organic carbon and other chemical compositions using standard methods. Input and outputs costs were recorded. Data for soil chemical composition analysis before and after treatments were subjected to t-test and analysis of variance (ANOVA) using the general linear model (GLM) in SAS version 9.4 software and mean separation done using Duncan's Multiple Range Test at $P \leq 0.05$. The CAN+TSP treatment had significantly higher grain yields (6.86 Mg ha^{-1}), while Minjingu phosphate rock on its own had the second-lowest than the control treatment (3.0 Mg ha^{-1}). We also observed a similar trend in the stover yields. Minjingu phosphate rock combined with either manure or *Tithonia diversifolia* led to a significant increase (over 100%) in the phosphorous levels. Sole application of Minjingu phosphate rock increased soil iron levels while magnesium, copper, and zinc levels decreased significantly. Other than the control, all treatments significantly lowered the P-sorption levels. However, CAN+TSP had the highest P-sorption (913 mg kg^{-1}) while *Tithonia diversifolia* had the lowest (744 mg kg^{-1}). During the LR2018 season, all treatments reached a break-even point, and the net benefit was significantly higher at $P < 0.05$. Conclusively, the use of phosphate rock, either solely or in combination with organic elements, improved yields, soil chemical composition, P-sorption or was very cost-effective. The use of phosphate rock combined with organic inputs as a soil fertility option will be presented to smallholder farmers, researchers, and stakeholders, including the local extension officers and organic farmers for use in their farms. The results will also provide added information to researchers on improving soil P replenishment potential in the study area by use of phosphate rock in combination with organic resources, especially tithonia and manure.