USE OF MINJINGU PHOSPHATE ROCK WITH \textit{Tithonia Diversifolia} IN MAIZE-BEAN INTERCROP FOR IMPROVED MAIZE YIELD IN TWO SOIL TYPES IN KENYA

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\section*{ABSTRACT}

Phosphorus deficiency and Al phytotoxicity are major factors limiting crop production in acid soils. Use of mineral fertilizers, especially by small scale farmers, to alleviate deficiencies of nutrients such as P, is mainly hindered by their high costs and frequent unavailability. This has made the low input approach using locally available resources such as \textit{Tithonia diversifolia} and Minjingu Phosphate Rock (MPR) gain a substantial research attention. However, less is known on the response of maize to integrated application of \textit{Tithonia} and MPR. Therefore, four experiments were conducted to generate this information. Experiment one aimed to examine the relationship between mineral N and available P of surface soils and \textit{Tithonia} biomass quality (N and P); whereas experiment two was to determine the effect of \textit{Tithonia} and MPR on soil nutrients, pH and exchangeable Al. The third and fourth experiments investigated the influence of the acid synthesized and secreted into the rhizosphere by beans on MPR solubilization and the agronomic responses of maize to \textit{Tithonia} and MPR application under maize-bean intercrop, respectively. In experiment one soil and leafy samples were collected from five areas and analysed for N and P. The second experiment was an incubation experiment with five treatments while the third experiment was a greenhouse pot experiment with two factors consisting of sole maize and maize-bean intercrop as main factor treatments; and use of different fertilizing input sources plus one combination as sub factor treatments. The forth was a field trial conducted for two consecutive planting seasons at Kavutiri in Embu County and Muguga in Kiambu County. The experiment was laid in a split plot organized in a Completely Randomized Block Design with two factors: sole maize and maize-bean intercrop as the main factor treatments; and sub factor treatments consisting of: Control; T alone (5t ha\(^{-1}\) dry weight); MPR alone (60 Kg P ha\(^{-1}\)); TSP alone (60 Kg P ha\(^{-1}\)); T (5t ha\(^{-1}\)) combined with MPR (50 Kg P h\(^{-1}\)); and T (5t ha\(^{-1}\)) combined with TSP (50 Kg P ha\(^{-1}\)). Analysis of Variance (ANOVA) was done using the General Linear Model (GLM) procedure of the Statistical Analyses Software (SAS), version 9.3. Results showed that the concentration levels of mineral N and available P of the top soils weakly correlated (-.22 \leq r \leq +.62) with their respective levels in the biomass while in the biomass, N concentration, however, increased with the rising concentration of P (r = +.95); integrated application of \textit{Tithonia} biomass with MPR not only resulted in significant rise above the control of available soil N (30.2%), P (182.3%), K (27.6%) and Ca (70.8%) but also in a significant decrease of the concentration of soluble Al; MPR solubilization was further enhanced by 68.7% for MPR applied alone and 223.6% for MPR combined with the biomass under maize-bean intercrop as compared to sole maize. Effects of the applied \textit{Tithonia} biomass and MPR on
agronomic parameters of maize differed under the two cropping systems. In conclusion, this study reveals that integrated use of the low fertilizing inputs (*Tithonia* biomass and MPR) under maize-bean intercrop improves maize yield on a P-deficient acid soil that is highly saturated with soluble Al more than mineral P fertilizers. Dissemination to farmers of this newly established low input technology by appropriate institutions such as the ministry of agriculture is highly recommended.