Department of Plant, Soil & Microbial Sciences
Announcement of Ph.D. Dissertation Defense Seminar

Crop & Soil Sciences

Candidate's Name: **Chiwimbo P. Mwika (Gwenambira)**

Seminar/Examination Information:

Date: **Friday, April 17, 2020**
Time: **9:00 am**
Zoom:

Join Zoom Meeting: https://msu.zoom.us/j/201059833

One tap mobile
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Title of Dissertation: Broadening smallholder farmer options through legume rotational and intercrop diversity in maize-based cropping systems of Malawi

Members of the Examining Committee and their Department:

- **Dr. Sieg Snapp; Plant, Soil and Microbial Science**
- **Dr. Regis Chikowo; Plant, Soil and Microbial Science**
- **Dr. Alvin Smucker; Plant, Soil and Microbial Science**
- **Dr. Nicky Mason-Wardell; Agricultural, Food, and Resource Economics**

The seminar will precede the examination, beginning at the time indicated above

Cc: Faculty
Grad Students

ABSTRACT

Sustainability of rainfed cropping across southern Africa is undermined by maize (*Zea mays* L.) monocultures which are mostly cultivated on nitrogen (N) deficient soils. Smallholder farmers rarely achieve access to adequate quantities of inorganic fertilizers, and this limits crop productivity and negatively impacts food and nutritional security. Sustainable intensification with legumes has been proposed as a solution to address these challenges. Legumes such as groundnut (*Arachis hypogaea* L.) and pigeonpea (*Cajanus cajan* L.) potentially improve soil fertility and productivity of cereal crops grown in sequence through biological nitrogen fixation (BNF) and high-quality organic residues. However, successfully addressing smallholder farmer challenges requires understanding cropping system performance on-farm, in different environments. This is critical for site-specific agricultural technology recommendations that suit smallholder farmer goals.

This dissertation consists of three studies on sustainable intensification with legumes in maize-legume cropping systems in central and southern Malawi. A participatory research approach of researcher designed, and farmer-managed trials were used to evaluate legume and maize production, the economic feasibility of cropping systems, BNF contributions and effect of residue quality and quantity on soil N dynamics. In the first study, four cropping systems in on-farm experiments, in five locations from three agroecologies in central Malawi were used to compare intercrop diversity and rotational diversity. Above and belowground biomass was monitored to understand inter and intra-specific competition of pigeonpea and groundnut compared to the traditional maize/pigeonpea intercrop. This allowed for the determination of suitable cropping systems for smallholder farmers in terms of grain production and economic viability. The second study is an evaluation of on-farm nitrogen dynamics, including a detailed

assessment of BNF by plant tissue components of groundnut and pigeonpea within four legume-maize diversified cropping systems. The findings show that the net nitrogen balance with groundnut varied markedly, from deficit to a net benefit for subsequent crops, depending on growth and residue management. Another finding was that pigeonpea, especially when grown as part of a doubled-up legume system, provided substantial nitrogen inputs on rain-fed smallholder farms. The third study involved determining the effect of incorporating high- and low-quality and quantity of crop residues on mineral N dynamics and subsequent maize yield in southern Malawi. Findings show the actual crop residue biomass quantity and quality that smallholder farmers are capable of producing depending on their biophysical environment. Each of the three studies highlight implications for on-farm sustainable intensification with legumes to address various farmer goals in different environmental contexts.