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Abstract
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Understanding the changes in Maize canopy structure caused by Fall Armyworm (*J.E. Smith Spodoptera frugiperda*) using field hyperspectral spectroscopy measurements

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Maize (*Zea mays L.)* is one of Africa's most popular crops due to its importance as a staple food for the majority of the population. Recurring invasion of Fall armyworm (FAW, *J.E. Smith Spodoptera frugiperda*) caused significant damage to the maize canopy structure and affect maize yield and production. The physical damage caused by FAW varies depending on its larval stage. Superficie feeding can cause semi-transparent patches on the leaves known as 'papery windows'. The larva also causes crop damage by feeding on the leaf tissue and causing holes in the leaf, a common symptom of this pest. Monitoring the changes to maize canopy structure is central to food security and alleviating poverty. Therefore, it is of critical importance to monitor these changes. Studies have used traditional and remote sense-based techniques. Traditionally, direct field and laboratory measurements, which are spatially and temporally limited, costly, and time-consuming have been used to measure the biophysical changes that have been used by FAW. Whereas remote sensing (RS) techniques can be used to explain the spatial, spectral, and textural features of canopy structures in a cost-effective and timely manner. This study aimed to understand the effects of FAW infestation on maize canopy structure in Mpumalanga, South Africa, using field hyperspectral spectroscopy measurements and machine learning algorithm (random forest (RF)). These were used to classify and model the spectral behaviours of maize crop biophysical changes under FAW. Spectral measurements were also taken in the field to observe the spectral difference between the infested and non-infested maize crops. The study hypothesised that changes in canopy biophysical variables (e.g., leaf area index, stem and leaf length, and biomass) can be used to study the changes in maize canopy structure caused by FAW infestation using field hyperspectral spectroscopy measurements. The preliminary results from this study show that structural changes (e.g., leaf area index, stem and leaf length, and biomass) caused by FAW can be mapped with high accuracy using field hyperspectral spectroscopy measurements. This study underscores the significance of comprehending maize canopy structure alterations for two primary purposes: enhancing crop yield and optimizing agricultural production to ensure food security.

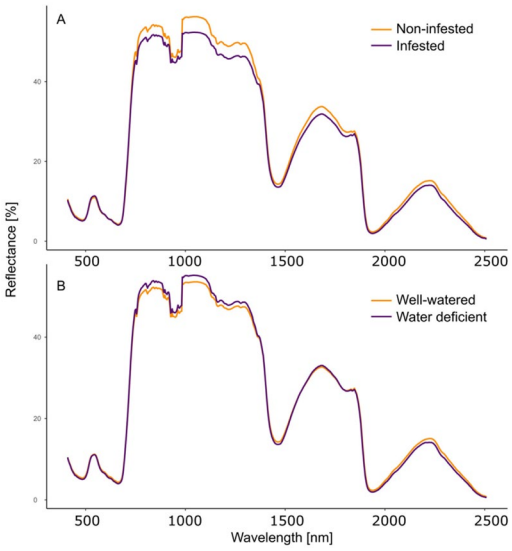

Figure 1: An example of the expected spectral reflectance: (**A**) non-infested and infested crops; (**B**) well-watered and water-deficient crops (Praprotnik et al., 2023; *agronomy)*.