SHORT COMMUNICATION

# PRELIMINARY STUDY ON SUGARCANE THRIPS (*FULMEKIOLA SERRATA*) DAMAGE DETECTION USING IMAGING SPECTROSCOPY

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## Abstract

In 2004, sugarcane thrips *Fulmekiola serrata* (Kobus) (Thysanoptera: Thripidae) was for the first time detected in southern African sugarcane. Since then it has become widespread in South Africa, and any control strategy would benefit from identifying and monitoring damage caused by this pest. Imaging spectroscopy is being investigated for this purpose, and is used in conjunction with space-borne remote sensing at regional and farm level. Hand-held devices are used at field or sub-field level. In this study, a hand-held field spectroradiometer was used at leaf level in the 350-2500 nm range of the electromagnetic spectrum. Reflectance spectra of thrips-damaged sugarcane leaves from varieties N19 and N12 were investigated. Significant differences in spectral reflectance were detected in leaves with increasing levels of thrips damage. Wavebands in the red edge region of the visible portion of the electromagnetic spectrum gave the highest significant differences. It is hypothesised that this could possibly be associated with thrips-induced chlorophyll and nitrogen deficiencies.

*Keywords:* sugarcane thrips; *Fulmekiola serrata*, Thysanoptera, imaging spectroscopy

## Introduction

First detected in South Africa in 2004, sugarcane thrips, *Fulmekiola serrata* Kobus (Thysanoptera: Thripidae), has now become widespread in the industry (Way *et al*., 2006). Any control strategy at field, farm or regional level would benefit from identifying and monitoring the damage caused by this pest, particularly ‘hotspots’. Adult and nymphs damage leaves in the leaf spindle; damage symptoms are visible on open leaves. Hence, thrips damage detection studies should investigate the open leaves of the sugarcane plant.

Imaging spectroscopy, or hyperspectral remote sensing, is a relatively new technology that entails acquiring data in narrow (<10 nm) spectral bands throughout the visible and infra red portions of the spectrum (Baltsavias, 2002). Data from hyperspectral sensors can be used in different aspects in agriculture. A recent review of applications in sugarcane was given by Abdel-Rahman and Ahmed (2008).

This paper describes the initial assessment of the feasibility of using imaging spectroscopy to detect thrips damage, using a hand-held field spectroradiometer at leaf level.

## Materials and Methods

Excised sugarcane leaves with different levels of thrips damage from different fields and farms in the Umfolozi mill area of the South African sugar industry were used in this study. Spindle leaves of 3-4 months old were taken from the sugarcane varieties N19 and N12. N19 samples (n=48) were visually categorised into four damage classes, namely undamaged, low, medium and severe. N12 samples (n=24) were categorised into undamaged, medium and severe classes, as it was not possible to differentiate between the low and medium classes in this variety. Relative reflectance data were measured from leaves using a spectroradiometer (FieldSpec® 3) that covers the 350-2 500 nm range of the electromagnetic spectrum. The fiberoptic cable of the spectroradiometer with a 1° field of view was pointed 0.1 m above the leaf samples to collect reflectance data on a clear sunny day between 11:00 am and 12:00 pm (South African local time). The data were analysed using one-way analysis of variance (SPSS, 2006) to test for significant differences in leaf mean reflectance in the samples.

## Results and Discussion

Figure 1 shows the mean reflectance spectra of sugarcane leaves as affected by thrips damage for wavelengths at which the reflectance differences between the thrips damage levels are significant ($P \leq 5\%$), i.e. in the visible region (400-700 nm) of the spectrum. The highest significant differences ($P \leq 0.1\%$) within the visible region are between 690 and 708 nm, which is within the red edge portion (690-720 nm) of the electromagnetic spectrum. These differences in leaf reflectance in the visible region are due to differences in pigment concentrations, which could be related to a decrease in chlorophyll concentration. The strong absorption feature in the visible region is chlorophyll, which absorbs violet-blue and red light for photosynthesis (see Kumar *et al*., 2003). The position of the inflexion point in the red edge region of the spectral reflectance signature has been used by Clevers and Jongschaap (2003) as a means of estimating foliar chlorophyll or nitrogen contents. Since there is a strong nitrogen-chlorophyll relationship (Nguyen and Lee, 2006), the highest significant differences in reflectance within the red edge region between different thrips damage levels could well be due to reduced leaf nitrogen levels as a result of thrips damage. This is confirmed by shifts in the inflection points between 675 and 700 nm in the data presented in Figure 1. The relatively higher reflectance between 725 and 750 nm associated with the healthy damaged leaves for variety N12 (Figure 1b) could possibly be explained by the slight differences in the ages of the leaves (3-4 months).

The results presented are a first step towards proof of the concept that imaging spectroscopy can be used to rapidly detect leaf damage caused by sugarcane thrips. Further work is recommended to investigate the feasibility of detecting sugarcane thrips damage at canopy level using hand-held and/or space-borne hyperspectral systems.

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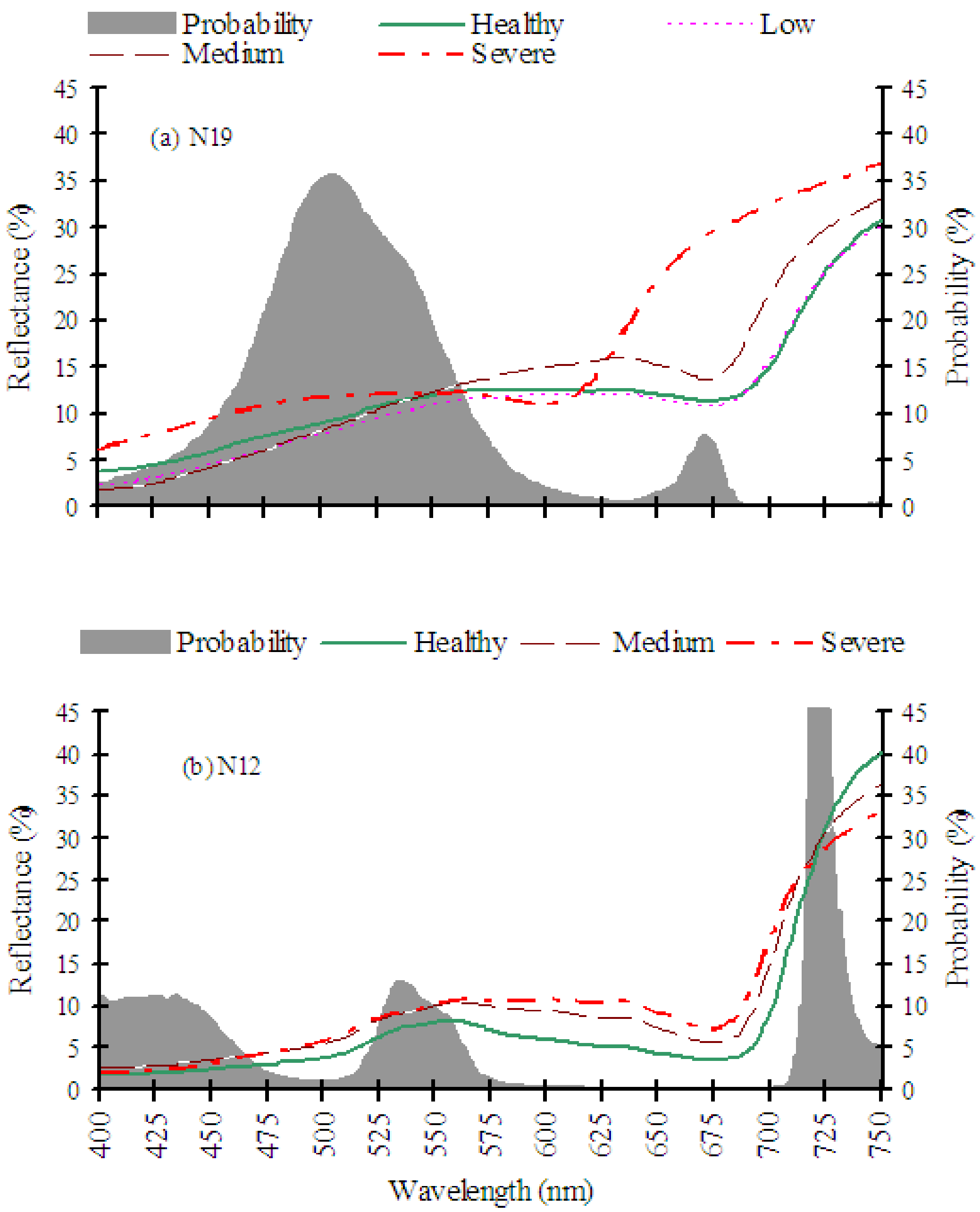


**Figure 1. Spectrum characteristics of sugarcane leaves at different *Fulmekiola serrate* (Kobus) (Thysanoptera: Thripidae) (sugarcane thrips) damage levels in (a) variety N19 and (b) variety N12, and results of one-way ANOVA showing wavelengths where reflectance differences between thrips damage levels are significant.**