



# Detection of rice sheath blight for in-season disease management using multispectral remote sensing

Zhihao Qin<sup>a,b</sup>, Minghua Zhang<sup>a,\*</sup>

<sup>a</sup>Department of Land Air and Water Resources, University of California, Davis, CA 95616, USA

<sup>b</sup>Institute of Agricultural Resources and Regional Planning, Chinese Academy of Agricultural Sciences, Beijing 100081, China

Received 22 August 2003; accepted 2 March 2005

## Abstract

Timely diagnosis of crop diseases in fields is critical for precision on-farm disease management. Remote sensing technology can be used as an effective and inexpensive method to identify diseased plants in a field scale. However, due to the diversity of crops and their associated diseases, application of the technology to agriculture is still in research stage, which needs to be elaborately investigated for algorithm development and standard image processing procedures. In this paper, we examined the applicability of broadband high spatial-resolution ADAR (Airborne Data Acquisition and Registration) remote sensing data to detect rice sheath blight and developed an approach to further explore the applicability. Based on the field symptom measurements, a comprehensive field disease index (DI) was constructed to measure infection severity of the disease and to relate to image sampled infections. In addition to direct band digital number (DN) values, band ratio indices and standard difference indices were used to examine possible correlations between field and image data. The results indicated that the broadband remote sensing imagery has the capability to detect the disease. Some image indices such as  $RI_{14}$ ,  $SDI_{14}$  and  $SDI_{24}$  worked better than others. A correlation coefficient above 0.62 indicated that these indices would be valuable to use for identification of the rice disease. In the validation analysis, we obtained a small root mean square error ( $RMS = 9.1$ ), confirming the applicability of the developed method. Although the results were encouraging, it was difficult to discriminate healthy plants from light infection ones when  $DI < 20$  because of their spectral similarities. Hence, it was clear that identification accuracy increases when infection reaches medium-to-severe levels ( $DI > 35$ ). This phenomenon illustrated that remote sensing images with higher spectral resolution (more bands and narrower bandwidth) were required in order to further examine the capability of separating the light diseased plants from healthy plants.

© 2005 Elsevier B.V. All rights reserved.

**Keywords:** Rice disease; Remote sensing; Sheath blight; Agriculture; Crop; Diagnosis

## 1. Introduction

Rice is an important crop worldwide and over half of the world population relies on it for food. Sustainable farming of rice depends on many factors including

\* Corresponding author. Tel.: +1 530 752 4953;  
fax: +1 530 752 5262.

E-mail address: mhzhang@ucdavis.edu (M. Zhang).