SPECTRAL DISCRIMINATION OF EARLY *Dchinochloa crasgalli* AND *Echinochloa crusgalli* IN CORN AND SOYBEAN BY USING SUPPORT VECTOR MACHINES

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ABSTRACT

This paper introduces a kind of multi-classification mode based on Support Vector Machines (SVM) and one-against-one-algorithm for weed seedlings (*Dchinochloa crasgalli*, and *Echinochloa crusgalli*) in corn and soybean fields. A handheld FieldSpec® 3 Spectroradiometer manufactured by ASD Inc., in USA was used to measure the spectroscopic data of the plant canopies within 350～2500nm wavelength in fields. The effective wavelength range for spectral data processing was selected as 350-1300nm and 1400-1800nm. Comparison of different kernel functions for SVM showed that higher precision was obtained by using 'Polynomial' kernel function with third-order. The accurate identification rates reached 80% and 85%, respectively for corn and soybean. By using of two-classification SVM model and one-against-one-algorithm voting procedure, a multi-classification model was set up for corn and soybean in fields. The accurate identification rates reached 80% for corn and 83.3% for soybean. The comparison of three-classification accurate rates for SVM, Neural Network (NN), and Decision Tree (DT) methods was done, which are 80% for SVM, 78% for NN, and 63% for DT. SVM achieved the highest correct classification rate.

Keywords: Weeds identification; Spectroscopy; Support vector machines; Corn; Soybean

INTRODUCTION

Weeds fiercely battle with crops for water and nutrients, which strongly disturbs the normal growth of crops and leads to yield reduction and quality deterioration. Weeds jeopardize nearly 40 million hm^2 of farmlands, causing an annual production reduction of 4 billion kilograms for wheat and 2.5 billion kilograms for corn (Li et al., 2007). The amount of herbicide consumed annually is nearly 470,000 tons, hours spent on weeding is about 2-3 billion working days and labors employed is 1/3-1/2 of the total agricultural labor force consumption (Li, 2003). In order to reduce costs and protect the environment, researchers carried on studies on the precise chemical application technology to precisely spray herbicide only on weeds (Deng & Ding, 2008). The key part of precise application is to correctly identify weeds (Geol et al., 2002). The advantages of spectral identification are quick response, real-time identification, simple structure,

low cost and easy commercialization (Slaughter et al., 2004).

In this study, the portable handheld FieldSpec® 3 Spectroradiometer manufactured by ASD Inc. in the US was used to measure the spectral data of plant canopy in the fields within the wavelength range of 350~2500nm and pattern recognition of Support Vector Machine (SVM) was applied in the spectral identification of weeds. The three-classification results for corn and weeds (*Dchinochloa crasgalli* and *Echinochloa crusgalli*) respectively using SVM, Neural Network (NN), and Decision Tree (DT) showed that the accuracy rate by using SVM is the highest.

RESULTS AND CONCLUSIONS

The bi-classification results between corn and weeds, and between soybean and weeds showed that SVM algorithm with polynomial kernel with third-order and quadratic optimization was the best by comprehensively considering the proportion of support vector and the correct recognition rate which is more than 80% for corn and 97.5% for soybean.

We used the third-order polynomial kernel function SVM and one-against-one three-classification to build the three-classification models for corn and weeds (*Dchinochloa crasgalli*, and *Echinochloa crusgalli*), and for soybean and weeds. The accuracy rates were 80% and 83.3%.

The three-classification correct rates for corn and weeds (*Dchinochloa crasgalli*, and *Echinochloa crusgalli*) by using SVM, Neural Network (NN), and Decision Tree (DT) were 80% for SVM, 78% for NN, and 63% for DT. It showed that the accuracy rate by using SVM is the highest.

Because the measurement in fields was influenced by a variety of external factors, such as the soil background, the illumination conditions, the impact of air temperature on the measurement equipment, and so on, this classification accuracy still indicated that SVM had promising perspective in weeds identification in various fields. The more, the SVM identification method requires fewer modeling samples which is a big advantage in field detection.

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