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# IDENTIFICATION OF VEGETATIVE INDICES AND BEST SPECTRAL BANDS FOR DIFFERENTIATING WEED AND CROP SPECIES.

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## Abstract

Site-specific crop management is becoming increasingly popular. Growers are beginning to utilize crop reflectance information from aerial imagery to schedule plant growth regulator and defoliant applications in cotton. By managing cotton on a site by site basis, growers can reduce chemical costs and decrease the number of trips across the field. Currently, aerial platforms that provide the imagery do not have the proper resolution or band width to correctly identify and separate weed species from the crop. The purpose of this study was to identify the best spectral bands and/or vegetation indices to correctly identify and separate weed and crop species.

Experiments were conducted at the Plant and Soil Science Research Center at Starkville MS, to evaluate the use of plant reflectance data to differentiate crop and weed species. The experiments were designed as a randomized complete block with 4 replications and repeated two years. Velvetleaf (*Abutilon theophrasti)* , redroot pigweed (*Amaranthus retroflexus*), johnsongrass (*Sorghum halepense*), broadleaf signalgrass (*Brachiaria platyphylla*), cotton (*Gossypium hirsutum*), and corn (*Zea mays*) were planted in $16m^2$ plots. Planted weed species were maintained free of other species and hyperspectral data were taken on two week intervals with an Analytical Spectral Device. Spectral data were taken from 350 to 2500 nanometers (nm) and the best band combinations were selected by HyperSpec, a program developed by Mississippi State University engineers. The best spectral bands for classification were selected by HyperSpec through supervised classification methods using a Best Spectral Band feature extraction and a nearest neighbor classifier. The top ten bands (710, 714, 716, 717, 720, 769, 772, 774, 1732, and 1741nm) selected by HyperSpec were analyzed further in SAS and reduced to 8 spectral bands. These bands, along with vegetation indices, were further analyzed through stepwise and linear discriminate analysis. The vegetation indices were calculated from discrete bandwiths corresponding with available airborne sensors. Bands selected were: Blue 440 to 460 nm; Green 540 to 560 nm; Red 640 to 660 nm; and Near Infrared 840 to 860 nm. The following vegetation indices were computed: Normalized difference vegetation index (NDVI); Green normalized difference vegetation index (NDVIg); Global Environmental Monitoring Index (GEMI); Near Infrared (NIR); Ratio vegetation Index (RVI); Anthocyanin Reflectance Index (ARI); Plant Sensing Reflectance Index (PSRI); Visibile Atmospherically Resistant Index (VARI); Chlorophyll Fluorescence Ratio (CF_685); and Chlorophyll Fluorescence Ratio (CF_735).

The computed indices and band widths were evaluated with a linear discriminate analysis technique, to categorize the dependent variable utilizing cross-validation procedures. Classifications from the 8 best spectral bands and 10 vegetation indices were compared collectively and separately. The highest classification of broadleaf signalgrass, johnsongrass, corn, cotton, pigweed and velvetleaf at 3 weeks after plant emergence (WAE) was accomplished by combining the 8 best spectral bands and the 10 vegetation indices which resulted in 85, 86, 97, 94, 97 and 93% respectively, in 2002. While the 8 best spectral bands alone provided decreased classification of 60, 75, 86, 85, 75, and 69% respectively. In 2003 the results were similar in that a combination of both indices and best spectral bands provided the highest classification accuracies (92, 83, 88, 100, 97, and 100% respectively) and a similar decrease was noted when the 8 best spectral bands or vegetation indices were analyzed separately. Classification accuracies were unchanged by 5 WAE with the exception of corn, which decreased in classification to 83% in 2002. Spectral profiles were also grouped over both years (2002 and 2003) and 3 sampling timings (3, 5 and 7 WAE). The results indicate an overall decrease in classification, however, the combination of vegetative indices and 8 spectral bands maintained the highest species classification of 74, 75, 60, 90, 84 and 85% of broadleaf signalgrass, johnsongrass, corn, cotton, pigweed and velvetleaf, respectively. These data indicate that best spectral bands for plant species classification can be identified and reduced to a viable number to determine ranges needed on multispectral or hyperspectral aerial platforms. These ranges could further be developed into vegetation indices to aid in weed and crop species classification and differentiation.