2003 BELTWIDE COTTON CONFERENCES, NASHVILLE, TN – JANUARY 6-10

USE OF MULTISPECTRAL IMAGERY FOR VARIABLE RATE "APPLICATION ZONE" IDENTIFICATION IN COTTON PRODUCTION

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Abstract

Historically, many farm management decisions have been made based on average conditions in a field. Recent advances in technology now provide new tools to vary the rate of agricultural inputs according to plant needs at a very fine scale. Researches have been trying to identify the correct management zones based on the variability in yield limiting factors within a field. Airborne near infrared imaging of crops at various stages of crop development can provide important spatial information concerning the establishment and development of crop plants. Spatial variations in crop vigor can be observed in near infrared wavebands and not in the visible wavebands. This spatial variability can be expressed in the yield map mainly in irrigated fields. The purpose of this study was the use of multispectral imagery for variable rate application zone identification in cotton production. The study was conducted during the period from 2000 to 2002 in West Tennessee in three farms fields whose total area was 150 acres. A Duncan's Camera was used to shoot the cotton fields obtaining multispectral pictures in the green, red and near infrared bands. The images had resolution of 0.5 to 1.5 m. The over flights matched with the cotton growth of 550^{DD60} for the years 2000 and 2001, and 750^{DD60} for the year 2002. The image analysis software ERDAS IMAGINE was used in the georeferencing process and to mosaic the images. Each field was classed into five productivity zones called low, low-medium, medium, medium-high and high zone via NDVI (Normalized Vegetation Index) classing by the SSToolbox software using an unsupervised classification procedure in the aerial image of a previous year. The SSToolbox was used as Geographical Information System. The DGPS NAVMAN was used to determine the coordinates of the points were the field data were collected. The DGPS was connected with a handheld IPAQ that contained specific software used in the precision farming called Farm Site Mate. The field data samples of the final plants maps were collected using standard total plant map methodology. The data were collected at eight sample points per each of the three productivity zones of low, medium and high zones of NDVI per field. The low-medium and medium-high NDVI classes were used as buffer zones. Each point sample had ten plants where the data were collected. The physical measurements sampled at each field point were: Stand Count, Height, Total Nodes and Total Bolls. SAS statistical software was used to perform the Tukey's Test. The comparison between NDVI classes for the year of 2001 and 2002 resulted in a good visual correlation for all fields that can be evidence for the fact that NDVI zones do not vary in place and shape from year to year. The statistical comparison resulted in correlation coefficients (R^2) of 0.53, 0.62 and 0.70. These correlations explain the consistence of the distribution of the NDVI zones across the years within the fields. According to the results, the comparison between stand in the cotton fields studied illustrated that this parameter was the same for all years as it was expected according to the conventional management that apply the same seed rate for the entire field. However, the height, total nodes and total bolls comparisons between averages of low, medium and high NDVI zones for the years of 2001, 2002 and 2001 and 2002 together demonstrated that the high NDVI zones have bigger height, more number of nodes per plant and more number of bolls per plant than the low NDVI zones. These results show that the high NDVI zones had cotton plants with more vigor than the low NDVI zones indicating that the Variable Rate Management of agricultural inputs can be applied. The relationships developed between NDVI and vegetation indices indicated that NDVI zones maps can be used to create management zones that will give profitable reduction of crop inputs when Variable Rate Technology is applied in cotton fields.