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RELATIONSHIPS BETWEEN NDVI AND PLANT PHYSICAL MEASUREMENTS

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Abstract

Airborne multispectral imaging system can provide fast data gathering over large areas and has the capability of collecting image data in very narrow and contiguous spectral bands through the visible, near infrared and mid-infrared regions of the electromagnetic spectrum with high spatial resolution. These data sets can be used either to monitor temporal changes in crops, for detecting abnormalities in the field or to estimate the final crop yield. The purpose of this work was the study of the relationships between NDVI (Normalized Vegetation Index) obtained by multispectral aerial images and ground plant physical measurements in three cotton fields managed by conventional and variable rate systems. Each field was classed into five productivity zones called low (L), low-medium (LM), medium (M), medium-high (MH) and high (H) zone via NDVI classing by the SSToolbox software using an unsupervised classification procedure in the aerial image of a previous year. The software SSToolbox was used as the Geographical Information System (GIS). One of the paired farm fields was applied the conventional management and on the other field was applied the Variable Rate Technology (VR). 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 spatial resolution of 0.5 to 1.5 m. The over flights matched with the cotton growth of 550^{DD60} and 750^{DD60} for the years 2001 and 2002, respectively. The image analysis software ERDAS IMAGINE was used in the georeferencing process and to mosaic the images. The Variable Rate fields received Variable Rate application of lime, pre-plant fertilizer, seeding, in-furrow fungicide, in-furrow insecticide, plant growth regulator, in-season insecticides and crop termination. The field data samples of the final plants maps were collected using standard total plant map methodology. The physical measurements sampled at each field point were: Stand Count, First Position Retention, Height, Total Nodes and Total Bolls. All height measurements were taken from the cotyledonary node to the terminal of the plant. Node counts were made from the cotyledonary node to the terminal of the plant with the cotyledonary node being designated as node zero. The comparisons between NDVI zones and first position retention, total bolls, total nodes, height and stand showed that the variable rate management system for cotton production resulted in improved plant physical properties as compared to a conventional cotton management system. It is likely the results of this study are associated with the interaction among all the management practices applied for each management system. The reduced seeding rate generally exhibited larger plants with more bolls as compared to the plants under conventional management having more space to grow with more soil resources available per plant. The described effect is further enhanced by the reduced level of Pix application, which allows for full expression of plant available resources. There were no observed negative effects associated with the reduced rates of Temik® and Ridomyl PC® in-furrow or in-season plant bug over sprays such as would be associated with either reduced stand or decreased plant vigor associated with seedling disease or thrips damage or lower boll retention associated with plant bug damage. The total reduction in crop inputs combined with improved plant parameters associated with improved yield would indicate that Variable Rate Cotton Production Systems which utilize multispectral image analysis for crop production zone creation are profitable and likely to have wide success in commercial cotton production in the Mid-South.