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CONSULTING FROM 12,000 FEET: THE USE OF MULTI SPECTRAL IMAGERY IN CONSULTING FOR INSECTS, DISEASES, PLANT GROWTH REGULATORS AND DEFOLIATION

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Abstract

Normalized Difference Vegetation Index (NDVI) (NIR-Red)/(NIR+Red) images were used as consulting tools on two North Mississippi farms in 2002. They were the farms of Mr. John McKee of Friars Point and the farms of Mr. Stan and Tripp Hayes of Clarksdale. Images were used to generate prescriptions from the field. These prescriptions were then applied geo-referenced. Nematicides, insecticides, plant growth regulators, and defoliants were all applied by ground as geo-referenced prescription applications. The application equipment was owned by either Mr. McKee or Mr. Hayes who made the applications to their own cotton. Approximately 8,455 acres of prescriptions were written, but not all were applied due to wet fields. In Time provided the images and software which allowed a very rapid turn around time from image acquisition to application of the subsequent prescriptions. Use of NDVI is a very usable tool for cotton consulting. Its use will cut input costs to the grower, and allow for more intense management of cotton crops in the field.

Introduction

Multi-spectral imagery has been used on cotton in the Mississippi Delta for at least 5 years. This technology has shown to have significant promise as a cotton production tool. Dr. Jeff Willers showed tarnished plant bug populations followed management zones produced by MVI images. Seal showed prescription insecticide applications using spatially variable insecticide (SVI) could significantly reduce insecticide costs for tarnished plant bug control. On the farms of Mr. John Mc Kee and Mr. Stan and Tripp Hayes in Coahoma County, MSI was used during the 2002-growing season.

Materials and Methods

John Deere High Clearance Sprayers applied all applications of insecticide plant growth regulators, or defoliants. NDVI images were supplied by In Time. The images were used to generate prescriptions used in nematode control, insect control, plant growth regulator use, and defoliant applications. The images were also useful in locating weedy and grassy spots in the fields. However no prescriptions were written for weed control.

Results and Discussion

Significant cost savings was realized in insecticides, mepaquat chloride, and defoliants. Due to heavy and frequent rains many prescriptions could not be applied. An unexpected benefit of the NDVI images was their use in mapping and locating infestations of root knot nematodes on the Hayes farms. There were areas of known root knot nematode infestation prior to the 2002 season, but the areas had never been geo-referenced, and were difficult to find from one season to the next. The Bennett Place of Mr. Hayes was sampled on a 5-acre grid in the fall of 2000. Fifteen per cent of the samples showed the presence of root know nematodes, but none were reported to be at treatment levels.

In May several spots in Mr. Hayes cotton began showing a slightly lighter green color than normal. This was true on the Bennett Place, Spendthrift, and Ellendale farms. There were several known root knot nematode spots on the Spendthrift farm, and they had been treated with five pounds per acre of Temik at planting. Nematodes were suspected when the lighter green shades if cotton were noted in the known nematode “hot spots”. Very close examination of the plant’s roots showed the presence of root knot galls and the beginnings of what looked like a Fusarium wilt problem. At this point the images were used to find other suspected locations of nematodes. For several days beginning about June1 the known spots of nematode infestation were side-dressed with 7.7 pounds of Temik per acre.

By the end of July several other spots of nematode infestation were found using the images. Our estimate of the infested acreage was from five to ten per cent of the total 3,300 acres of cotton. Fumigation for the problem would be a questionable economic proposition if applied on a broadcast basis. However, off-season treatment of the geo-referenced locations should

show a reasonable return on the fumigation treatment. Without the images the magnitude, location, and treatment of the nematode problem could not be done efficiently.

Dr. Jeff Willers has shown the distribution of tarnished plant bugs to follow the NDVI maps. Using Dr. Willer's approach we were able to use the images to write prescriptions for tarnished plant bug control. This was the most difficult part of the technology to become comfortable with. To be on the conservative side spray thresholds of two per cent or one tarnished plant bug captured per 50-sweep count were used as the treatment threshold. In the first field where a prescription was written for tarnished plant bug control three hours was spent by myself and four scouts with GPS units and sweep nets before we could be comfortable with the prescription.

Sweep net samples were taken in many locations in the field in each of the 7 management zones. When the determination was made as to which zones were to be treated plants were then mapped. In the zones treated and the not treated the difference was two more main stem nodes and 3-4 inches in height in the treated vs. non-treated cotton. A savings in chemical costs from this application was approximately 70% based on the maximum rate applied broadcast rather than geo-referenced.

On the Bess Place Farm of Mr. Hayes the NDVI images were used to cut costs on tobacco budworm applications in early July. The cotton variety was Stoneville 457 which is conventional cotton. When eggs were found they were determined to be 100% tobacco budworms using the AgDia test kit. Using the images it was possible to determine where the populations were above threshold and write a prescription for treatment. Zones 4,5,6 and 7 were treated for tobacco budworms and zones 1,2, and 3 were not treated. This amounted to approximately 40% savings in insecticide cost.

Also on the Bess Place one corner of one field was found to have a 2 spotted mite population. A prescription was written to treat these mites giving a 150-foot buffer zone of treated cotton around the population. Approximately 7 acres were treated which was the only mite application on the Hayes Farm in 2002.

Use of the NDVI images proved to be very useful in 2002 in the application of mepaquat chloride or Pix. Because of the frequent and heavy rains the Pix rates and total amounts used were very high. However, being able to use varying rates was able to reduce costs considerably while using very high rates on the rankest cotton. On the Martin, Fairview and Cruder Farms of Mr. Hayes prescriptions were applied using mepaquat chloride. The prescriptions were written from July 1 images on a field by field basis and are shown as Table 1.

Heavy rains showed these rates not to be adequate, but were high enough to insure that none of the cotton was allowed to get excessively tall or rank. Many mepaquat chloride applications had to be made by air and were put on the whole field due to excessive rains. Could these applications have been put on by prescription by air or more fields covered by ground greater savings in mepaquat chloride could have been realized.

Defoliation also proved to be difficult on the 2002 crop due to the rains. Defoliation showed great promise when done by prescription using NDVI. As rates of defoliant were changed only by changing water volume it was possible to put very high water volumes on the more rank cotton, less water on the less rank cotton, and still defoliate all the cotton with one application.

The Wheatland field of McKee Farms was defoliated on September 30 by prescription written from the September 23 image. The prescription was applied as shown below in Tables 2 and 3. This cotton defoliated very well with one application, and was more cost effective than the non-prescription defoliation done on the same farm at the same time.

On the Little Texas Field on the Bennett Place of Mr. Hayes a prescription was written for defoliation from the September 23 images. Dropp and Prep were used with rates of application from 1 pound per 7-10 acres, and Prep 1 gal. per 6-7.8 acres. Defoliation was complete with one application. Key to the success is using spray volumes of at least 20 gap on the harder to defoliate spots in the fields.

Use of MDVI was not without problems. With the GPS unit located on the top of the cab of the John Deere spray machine it is forwards of the spray boom by several feet and crosses the geo-referenced field boundary prior to the spray boom. Crossing the field boundary cuts off the spray and can leave gaps of row ends unsprayed. Also as the machine turns the end of the spray boom away from the direction of the turn moves very fast and the end of the boom in the direction of the team moves very slowly causing differences in application rates.

Software, hardware and GPS problems were encountered during the process of trying to use the technology. However, having a hard copy map of the field images allowed the work to continue. With hard copy maps use of the hand held computer and the GPS systems was not mandatory.

Due to cloudy weather images could not be obtained exactly when desired, but rather when proper maps could be made due to the weather. This may be a problem in certain circumstances in the future, but in 2002 it never became a serious problem. Airplanes flew and images were made on a 6-10 day schedule as the weather allowed and this was found to be adequate for our needs.

Conclusions

Use of MDVI technology proved to be economically viable in the production of cotton in the North Delta of Mississippi. In 2002 prescriptions were written for site-specific applications of insecticides, plant growth regulators and defoliants. In most cases a financial savings was made due to lower input costs. However changing rates of chemicals sprayed across a field due to plant variability made for a much more efficient use of the chemicals. More efficient use of the chemicals tended to make their use more efficatious. Insecticides were applied based on the MDVI images successfully. However, there are many questions that need to be answered. What is the effect on predator, parasite, and prey relationships within a field that is only partly treated with insecticide? Do the predators and parasites readily enter the sprayed portions of the field? Can these increased numbers of predators and parasites be measured to the extent that treatment thresholds can be changed and further insecticide cost savings realized? Some means for treating row ends is needed when applying a prescription. This is not a serious problem, but needs to be addressed. It is my opinion that a separate row end treatment will probably be necessary to get the uniformity desired across entire fields.

References

Willers, J.L. and D.C. Atkins. 2000 Sampling for Plant Bugs (Heteroptera: Miridea) in Mid-South Cotton. Southwest Entomologist.

Seal, M.R., 1999. Precision Insecticide Research Shows Potential Input Savings. Crop Decisions, October 14-15.

Table 1. Prescriptions for mepaquat chloride (Pix) written from July 1 2002 images on the Martin Fairview and Cruder Farms of Mr. Hayes.

Farm	Zones	Mepaquat chloride rate
Fairview and Cruder	1, 2, 3	0
	4, 5	8 ozs/acre
	6, 7	12 ozs/acre
Martin	1, 2	0
	3, 4	8 ozs/acre
	5, 6, 7	12 ozs/acre

Table 2. Concentration rates for the defoliation chemicals and the high, low and average prescription rates used on the Wheatland field of McKee Farms.

Defoliation chemical	Concentration Rates	High	Low	Average
Dropp	0.00667 # / gal	1# / 7.5 ac	1# / 15 ac	1# / 10 ac
DEF	0.41 ozs/gal	1 oz / 15.75 ac	1 gal / 31.5 ac	1 gal / 21 ac
Prep	1.42 ozs/gal	1 oz / 4.5 ac	1 gal / 9 ac	1 gal / 6 ac

Table 3. Prescription rates applied on the Wheatland field of McKee farms for each zone.

Zone	Spray volume
1	10 gal/acre
2	12 gal/acre
3	14 gal/acre
4	15 gal/acre
5	17 gal/acre
6	18 gal/acre
7	20 gal/acre