2002 BELTWIDE COTTON CONFERENCES, ATLANTA, GA – JANUARY 8-12

CLASSIFICATION OF PLANT GROWTH REGULATOR TREATMENTS USING MULTISPECTRAL AND HYPERSPECTRAL REFLECTANCE DATA

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Abstract

Cotton management often involves field scouting to determine when, where, and how much plant growth regulator (PGR) to apply. This study was conducted to determine the capability of remote sensing to discriminate differences in cotton growth and physiology due to applications of either mepiquat chloride or mepiquat pentaborate ranging from 0 to 36 oz per acre. Remote sensing data comprised (1) airborne multispectral imagery at 540, 695 and 840 nm in 20 nm-wide wavebands using ITD Spectral Visions RDACS system, and (2) *in situ* hyperspectral leaf and canopy reflectance measured in 5-nm wide wavebands between 350 and 950 nm using GER 1500 Spectroradiometer. Moderate rates of PGR decreased plant height, but did not affect plant spectral properties. For the 36 oz treatment, multispectral data indicated significantly ($P<0.05$) less reflectance in the near-infrared (NIR) region at 840 nm and lower values for NDVI [(R840-R695)/(R840+R695)], as compared to controls. The 36 oz rate also led to greater chlorophyll, K, Ca, Zn, and Mn in leaves. Except for significant treatment difference in blue wavebands (370-420 nm), discriminate analysis of *in situ* leaf and canopy reflectance agreed closely with wavebands obtained from multispectral data. Remote sensing was unable to delineate vigorously growing cotton from plants that received 8-16 oz PGR per acre. While wavelengths, and therefore radiances, in the three spectral channels of the RDACS airborne multispectral imagery appeared adequate for differentiating large difference in PGR rate, our data suggest the need to consider additional reflectance wavebands or vegetation indices to detect levels of PGR encountered in the field.

Acknowledgements

The authors wish to acknowledge NASA Commercial Remote Sensing Program (CRSP) and MSU Remote Sensing Technology Center (RSTC) for their support and administration in acquiring the airborne imagery.

[1]Mention of a trademark or proprietary product is for information purposes only and does not constitute an endorsement or recommendation of the product or vendor by the USDA-ARS or MAFES

References

J.T. Cothren and D.M. Oosterhuis, "Physiological Impact of Plant Growth Regulators in Cotton." In Proceedings of the Beltwide Cotton Conference, ed(s) National Cotton Council, pp. 128-132, 1993.

Y.L. Grossman, S.L. Ustin, S. Jacquemoud, E.W. Sanderson, G. Schmuck and J. Verdebout. 1996. Critique of Stepwise Multiple Linear Regression for Extraction of Leaf Biochemistry Information from Leaf Reflectance Data. Remote Sens. Environ. 56: 182-193.

J. R. Jensen, Remote Sensing of the Environment: An Earth Resource Perspective. Prentice-Hall, Inc., Upper Saddle River, NJ, pp. 333-377, 2000.

D.J. Munier, B.L. Weir, S.D. Wright, and T.A. Kerby, "Applying Pix at Variable Rates when Plant Height Varies in a Cotton Field." In Proceedings of the Beltwide Cotton Conference, ed(s) National Cotton Council, pp. 1206-1207, 1993.

T.P. Wallace, B. W. White, C. E. Snipes, and P. M. Bourland, "Evaluation of Single and Multiple Applications of Pix in Mississippi." In Proceedings of the Beltwide Cotton Conference, ed(s) National Cotton Council, Las Vegas, NV. p. 650, 9-14 Jan. 1990.

D. Zhoa and and D. Oosterhuis. "Physiological, Growth and Yield Responses of Cotton to Mepplus and Mepiquat Chloride." In Proceedings of the Beltwide Cotton Conference, ed(s) National Cotton Council, Orlando,FL, p. 599-602, 3-7 Jan. 1999.

Table 1. Pix Treatments for Study I and Study II.

Study	Sequential Pix treatments	Dates applied	Total L ha^{-1} (oz ac^{-1})	
I	Control (No mepiquat penta-borate)	----------	0	(0)
	580 ml/ ha applied 2 times	10 and 24 July	1.16	(16)
	290 ml/ ha applied 4 times	20 June; 3, 14 and 28 July	1.16	(16)
	880 ml/ ha applied 3 times	3, 14, and 28 July	2.64	(36)
II	Control (No mepiquat chloride)	----------	0	(0)
	580 ml/ ha applied 5 times	5, 16, 23 and 30 July; 9 Aug.	2.90	(40)

Table 2. Effects of Pix Treatments on Plant Growth and Leaf Area.

Date	Pix	Height (cm)	Nodes	Leaf Area (m^2 m^{-1} row)
Study I				
July 26	No	94.8 a[1]	18.3 a	2.05 a
	Yes	65.8 b	16.7 b	1.57 a
Study II				
July 21	No	91.7 a	17.2 a	-----
	Yes	78.3 b	15.8 b	-----
Aug 10	No	113.6 a	20.9 a	-----
	Yes	88.2 b	19.4 b	-----

[1]Means within a column followed by a different letter are significantly different according to Fisher's protected F test at P< 0.05.

Table 4. Mean DN and NDVI Values from Areas of Interest in Replicated Plots With No Pix and Plots with Sequential Applications of Pix.

Imagery Date	Pix	540 nm (green)	695 nm (red)	840 nm (NIR)	NDVI
Study I					
July 22	No	108.6	93.1	212.5	0.390
	Yes	121.1	114.5	190.5	0.247
	Pr > F	0.004	0.001	0.019	0.002
July 28	No	84.1	80.6	173.7	0.365
	Yes	84.9	75.4	149.2	0.328
	Pr > F	0.91	0.062	0.001	0.030
Study II					
July 14	No	107.7	106.6	174.3	0.238
	Yes	108.3	110.5	164.8	0.194
	Pr > F	0.87	0.52	0.37	0.402
July 28	No	81.7	98.8	200.4	0.338
	Yes	81.7	96.0	187.2	0.319
	Pr > F	0.97	0.002	0.121	0.343
Aug 12	No	102.6	91.6	215.4	0.403
	Yes	102.6	95.6	202.9	0.359
	Pr > F	0.99	0.033	0.070	0.038