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SPATIALLY VARIABLE APPLICATION OF PLANT GROWTH REGULATORS AND DEFOLIANTS BASED ON REMOTE SENSING

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Abstract

Remotely sensed imaging offers great potential as a method to base variable rate sprays of plant growth regulators (PGR) and defoliants. Normalized Difference Vegetative Index or NDVI is most often used as a method of remotely sensing plant vigor. Initially, images obtained are multi-spectral images that capture data in the green, red and near infra-red wavelengths. These images can be obtained from either a satellite or from an aircraft equipped with a multi-spectral camera. NDIV is then calculated as a ratio of light intensity in the near infra-red wavelength to the light intensity in the red wavelength. This ratio provides a relative measure of plant biomass. NDVI values are thus used as the basis for changes in rate structures of PGRs and defoliants. Little research has been conducted to evaluate variable rate applications of PGRs or defoliants, presumably because the intuitive relationship between NDVI and rate structure needs for PGRs and defoliants. Most research in this area defiantly indicates that PGR and defoliant rates can be varied without significantly impacting lint yield or quality. There are, however, limitations to NDVI images such as equal distribution of class data within the image and difficulty obtaining cloud free images. Equal distribution of class data within an NDVI means that comparisons cannot be made from field to field or on a single field over time. Research and demonstration with variable rate PGRs based on NDVI indicates that little reduction in PGR use when the grower is given the option of varying PGR rate. Growers/consultants tended to select a variable rate structure where the average use rate is similar to the rate that the grower/consultant would have used had a broad cast application been applied. Thus, when given the opportunity to make a variable rate application the producer has opted to apply a higher rate on areas with a high NDIV and a lower rate on areas with a low NDVI in comparison to the rate of PGR selected when a broadcast application is applied. Research with variable rate applications of defoliants based on NDVI indicates defoliant savings from 0 to 40% of the cost of defoliant without significant impact on lint yield or quality. The savings range is directly related to the amount of in-field variability. The 40% reduction in defoliant cost only occurred when in-field variability was extremely high (30% to 95% open bolls with considerable natural defoliation occurring) and multiple defoliant applications were made. Savings of 20 to 30% (approximately $4.00/acre) reduced defoliant costs have been common for most variable rate defoliation application. Evaluations of variable rate defoliation applications in California have indicated little in-field variability, thus no significant savings on defoliant cost using variable rate applications based on NDVI. Current application technology is such that variable rates are achieved by varying the volume output from the spray equipment. Pump capacity thus limits the variable rate applications because of a maximum output rate and speed of rate change. Application error rates are increased as the complexity of the prescription increases. Future work with variable rate applications will probably include studies that have an initial prescription basis in the historical yield and studies of new remote sensing technology such as hyper-spectral imaging. Advances in application technology will also occur. Advances such as injection systems are already available for ground based sprays and should become available for aircraft in the near future.