USING INFRARED PHOTOGRAPHY AS A TOOL FOR REPLANT DECISIONS AND HERBICIDE APPLICATION DECISIONS

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Abstract

Infrared photography was evaluated as a tool to make replant and weed control decisions. Infrared emphasizes the plants that are alive. This is needed for making a replant decision and also for determining the need for weed control. Decisions need to be made quickly, so film development time is critical. Infrared color film with the use of only a yellow filter produces a photo that has bright red live plant tissue and all other colors are muted. Digital photography eliminates virtually all of the development time by allowing the photos to be processed in the field on a laptop computer. With only two steps, changing hue and saturation can modify photos. The photos are then ready for interpetion for making replant and weed control decisions. This technique can be a valuable tool for producers, consultants, seed companies, extension personnel and chemical companies.

Introduction

Early in the growing season, a young cotton crop is vulnerable to many hazards such as sand blasting, hail and seedling diseases. When observing fields it is easy to see that much of the crop is dead or dying. What is important is what is still alive. These plants are the crop of the future. Dead plants are a thing of the past. Many producers want to replant when there is an adequate plant stand. After herbicides are applied it is natural to observe the dead weeds. Again what is important is what is alive. The dead and dying plants are history. Very small weeds are not easily observed and it is critical that these are sprayed before the fifth true leaf stage of the cotton crop when *Roundup Ready* varieties are planted. Aerial and satellite infrared photography has been used to evaluate crop conditions for many years. However these are unsatisfactory for making replant decisions. Barry Bean, being an amateur photographer found that certain special effects were observed using infrared photography from only a few feet away from the crop and had potential for evaluation of crop condition. The slow development time for infrared film development was a problem since replant and weed control decisions need to be made immediately. If a digital camera could be used, the photos could be loaded into a laptop and modified. Then replant or weed control decisions can be made immediately while in the field.

Materials and Methods

Olympus OM2000 single lens reflex cameras with a twenty-eight mm F2.8 lens using thirty-five mm film was used. Three Kodak film types were used: Ektachrome Professional Infrared EIR, High-Speed Infrared black and white negative, and Elite chrome. Small plants, cotton and weeds were photographed using cameras mounted on a three-foot tripod with cameras loaded with each of the film types using a series of filters, shutter speeds and f stops. Filters used were Schneider E+W infrared 093 and 092. Other filters used were Hoya yellow (K2), orange (G), green (X-1), red (25A) and polarizing (CIR). Film was developed using a Rapid E-6 home processing kit manufactured by Unicolor. Temperature of the water bath was regulated with a CPM model 800 water temperature control.

A Sony Digital Mavica MVC FD73 camera was also evaluated using the same filters used on the SLR camera. The camera uses a 3.5-inch floppy diskette. The digital photographs were modified using the Sony software supplied with the Sony camera and Photoshop 6.0 by Adobe. The Sony Mavica camera can see infrared light whereas some cameras have built in filters that filter out infrared light. This was determined by pointing a hand held TV remote control at the camera and observing the red dot on the viewfinder. Hue and saturation were adjusted in two steps to achieve the desired effect.

Results and Discussion

The recommended ASA speed of Kodak Ektachrome Professional Infrared EIR film is 200, however we found that 360 is better for our purposes. The exposure was better at this ASA film speed setting regardless of filters used. The special effect we needed was to show live tissue in sharp contrast to dead tissue or soil. The yellow (K2) filter was superior to any of the other combinations. It would be expected that the 092 or 093 filters that admit only infrared light would be superior. The yellow filter gave a very red color to the green tissue and the rest of the photo is muted. It greatly emphasized the live tissue. We found that the film is sensitive to temperature during development. The temperature must be closely monitored.

The Kodak High-Speed Infrared black and white negative film did not emphasize the live tissue. At any exposure or combination of filters, the photos were not suitable for this use.

The color film produces very desirable colors but the delay between exposure and being able to evaluate the photos is at the minimum a few hours when developed in a home lab or several days when developed in a commercial lab. It is much more desirable to evaluate photos while in the field. The digital camera would eliminate this problem by eliminating the development time. Photos with filters, even yellow and infrared and yellow did not give the desired effect. Photoshop 6.0 was used to modify unfiltered photos and satisfactory results were found. It was then decided to use the software that was supplied with the camera. This proved to be easy to accomplish by adjusting the hue and saturation. First the hue must be adjusted to seventy-five and the saturation set at 100 percent. This photo must be saved and then modified again. In the second step the hue must be adjusted to 143 and the saturation again set at 100 percent. These adjustments will color the green tissue bright red and the background colors will be blue. This can be easily accomplished in the field in a vehicle.

It was not determined if the higher infrared reflectance of live tissue or manulipition of green color is the cause of the red color in the final photos.

Summary

Color infrared film produced a very desired contrast between live tissue dead tissue in cotton or weeds and everything else when used with only a yellow filter and without an infrared filter. Developing temperatures must be monitored very closely. The black and white infrared film was unsatisfactory for producing the desired effect. A problem with the film is the delay between exposure and finished print or slide.

Digital photography can emphasize the live tissue with proper color manipulation of the photos. This requires two separate steps and can be done in the field with a laptop computer. It did not require special software other than the software supplied with the camera. However we did not use software from other camera manufacturers.

This technique can be a useful tool for producers, chemical companies, seed companies, crop consultants and extension personnel.

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References

Fitzgerald, G.J., and S.J. Maas. 2000. Comparison of Remotely Sensed Imagery Acquired with Infrared Film and Digital Cameras. Agronomy Abstracts pp. 15.

Maas, S.J. 1988. Using Satellite Data to Improve Model Estimates of Crop Yield. Agronomy J. 80:655-662.

Maas, S.J. and J.R. Dunlap. 1989. Reflectance, Transmittance, and Absorptance of Light by Normal, Etiolated, and Albino Corn Leaves. Agronomy J. 81:105-110.

Plant, R.E. Munk, D.S., Roberts, B.R., Vargas, R.L., Rains, D.W., Travis, R.L., and R.B. Hutmacher. 2000. Relationships Between Remotely Sensed Reflectance Data and Cotton Growth and Yield. Transactions of the American Society of Agricultural Engineers 43:(2): 0.

Read, J.J., Tarpley, L., McKinion, and K.R. Reddy. 2000. Hyperspectral Reflectance Properties for Remote Detection of Nitrogen Stress in Cotton. Agronomy Abstracts pp. 125.

Staggenborg S.A. and R.K.Taylor. 2000. Predicting Corn Yield with Sparsely Collected Infrared Images. Agronomy Abstracts. Pp. 140.

Figure 1. Photo with infrared film and yellow filter.

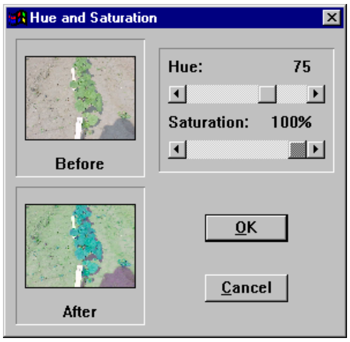

Figure 3. First step changing hue and saturation.

Figure 2. Digital photo of cotton and weeds.

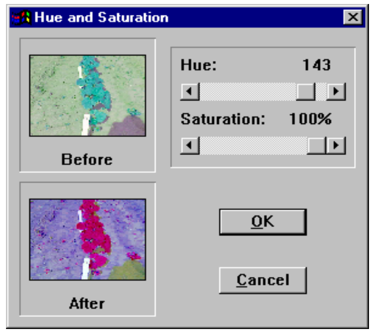

Figure 4. Second step changing hue and saturation.

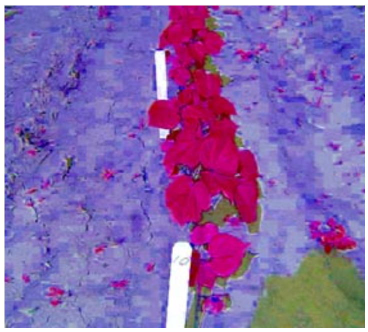

Figure 5. Modified photo.