

USING A DIGITAL CAMERA TO DETERMINE SURVIVAL OF COTTON SEEDLINGS AND EARLY EXPRESSION OF BRONZE WILT

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Abstract

Digital photography is a new tool that can be used for making crop production decisions quickly. Live tissue reflects more infrared light than dead tissue. This can be observed using infrared film with a yellow filter. The live tissue is red and the rest is a blue or a very muted color. Replant decisions must be made quickly and infrared film can take as much as a week to be processed. Decisions need to be made quickly, so film development time is critical. A digital camera virtually eliminates all of the development time by allowing the photos to be processed in the field on a laptop computer. A photo that mimics an infrared photo can be seen within five minutes. With only three or less steps, changing hue and saturation each time, the photos can be modified to produce the desired result, which takes less than 5 minutes. The photos are then ready for interpretation so replant decisions can be made. The healthy tissue is a bright red. Plants that appear healthy to the eye can be observed in the photos to have a problem since they will not have a bright red color. This can be seen as much as a week before death of the plant. Early determination of bronze wilt can also be observed with a modified digital photograph. Diseased plants have a higher leaf temperature and will be a brighter red in the photos. This photography 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. The surviving plants are what need to be evaluated, they are the crop of the future. The dead plants are history. Many producers want to replant when there is an adequate plant stand. Aerial and satellite infrared photography has been used to evaluate crop conditions for many years; however these are unsatisfactory for making replant decisions because of distances involved. Barry Bean, being an amateur photographer found that certain special effects were observed using infrared photography and a yellow filter. Photographs made only a few feet away from the crop had potential for evaluation of crop condition. The slow development time for infrared film development was a problem since replant decisions need to be made immediately. If a digital camera could be used, the photos could be loaded into a laptop and modified in the field and a decision made immediately. Bronze wilt is very difficult to determine early in the season. Leaf angle and subtle changes in leaf color are the only visible symptoms. Leaf temperatures are one to nine degrees higher than unaffected plants. Infrared film should be able to illustrate this and possibly could be seen using a digital camera.

Materials and Methods

A Sony Digital Mavica MVC FD73 camera was used. The camera uses a 3.5-inch floppy diskette. The digital photographs were modified using the Sony software, ArcSoft PhotoStudio, supplied with the Sony camera and Photoshop 6.0. The Sony Mavica camera can detect infrared light whereas some cameras have built in filters that eliminate infrared light. This was determined by pointing a hand held television remote control at the camera and observing the red dot on the viewfinder. No filters were used in making the photos. Using the Sony software the photos were enlarged and cropped with the hue and saturation modified.

In early planted cotton three row feet was photographed each week to determine surviving plants. Using Photoshop 6.0 hue, saturation, and lightness were adjusted in the master along with yellow green to achieve the desired effect. The master settings are 70 hue, 75 saturation, and 0 lightness. The yellow is -100 hue, 0 saturation, and 100 lightness. The green is 135 hue, 50 saturation, and 0 lightness.

Late in the growing season fields were beginning to show early symptoms of bronze wilt and these were photographed. Leaf wilting, change in leaf angle and very slight changes in the shade of green are the earliest symptoms. It is difficult to make a positive identification early before squares drop. The photos were taken at the first sign of wilt development. The photos were modified by changing the hue in two steps with ArcSoft PhotoStudio. In the first step hue was at 75 and 100 percent saturation. In the second step the hue was set at -136 and saturation at 75 percent.

Results and Discussion

Photoshop 6.0 was used in the original work to modify unfiltered photos and satisfactory results were found. It was then decided to use the software that was supplied with the camera. Photo modification using the software supplied with the Sony camera

proved to be easy to accomplish by adjusting the hue and saturation. First the hue was adjusted to seventy-five and the saturation set at 100 percent. This photo was saved and 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. Changing hue changes the colors shown on a color wheel. With the Sony software the wheel is measured in degrees going either clockwise for a positive number or counter clockwise for a negative value to a maximum of plus or minus 180. Some software uses one turn around the color wheel to be 100 (one unit is equal to 3.2 degrees). The same result as in the first example can be achieved by changing the hue to a negative 142 and saturation to 100%. Save this and modify by changing the saturation again to 75. Changing the saturation twice is necessary to achieve the proper amount of color, the red needs to be very bright in order to emphasize the live tissue. The amount of color is controlled by modifying the saturation. Zero saturation is black and white and 100 percent is maximum color. This can be easily accomplished in the field using a laptop computer.

A superior photo modification was found by using Photoshop 6.0 and using a three step process where the hue, saturation and lightness are modified followed by modification of the yellow and green colors. Unhealthy leaves have little red coloring and in photos made a week later were found to have died. Before modification the sick leaves had enough green color to appear to the eye that they would live.

In a field with the beginning development of bronze wilt the diseased plants were much easier to identify using the bright red color in the modified photographs. The original photos were modified by using ArcSoft and changing the hue in one step and the saturation in two steps.

No special filters are needed for the camera.

Seeing the red dot from the television remote in the viewfinder implies that the infrared light is modified in the camera to a visible red light. Therefore the infrared reflected by plants should be changed to a red but must be masked by other colors. It was not determined if the higher infrared reflectance of live tissue or manipulation of green color is the cause of the red color in the final photos however the desired effect was achieved.

Summary

Digital photography can emphasize the live tissue with proper color manipulation of the photos, which will aid in making a replant decision and identifying bronze wilt. This requires three or less separate steps and can be done in the field with a laptop computer. Diseased plants can also be identified early. ArcSoft and Photoshop 6.0 were the only software needed.

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

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Figure 1. Seedling cotton.



Figure 2. Seedling cotton with modification.



Figure 3. One week later without modification.



Figure 4. Bronze plant.

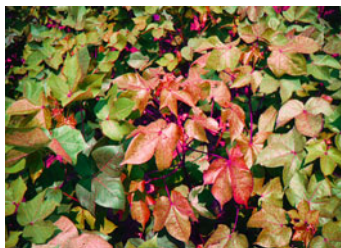


Figure 5. Bronze plant modified.