EVALUATION OF COTTON GENOTYPES PERFORMANCE USING GROUND-BASED REMOTE SENSING

Juan A. Landivar
Carlos J Fernandez
Texas A&M AgriLife Research and Extension Center
Corpus Christi, TX
Ruixiu Sui
USDA ARS Crop Production Systems Research Unit
Stoneville, MS
Clinton W. Livingston
Texas A&M AgriLife Research and Extension Center
Corpus Christi, TX

Abstract

The efficiency of a genotype to produce carbohydrates is a function of solar radiation intercepted by its canopy and the capability of the foliage to assimilate this energy for photosynthetic production. Our working hypothesis is that breeding progress can be achieved by screening for the efficiency of genotypes to capture sunlight and assimilate this energy. The purpose of this study is to identify the highest yielding cotton genotypes in a large cotton cultivar test conducted in Corpus Christi, Texas using a ground-based remote sensing system.

Sensors used in this ground-based platform include an ultrasonic sensor, mounted at 60 in above the soil surface (used to determine plant height) and a multi-spectral optical sensor used to estimate Normalized Difference Vegetation Index (NDVI). Plant height is an important component of canopy cover and interception of solar radiation. NDVI is a parameter that takes into account the amount of infrared reflected by plants. Healthy vegetation reflects very well in the near-infrared part of the electromagnetic spectrum. We used plant height and NDVI measurements to derive a canopy efficiency term (CanEff) using the following relationship; CanEff = 1.12*(height/row space)*NDVI; where height is the plant height measured by the system, row space was 100 cm and NDVI estimated as (IR-R) / (IR+R) (IR=normalized near-infrared and R normalized Red part of the electromagnetic spectrum).

The analysis showed that eliminating observations displaying CanEff values in the lower 20% range would reduce the number of entries from 136 to 74. Then, selecting observations in these 74 plots only with CanEff values in the 20% highest range would further reduce the number of selected entries to 29. This screening criterion increased the yield mean from 1006 lbs. of lint per acre in the original population (136 entries) to 1112 lbs. in the selected 29 entries (10.5% genetic gain). Although this genetic gain is noteworthy, it is possible to improve these results by the use of plant height elongation rates or changes in NDVI estimations from consecutive sampling dates.

The study indicated that the use of remote sensing technology can help plant breeders select desirable genotypes. The technique allows for a rapid screening of large number of genotypes. The study also demonstrated that development of hardware is ahead of evaluation and data processing tools. We recommend cotton agronomist to focus on sensor selection to fit the research objectives and the development of data analysis and visualization tools.