MODELING PLANT N STATUS AND LINT YIELD OF SAN JOAQUIN VALLEY COTTON

B. A. Roberts, R. R. Favreau, F. B. Fritschi, R. B. Hutmacher, D. W. Rains and R. L. Travis
University of California, Davis

Introduction

The current interests in expert system management tools for cotton production has also rekindled interest in using cotton physiological models for regional yield predictions and as extension educational tools. The physiological crop models developed for cotton yield prediction were developed in the Mid-south. There has been little effort in testing these models under western conditions. The purpose of this project was to utilize information from a nitrogen uptake study as input data for existing cotton models validation and fit to western conditions and different N levels. The N study was conducted in California's San Joaquin Valley from 1998 to 2000 (Marsh et al. 2000 and Roberts et al 2001). The field study provided detailed soil and plant data from two different locations, weather conditions, soil types and management practices (Fritschi et al. 2000).

The model used for this paper was the CIRAD *Cotons* (Jallas et al. 1998 and 2000). This model is an adaptation of the USDA GOSSYM model (Baker, McKinion and Lambert. 1983). A unique feature of *Cotons* is the visualization component that portrays the cotton plant's seasonal development or development through any assigned run interval. From standard input variables the model interfaces weather (temperature and solar radiation), soil factors, irrigations, and N inputs to predict plant N status, moisture stress levels and final lint yields.

Model Variables and Outputs

Input variables were soil type and texture of the two sites, soil organic matter, irrigation dates and amounts, residual soil N values to two feet and two N rates (50 lb and 150 lb/acre as urea). The field sites were a Panoche clay loam (3 years: 1998-2000) and a Wasco sandy loam (2 years: 1998 and 2000). A variety was selected from the model options that represented a mid-season variety. Acala Maxxa was the variety used in the field trials.

The model output was cotton lint yield. The model values were compared to the actual field values machine picked and weighted at harvest. Actual lint yields were calculated from seed cotton weights corrected with sampled gin turnouts.

Results

Predicted lint yields from the low N rate averaged 15 and 11% higher than the actual values for the sandy loam and clay loam soils, respectively. The range in variation for the Wasco sandy loam was between 1.5 and 28% and 3 to 25% for the Panoche clay loam. The predicted values were closer to the actual field values for the 1998 season, which experienced lower than average lint yields throughout the San Joaquin Valley.

Predicted yields from the high N rate averaged 61 and 34% higher than actual yields from the sandy loam and clay loam sites, respectively. The range in variation for the two years data from the sandy loam site was 57 and 65 % above the actual yields. The three-year range for the clay loam site was from 11 to 66% above the actual field values.

The model predictions were improved when using the high N rate soil residual N values without any additional N input adjustments. The three-year average for this modeled prediction was 27% above the actual field values. The yield variation during these years ranged from 18 to 35% above actual yields.

Summary

The *Cotons* Model over predicted lint yields from the N trials conducted between 1998 and 2000 in the San Joaquin Valley, CA. Possible variations exist in the variety selections that are provided in the model options compared to the variety used for the field studies. The limited runs from this exercise suggest that the soil fertilizer component of the model is too sensitive. Model predictions were improved (variation and range reduced) when no fertilizer inputs were added or for lower yielding seasons (i.e. 1998). If soil N values were adjusted below the two-foot depth predicted lint yields were unrealistic.

Continued validations will help improve the predictive ability of future versions of physiological models. Additional information on site-specific utilization of residual and added N plus a better understanding of the mineralization potential of organic residues will improve the predictability of these tools (Roberts et al. 2000, Fritschi et al. 2001).

References:

Fritschi, F.B., B.A. Roberts, D.W. Rains and R.L. Travis. Seasonal soil microbial dynamics as influenced by soil type and nitrogen fertilization. Beltwide Cotton Conf. Proc., Anaheim, CA.

Fritschi, F.B., B.A. Roberts, R.L. Travis and D.W. Rains. 2000. Using ^{15}N in defining nitrogen fertilization guidelines. Beltwide Cotton Conf. Proc., San Antonio, TX. 1387.

Jallas, E., R. Sequeira, P. Martin, S. Turner and M. Cretenet. 1998. COTONS, a Cotton Simulation Model for the Next Century. Second World Cotton Research Conf. Athens, Sept. 1998.

Jallas, E., S. Turner, P. Martins, M. cretenet and R. Sequeira. 2000. COYONS-IMS: an Insect and Plant Damage Management system for Cotton. Beltwide Cotton Conf. Proc., San Antonio, TX. P. 437.

Marsh, B.H., R.B. Hutmacher, B.A. Roberts, R.L. Travis and D.W. Rains. Why develop new nitrogen guidelines for California cotton? Beltwide Cotton Conf. Prod., San Antonio, TX. p.1385.

Roberts, B.A., F.B. Fritschi, R.L. Travis and D.W. Rains. 2000. Effect of soil type on cotton residue mineralization under controlled incubation. Beltwide Cotton Conf. Proc., San Antonio, TX. 1388.

Roberts, B.A., R.B. Hutmacher, M.P. Keeley, R. Delgado, R.L. Travis, D.W. Rains, F.B. Fritschi, B.H. Marsh, B.L. Weir, S.D. Wright, D.S. Munk and R.N. Vargas. 2001. N management in San Joaquin Valley Acala cotton: growth, nutrient uptake and yield responses. Beltwide Cotton Conf. Proc., Anaheim, CA.

Reprinted from the *Proceedings of the Beltwide Cotton Conference*
Volume 1:595-596 (2001)
National Cotton Council, Memphis TN