APPLICATION OF WEATHER INFORMATION FOR COTTON PRODUCTION IN THE SOUTHEAST

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Abstract

Cotton producers, consultants, and other professionals require detailed weather forecasts and observations for making decisions regarding many aspects of the crop. Products such as soil temperatures for planting, observed and predicted degree day tabulations for routine crop management, and harvest weather guidance are described as well as their application to crop management. The utilization of automated weather station observations in the GOSSYM-COMAX cotton management model is described. An automated, multidisciplinary, multiagency approach to making this critical information available in a timely manner has been developed. Cotton producers and professionals now have direct access to a computerized source of this information. Internet gopher and World Wide Web servers have been established at Auburn University which provide this information in an easy-to-use format for users having access to the Internet or a PC and modem. This information is also available to all Alabama county agents. Many of these products are available over the NWS Weather Wire Service, NOAA Weather Radio, and the NWS Family of Services computer system.

Introduction

The Alabama Cooperative Extension System's (ACES) Weather Program is the result of a unique cooperation between the National Weather Service's Southeast Agricultural Weather Service Center (SEAWSC) and the Alabama Cooperative Extension System. The ACES Weather program consists of three components: 1) detailed weather information for agricultural producers, 2) the Alabama Mesonet, a network of fully automated weather stations in Alabama, and 3) the Agricultural Weather Information Service (AWIS) which disseminates the information over the Internet and a dial-up computer bulletin board. A broad range of weather information is available on AWIS for hundreds of sites in AL, FL, GA, MS, NC, SC, and TN. This information includes detailed and general forecasts for 1 to 30 days, radar and satellite graphics, current weather observations, and specific weather information for individual crops at hundreds of locations.

Cotton is the most economically important row crop grown across the Southeast United States (AASS, 1994). Many of the weather impacts on cotton are well understood and documented in the literature (Riley et al., 1964; Wootern, et al., 1959; Riley, 1961; Williamson et al., 1960). These documented relationships have allowed the SEAWSC to develop a number of specific weather information products targeted to the cotton producer (Getz et al.,1994). In combination with grower guides published by the Cooperative Extension Service and by private sources (Rutz, 1995), these weather information products can be used by cotton producers to effectively manage several aspects of the crop from planting to harvest. Examples of weather information products for each major phase of cotton production are described below.

Weather Information for Cotton Production

Adequate soil moisture and soil temperatures of 64° F or higher are required for optimum germination of cotton seed (Riley et al., 1964). Soil temperatures are subject to rapid day-to-day change during the early part of the planting period (typically April). The trend of soil temperatures over the previous five to seven days along with a forecast of conditions expected over the next five to seven days are used by growers in making planting decisions. Table 1 shows an abbreviated example of a seven day summary of soil temperatures for several reporting stations in Alabama. Agricultural Weather Advisories (AOAs) are used to provide growers with information on the expected trends and their impact on planting (Table 2).

Detailed weather information is available via AWIS for routine crop management such as cultivation, fertilization, and control of insects, weeds, and plant diseases. AOAs and other routine forecast products issued by the National Weather Service (NWS) are also disseminated through AWIS. In addition, Auburn University Extension specialists release timely commen-taries through AWIS. The commentaries include disease and insect warnings, crop protection suggestions, and pertinent information on economic and market conditions.

For those growers who irrigate cotton, two weather information products are provided to assist in irrigation decisions. Many growers utilize daily pan evaporation rates (based on data collected from NWS instrumented sites and Mesonet locations) to determine irrigation requirements for cotton and other crops. The trend of pan evaporation rates is provided in a daily product (Table 3). The 5-day probability of precipitation is another useful product for scheduling irrigation.

Reprinted from the *Proceedings of the Beltwide Cotton Conference*
Volume 1:398-400 (1996)
National Cotton Council, Memphis TN

The use of accumulated heat units or growing degree days (GOD) has become an integral part of cotton production in many areas across the Belt. Research has shown that cotton development occurs at 60° F and above. The term "DD60" is often used to describe GOD base 60 for cotton. Each major developmental stage of cotton can be matched with an accumulation of DD60s, allowing the grower to carefully monitor the progress of his crop and make management decisions. DD60s are calculated by subtracting 60 from the daily average air temperature. If the daily average temperature is below 60°F, the DD60 accumulation for that day is 0. Because the rate of cotton development does not increase above 93°F, DD60 products are generated with maximum temperatures capped at 93°F. DD60s are tabulated for different planting dates. Using Table 4, a grower can easily determine the approximate DD60s accumulated for various time periods. Future crop growth can be determined using the five to ten day DD60 projections as shown in Table 5.

Two products, the 5-day hourly temperature forecast and the 5-day probability of precipitation forecast can be extremely useful in scheduling fieldwork and chemical applications. These forecast estimates have exhibited a high degree of reliability when compared to actual observations.

The GOSSYM-COMAX model (USDA, 1992) simulates cotton growth on a personal computer. At present, GOSSYM-COMAX has not been widely adopted by Alabama growers. One of the critical inputs to the model is weather data. When growers do start to use the model, detailed hourly weather data will be made available from the Alabama Mesonet. The Mesonet stations are solar powered. Each station in the network is interrogated hourly by telephone or radio telemetry and the weather observations are downloaded into the data banks of the Southeast Agricultural Weather Service Center. The data is disseminated through AWIS and is used to create weather products. Fifteen fully automated Campbell Scientific CR10 weather stations are already in operation in cotton producing areas of Alabama and are providing hourly temperature data (air and soil), pan evaporation, solar radiation observations, and rainfall, which are required for the GOSSYM-COMAX model. Wind speed and direction are also reported.

Optimum conditions for defoliation occur on warm, sunny days with low humidity. At least 60% of the bolls should be open before applying defoliants. Routine AOAs and NWS forecasts are available to the grower to determine when weather conditions are expected to be optimum for defoliation. High winds, high temperatures, low humidity, and rain should not be in the forecast.

Once cotton has been defoliated, picking normally commences within ten days. Research has shown (Riley, 1961) that optimum picking conditions exist when the relative humidity drops to 60 percent or lower and should cease when the relative humidity increases to 65 percent or higher. A numerical weather prediction model is used to calculate hourly relative humidity for selected locations for up to 60 hours in advance. Table 6 shows an example of the cotton harvesting guidance.

Access to Weather Products

AWIS permits easy access to all the weather information discussed above, as well as hundreds of other products. The AWIS gopher (gopher.awis.auburn. edu) and World Wide Web (http://www.awis.auburn.edu) servers are easily accessed by anyone with Internet connectivity. Computer users without Internet connectivity can access AWIS by means of a dial-up bulletin board maintained by the Alabama Cooperative Extension System. Alabama producers can contact their county agent for more information on bulletin board access. Direct computer links to the Extension computer network, ACENET, provide county agents with all of the weather information disseminated through AWIS. Although AWIS permits easy direct access to information, Alabama county agents can and routinely do provide the information directly to producers.

In addition, many of the products described (daily AOAs and other routine NWS forecast products) are made available to Alabama and other Southeast cotton interests over the NWS Weather Wire Service, NOAA Weather Radio, and the NWS Family of Services computer system. These provide direct access to the public and media. Much of the NWS information is redistributed directly to growers over numerous commercial agricultural information delivery services that also provide market information. However, most of the detailed, commodity specific information such as the cotton harvesting guidance is not disseminated through any of the NWS systems which are not intended for such specific information.

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Table 1. Portion of soil temperature product.
Average four inch soil temperatures for Alabama

STATION	4/1	4/2	4/3	4/4	4/5	4/6	4/7	AVG
Auburn	61	63	58	51	55	56	58	57
Camp_Hill	60	64	60	53	55	58	58	58
Cullman	55	57	55	56	50	54	56	55
Fairhope	60	65	64	65	61	64	62	63

Where AVG = AVERAGE from 4/01/95 to 4/07/95

Table 2. Sample Agricultural Weather Advisory (AOA) for cotton planting.

ALABAMA AGRICULTURAL WEATHER ADVISORY
NATIONAL WEATHER SERVICE AUBURN AL
1023 AM CDT THU APR 1 1995

SOIL TEMPERATURES ARE TOO COOL FOR EFFECTIVE GERMINATION OF COTTON SEED. ALTHOUGH WARMER WEATHER IS FORECAST THE NEXT TWO DAYS, A COOLING TREND WILL FOLLOW AND RESULT IN A DECLINE OF SOIL TEMPERATURES. SOIL MOISTURE REMAINS FAVORABLE FOR PLANTING.

Table 3. Portion of observed pan evaporation product.
Observed pan evaporation data for ALABAMA
For the period: Thursday, July 1, 1995 to: Wednesday, July 7, 1995

STATION	7/1	7/2	7/3	7/4	7/5	7/6	7/7	AVG
Auburn (AG)	21	.30	.31	.31	.29	.23	.21	.27
Camp Hill	.25	.28	.21	.32	.30	.33	.29	.28
Demopolis	.16	.24	.30	.25	.26	.27	.14	.23

Where AVG = AVeraGe from 7/ 1/95 to 7/ 7/95

Table 4 . Growing Degree Day (GDD) summary for Belle Mina, AL.
Growing Degree Days (GDDs) summary -- {Base 60: Max Temp Cap of 93 F) for Belle Mina, AL (Limestone County)
Latitude: 34.7N; Longitude: 86.9W

Cumulative GDDs from planting date through:
Thursday August 5, 1995

EMERGENCE DATE	04/30	05/31	06/30	07/31	08/5
04/05/95	118	445	882	1504	1583
04/10/95	106	433	870	1492	1571
04/15/95	77	404	841	1436	1515
04/20/95	39	366	803	1425	1504
04/25/95	9	336	773	1395	1474
04/30/95	0	327	764	1386	1465

Table 5. Portion of projected DD60s product.
Growing Degree Day (Base 60) projections for ALABAMA
FOR THE PERIOD: Sunday, September 10,1995
To: Thursday, September 14, 1995

STATION	Sun 09/10	Mon 09/11	Tue 09/12	Wed 09/13	Thurs 09/14	Total GDDs
Andalusia	17	12	13	14	16	72
Anniston	15	8	9	12	17	61
Auburn	18	12	11	13	16	70
Bay Minette	18	13	15	17	18	81
Belle Mina	12	6	8	13	16	55