1995 Weather Conditions

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Abstract

The 1995 cotton season proved to be one of the most challenging in many years. Cold, dry spring weather delayed planting and forced many growers to replant a significant portion of their crop. The late crop then ran into extreme summer heat in July and August and very high August humidity. Daytime temperatures in excess of 120°F were reported in the low deserts in July and many locations reported extended periods with daytime temperatures above 110°F. Poor fruit retention was a common grower observation as the summer heat continued. The saving grace for 1995 proved to be warm and dry fall weather which assisted late season development and harvest operations.

Introduction

The 1995 growing season proved to be less than optimal for many Arizona cotton producers. Much of the blame for the poor 1995 cotton crop has been assigned to subpar weather conditions, particularly the cold spring and the very hot late summer. In this report we review the 1995 weather conditions in key cotton production areas using information obtained from the Arizona Meteorological Network (AZMET).

Methods

Weather data collected from six AZMET stations -- Coolidge, Litchfield Park, Marana, Parker, Safford and Yuma Valley -- were selected for review in this report. The selected locations range in elevation from 120' (Yuma Valley) to 2955' above sea level (Safford) and provide a broad geographic representation of the cotton production regions of Arizona.

Meteorological parameters of importance to cotton production -- temperature, dew point temperature, precipitation and heat unit accumulation (86°F/55°F thresholds: sine curve method) were summarized for calendar year 1995, then plotted in such a manner to facilitate comparisons against normals. Temperature, dew point and heat unit normals were computed using past AZMET data collected over the period 1987 through 1994. A seven-day moving average (equal weights) was used to smooth temperature and dew point normals to improve graphical presentation. Precipitation normals were obtained from the nearest NOAA Cooperative Observer station; AZMET PPT normals proved too variable due to the relatively short record length (1987-94) of the AZMET data.

Graphs which depict how a particular weather variable behaved relative to normal are presented for each location. Maximum and minimum temperature and dew point temperature are presented showing 1995 values and normals. Patterns of above or below normal conditions are clearly evident from these graphs. Cumulative precipitation plots are used to show how PPT accumulated relative to normal during 1995. Finally, HU accumulation is presented as the departure from normal throughout calendar year 1995. Readers should note that any time HU departure from normal moves in a positive direction (positive slope) HU accumulation is above normal. Likewise, anytime the line depicting HU departure from normal moves in a negative direction (negative slope), HU accumulation is below normal.
Results

In reviewing the 1995 weather conditions we have chosen to break the year into six, two-month production periods as indicated below:

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A description of the major weather events impacting each production period follows.

Pre-Plant Period: January & February

Mild and relatively wet weather conditions were observed during much of the 1995 pre-plant period (Figures 1-24). Precipitation (PPT) totals were normal at Yuma Valley and Litchfield Park and slightly above normal at Coolidge and Safford. Heavy PPT was observed at Marana and Parker with both locations reporting PPT totals nearly 2" above normal for the period.

Dew point temperatures (Td) clearly show the high level of atmospheric moisture during the pre-plant period (Figures 13-18). Average Td exceeded normal values by more than 10°F at most locations. Mild nighttime temperatures are generally associated with high Td and 1995 was no exception. Minimum temperatures (Tn) were above normal during most of the pre-plant period (Figures 7-12).

In contrast, maximum temperatures (Tx) did not run above normal during the pre-plant period (Figures 1-6). In fact, Tx in January were generally below normal. Such below normal Tx during periods of wet, humid weather are not uncommon due daytime cloudiness and above normal evaporation rates in the normally dry desert. February brought not only a continuation of high Td and Tn, but also periods of daytime warmth during the first and third weeks of the month (Figures 1-18). The warm period during the third week of February was perfectly timed for Yuma growers that plant near legal first planting date (15 February); both Tx and Tn were in the optimal range for germination (Tx above 83°F and Tn above 48°F).

For the rest of the state's producers, the warm and humid February (Figures 1-18) allowed soils to warm close to proper planting temperatures by the first of March. Heat unit (HU) accumulations used to define planting windows were 25-75 HUs above normal by 1 March (Figures 25-30), leading many to believe that 1995 would be an early planting season.

Planting Season: March & April

Cool, dry air entered the state just after legal first planting date in central Arizona (15 March). The impact of this change in weather pattern is evident in plots of Tx, Tn and Td in all production areas (Figures 1-18). Temperatures in late March and much of the first three weeks of April averaged well below normal and below optimal values for germination. Sub-freezing temperatures were observed in higher elevation production areas in late March (e.g. Safford, Marana, and Coolidge), and with the exception of a brief early April period, the first good planting period occurred during the last week of April.
HU accumulation registered well below normal at all locations during the planting season (Figures 25-30). Annual HU totals declined from well above normal in mid-March to normal or below by late April. Fortunately, the high levels of PPT observed in the pre-plant period diminished with the drier air. Most locations reported near or slightly below normal PPT (Figures 19-24). The exceptions were Litchfield Park, Parker and Yuma which reported slightly above normal PPT.

**Early Season: May & June**

Cool, dry weather remained entrenched across the state through much of May, adding further to the delays already experienced by the crop. Both Tx and Tn were significantly below normal at all locations in May (Figures 1-12). Early May proved quite cold, especially at higher elevations where Tn on several nights were below 40°F. Daytime temperatures were actually cooler (relative to normal) than were night temperatures. Most areas reported only a handful of days with above normal Tx. Graphs depicting the departure of HU accumulation from normal clearly show the impact of the very cool May weather (Figures 25-30). May HU totals were 50-125 HUs below normal with the greatest departures from normal coming at Marana (-115 HUs) and Yuma Valley (-110 HUs). The dry weather generated near normal to below normal Td values (Figures 13-18) and only Safford and Marana reported any May PPT (Figures 19-24).

Weather conditions improved in June only because of general seasonal warming. Normal dry June weather was experienced at most locations; however, temperatures remained quite variable (Figures 1-12). The month started with below normal day and night temperatures. A period of rapid warming about the 10th of the month produced a brief period of very hot weather with Tx approaching 110°F in low desert locations. The brief heat wave was shortlived as temperatures once again plunged well below normal by mid-month. The subsequent return to hot June weather was slow in coming with most locations not experiencing a return to normal temperatures until the end of the month.

The dry and variable June weather kept Td in the normal range at most locations (Figures 13-18). Exceptions to this pattern were the central Arizona locations of Coolidge and Litchfield Park which reported below normal Td. Precipitation was non-existent at most low elevation locations; higher elevation areas (Marana and Safford) received light rains late in the month (Figures 19-24).

The variable June temperatures generated below normal temperatures for the month which naturally led to below normal HU accumulation (Figures 25-30). Most locations reported monthly HU totals that were approximately 50 HUs below normal; Yuma Valley reported the largest reduction in HU accumulation (relative to normal) of nearly 100.

**Mid-Season: July & August**

The 1995 cotton crop entered the mid-summer months of July and August well behind schedule due to cool weather conditions encountered during the planting and early growth periods. The period of cool summer weather ended shortly after the first of July. A sudden bout of hot weather and the first surge of monsoon moisture brought above normal day and night temperatures to central and southeastern Arizona during the first week of July (Figures 1-18). Only the Yuma area seemed to escape this first surge of above normal July temperatures. Monsoon moisture departed the state in mid-month and brought a brief cooling period. This cool spell was most pronounced at night with most locations reporting night temperatures in the 60s. The cool spell proved shortlived and a heat wave enveloped the entire production area by late July. Day temperatures during the heat wave reached well above normal, exceeding 120°F at several low desert locations and 110°F at higher elevations. The heat wave also increased Tn well above normal, with many low desert locations reporting Tn above 80°F. The warm July halted the 4-month stretch of below normal HU accumulation (Figures 25-30). Most locations reported monthly HU accumulations within 20 units of normal.
The late July heat was associated with below normal humidity (Td) due to a non-existent monsoon flow (Figures 13-18). July PPT totals were among the lowest on record at many Arizona locations (Figures 19-24). PPT totals in most production areas were well below normal and some locations reported no July PPT.

The late July heat wave continued through the first 10 days of August. Maximum temperatures exceeded 110°F at most low desert locations while nights remained in the upper 70s or lower 80s (Figures 1-12). Humidity, as measured by Td, remained below normal during the first week, then surged to above normal levels for most of the rest of the month (Figures 13-18). This surge in humidity led to significant PPT in most locations (Figures 19-24), which in turn helped bring Tx back to near normal levels. Only Parker and Yuma escaped significant PPT during August.

The strong influence of humidity on night temperatures was clearly evident at most locations (Figures 7-18). Nights stayed quite warm through most of August due in large part to very high humidity. Day temperature, however, moderated during mid-August due to increased cloudiness and increased regional evaporation (a heat consuming process).

A final surge of extreme heat began in late August, producing very hot days and nights (Figures 1-12). Maximum temperatures again approached the 110°F level in the low desert and 100°F in the higher elevations. Humidity levels (Td) declined slightly to normal values with this final heat wave (Figures 13-18), and only light and very scattered PPT was observed in most areas (Figures 19-24).

August HU accumulation totaled well above normal (Figures 25-30). HU totals at most locations were 30-50 HUs above normal. Safford reported the largest HU increase relative to normal of 70 HUs.

**Late Season: September & October**

The heat of late August continued through the first half of September across much of the production region (Figures 1-12). Low desert regions experienced yet another stretch of 110°F daytime temperatures while higher elevations observed temperatures approaching 105°F. Night temperatures remained particularly high due mostly to above normal humidity (Figures 13-18). Minimum temperatures in many low desert locations exceeded 80°F on several nights during early September -- a rare occurrence (Figures 7-12). The warm September weather continued until the last week of the month when normal dry fall weather set in bringing much lower humidity, cooler nights and moderate daytime temperatures. However, as a whole, September proved to be another hot month with above normal HU accumulation (Figures 25-30). Monthly HU totals exceeded normals by 40-80 HUs.

The above normal September humidity produced some PPT in most production areas (Figures 19-24), but monthly PPT totals ranged from normal to below normal at most locations. The exception to this below normal PPT trend was Coolidge which reported slightly above normal September PPT.

October proved to be an excellent month for harvest preparation and early harvest activities. Mild, dry weather conditions were observed across the state in October. Dew point temperatures were exceptionally low (Figures 13-18) in many places which contributed to below normal PPT levels (Figures 19-24). The clear, dry weather produced very warm days but relatively cool nights (Figures 1-12). Again, the importance of humidity (Td) on night temperatures is clearly evident in the October temperature data. Only the Colorado River Valley seemed to buck the October temperature trend. There, the Tn were well below normal while Tx averaged slightly below normal.

The combination of mild to warm day temperatures and cool nights produced near normal monthly HU totals at most locations (Figures 25-30). Exceptions were in Yuma Valley and Parker where monthly HU accumulation ran below normal and Safford where HU accumulation exceeded normal by about 30 HUs.
Harvest & Tillage Season: November & December

The excellent October weather continued into November across the entire production region. A brief wet spell in late October and early November brought the last significant 1995 rainfall for many areas (Figures 19-24). Warm, dry weather followed this wet spell and lasted through the end of the month. Both Tx and Tn averaged well above normal at all locations (Figures 1-12). Oddly enough, the below normal November PPT was not associated with low humidity. Td values actually averaged above normal in most areas (Figures 13-18) and was a major contributing factor in the above normal Tn observed throughout the state. The switch to normal dry November weather did not occur until the last week of November. This surge of cool, dry weather -- the only one of the month -- produced the first subfreezing temperatures at higher elevation production areas.

HU accumulation averaged well above normal at all production locations in November (Figures 25-30). Most locations reported HU accumulations of 100 HUs above normal.

The run of exceptional fall weather continued through the first half of December. Temperatures and humidity continued well above normal through mid-month (Figures 1-18). PPT was absent from the state during the first half of the month, assisting late harvest and fall tillage operations (Figures 19-24). A mid-month cooling spell signaled the end of above normal temperatures for December. This weather change also generated the only PPT during the month -- light PPT amounts in the higher elevation production areas.
Figure 1. Maximum temperatures observed at Yuma Valley during calendar year 1995. Heavy line indicates normal conditions.

Figure 2. Maximum temperatures observed at Parker during calendar year 1995. Heavy line indicates normal conditions.
Figure 3. Maximum temperatures observed at Litchfield Park during calendar year 1995. Heavy line indicates normal conditions.

Figure 4. Maximum temperatures observed at Coolidge during calendar year 1995. Heavy line indicates normal conditions.
Figure 5. Maximum temperatures observed at Marana during calendar year 1995. Heavy line indicates normal conditions.

Figure 6. Maximum temperatures observed at Safford during calendar year 1995. Heavy line indicates normal conditions.
Figure 7. Minimum temperatures observed at Yuma Valley during calendar year 1995. Heavy line indicates normal conditions.

Figure 8. Minimum temperatures observed at Parker during calendar year 1995. Heavy line indicates normal conditions.
Minimum temperatures observed at Litchfield Park during calendar year 1995. Heavy line indicates normal conditions.

Minimum temperatures observed at Coolidge during calendar year 1995. Heavy line indicates normal conditions.
Figure 11. Minimum temperatures observed at Marana during calendar year 1995. Heavy line indicates normal conditions.

Figure 12. Minimum temperatures observed at Safford during calendar year 1995. Heavy line indicates normal conditions.
Figure 13. Dew point temperatures observed at Yuma Valley during calendar year 1995. Heavy line indicates normal conditions.

Figure 14. Dew point temperatures observed at Parker during calendar year 1995. Heavy line indicates normal conditions.
Figure 15. Dew point temperatures observed at Litchfield Park during calendar year 1995. Heavy line indicates normal conditions.

Figure 16. Dew point temperatures observed at Coolidge during calendar year 1995. Heavy line indicates normal conditions.
Figure 17. Dew point temperatures observed at Marana during calendar year 1995. Heavy line indicates normal conditions.

Figure 18. Dew point temperatures observed at Safford during calendar year 1995. Heavy line indicates normal conditions.
CUMULATIVE PRECIPITATION: YUMA VALLEY
1995 vs. NORMAL

Figure 19. Cumulative precipitation observed at Yuma Valley during calendar year 1995. Heavy line indicates normal conditions.

CUMULATIVE PRECIPITATION: PARKER
1995 vs. NORMAL

Figure 20. Cumulative precipitation observed at Parker during calendar year 1995. Heavy line indicates normal conditions.
Figure 21. Cumulative precipitation observed at Litchfield Park during calendar year 1995. Heavy line indicates normal conditions.

Figure 22. Cumulative precipitation observed at Coolidge during calendar year 1995. Heavy line indicates normal conditions.
Figure 23. Cumulative precipitation observed at Marana during calendar year 1995. Heavy line indicates normal conditions.

Figure 24. Cumulative precipitation observed at Safford during calendar year 1995. Heavy line indicates normal conditions.
Figure 25. Departure of heat unit accumulation relative to normal for Yuma Valley during calendar year 1995.

Figure 26. Departure of heat unit accumulation relative to normal for Parker during calendar year 1995.
Figure 27. Departure of heat unit accumulation relative to normal for Litchfield Park during calendar year 1995.

Figure 28. Departure of heat unit accumulation relative to normal for Coolidge during calendar year 1995.
MARANA HEAT UNIT ACCUMULATION
1995 RELATIVE TO NORMAL

Figure 29. Departure of heat unit accumulation relative to normal for Marana during calendar year 1995.

SAFFORD HEAT UNIT ACCUMULATION
1995 RELATIVE TO NORMAL

Figure 30. Departure of heat unit accumulation relative to normal for Safford during calendar year 1995.