

# Weather Conditions During the 1991 Growing Season

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## *Abstract*

*The 1991 growing season was characterized by a cool, wet spring and a cool, dry summer. Heat unit accumulation for the season was the lowest in 5 years at most locations. Precipitation was concentrated in two periods: early (Jan. - Mar.) and late (Nov. - Dec.). Summer rainfall was well below normal at most locations.*

## **Introduction**

The 1991 cotton season has been described by growers and others in agribusiness as the shortest in several years. Cool spring and summer weather delayed crop development and forced many growers to carry their crop later than anticipated. Growers then encountered an extended period of above normal rainfall in the fall and early winter which interfered with picking and post-harvest land preparation, eventually resulting in an extremely late plowdown in many parts of the state. This report reexamines weather conditions during the 1991 using weather information obtained from the Arizona Meteorological Network (AZMET).

## **Methods**

Weather information collected from 6 AZMET weather stations -- Coolidge, Litchfield Park, Marana, Parker, Safford and Yuma Valley -- were selected for evaluation in this review. The selected stations provide a broad geographical representation of the cotton production regions of Arizona. Monthly totals and/or means of heat unit (HU) accumulation (86F/55F, upper and lower temperature thresholds, respectively), precipitation, maximum temperatures and minimum temperatures were summarized for each location and compared against weather records observed in recent years (HU only) and long-term normals.

## **Results**

### **1991 Heat Unit Accumulation: Comparison With Recent Years**

Growth and development of cotton can be predicted using HUs (Silvertooth et al. 1991). Total HU accumulation during a growing season can therefore provide an estimate of growing season length. Figure 1 shows the total growing season HU accumulation (from legal first planting date to 30 September) for Yuma Valley, Coolidge and Safford for each of the past 5 growing seasons. HU accumulation was lower in 1991 than in any of the past 5 years at Yuma Valley and Coolidge. HU accumulation at Safford was the lowest since 1987. The results for seasonal HU accumulation clearly support the general feeling that 1991 was a short growing season.

Figure 1 also provides insight on the year-to-year variance in HU accumulation. Seasonal HU accumulation has varied by 476, 352 and 256 HUs over the past 5 years at Yuma Valley, Coolidge and Safford, respectively.

Translated back to calendar days (by dividing by the normal daily HU accumulation for the growing season), this seasonal variation in HU accumulation equals 24, 17 and 14 days for Yuma Valley, Coolidge and Safford, respectively.

## **The 1991 Growing Season: Comparison To Normal**

Comparison of particular weather variables with long-term normals is a time honored way of examining a growing season. In this section, monthly totals (precipitation & heat units) or monthly means (maximum & minimum temperature) are compared against long-term normals for 6 locations -- Coolidge, Litchfield Park, Marana, Parker, Safford and Yuma Valley. The four figures referenced in this discussion depict the deviation of a particular weather parameter from normal. Data points located above the zero line (normal) represent above normal conditions; data below the zero line, a below normal condition.

### **Growing Season Precipitation**

1991 can be characterized as a year when much of the rainfall fell during the early and late months (Figure 2). Precipitation was above normal at most locations during the first 3 months of 1991. Of particular interest to cotton producers were the high precipitation rates observed in March. This precipitation, when combined with the cold March temperatures, forced significant delays in planting and produced problems with germination and stand establishment.

Precipitation was nearly nonexistent during the second quarter -- a fairly common occurrence in much of the Arizona cotton production region. However, the dry weather continued through the traditional monsoon period of July through September. All locations except Safford reported below normal precipitation for each of the monsoon months (Jul. - Sept.). Above normal precipitation was reported for Safford in August; however, total precipitation for the monsoon period still registered below normal.

The last quarter of 1991 started warm and dry. October precipitation was below normal at all locations. The dry conditions disappeared in central Arizona by mid-November, and across much of the rest of the cotton region by early December. Frequent December rains combined with low evaporation rates (from cloudy weather) to produce extended periods when soils were too wet to work. As a result, both harvest and post-harvest field activities were delayed. The only location reporting below normal precipitation for December was Parker. Of particular note is the huge amount of December rain (3.3" above normal) reported at Safford.

### **Maximum Temperatures**

The most unique (and remembered) feature of the 1991 growing season was the temperature patterns in February and March (Figure 3). Much of southern and central Arizona experienced a climate anomaly when February temperatures were on average warmer than those of March. Such an occurrence does not happen with great frequency anywhere in the United States and is quite unusual in desert regions. February maximum temperatures averaged 4 - 9 °F warmer than long-term normals across the region. March responded in nearly the opposite fashion, with maximums running 3 - 9 °F colder than normal. As previously mentioned, high levels of precipitation occurred with the cold March weather, making soil preparation and planting difficult.

Another less discussed feature of the 1991 climate was the mild daytime (maximum) temperatures observed throughout the summer months. This more subtle climate feature, when combined with the cool spring, created the short 1991 growing season. Daytime temperatures remained below normal at all locations except Safford from April through July. Daytime maximums averaged 5 °F below normal for much of the period at Coolidge, Parker, and Litchfield Park. In contrast, slightly above normal daytime temperatures were observed at Safford over the period.

The cool conditions continued through September at all locations except Yuma where normal daytime temperatures were observed in both August and September. The growing season finished warm with all locations reporting daytime temperatures in the normal to above normal range in October. Conditions cooled in November and December -- a result of the cloudy and wet weather. Most locations reported slightly below normal daytime temperatures. The exceptions were Parker and Safford where normal conditions were observed.

### **Minimum Temperatures**

Minimum temperatures followed the same general pattern as maximum temperatures in 1991 (Figure 4). January and February minimums generally were above normal, the exception being Parker where normal conditions prevailed. February was particularly warm, with minimum temperatures averaging more than 5 °F above normal at several locations. March minimum temperatures averaged near normal at most locations -- a surprising result given the widespread perception that March was cold. However, March weather was quite humid and very cloudy -- conditions that prevent extremely cold nighttime temperatures. This same cloudy, humid weather was effective at blocking solar radiation and therefore produced the below normal daytime temperatures in March.

Minimum temperatures in April remained at or above normal at all locations except Parker. However, the period from May through July generated below normal minimum temperatures at most locations, with Parker and Coolidge recording monthly mean minimum temperatures of 5 °F or more below normal.

Above normal minimum temperatures were observed from August through December at Yuma Valley, Marana, and Litchfield Park. Safford minimums averaged at or above normal for the same period. Only Parker reported below normal temperatures for the entire period. Particularly high minimum temperatures were observed at Yuma Valley, Marana and Litchfield Park during the warm October and the wet, humid December.

### **Heat Units**

Heat unit accumulation ran below normal at most locations during 1991 (Figure 5). February was the only month where all locations reported above normal HU accumulation. February was followed by a very cold March that produced HU accumulations well below normal. During the early summer (Apr. - Jul.) Yuma Valley and Safford accumulated HUs at a near normal pace while the remaining locations observed below normal HU accumulation.

In late summer and early fall (Aug. - Oct.) all locations except Coolidge and Parker accumulated HUs at rates equal to or above normal. High levels of HU accumulation were observed during this period at Yuma Valley and Safford. Litchfield Park and Marana HU accumulations ran slightly above normal over the late summer/early fall period. Heat unit accumulation at Parker and Coolidge, however, remained well below normal. The end of the year (Nov. - Dec.) generated slightly below normal HU accumulations at most locations.

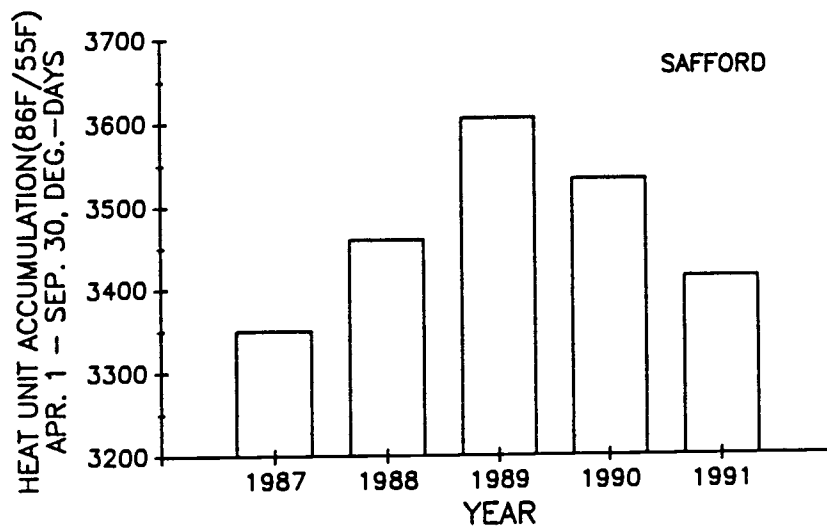
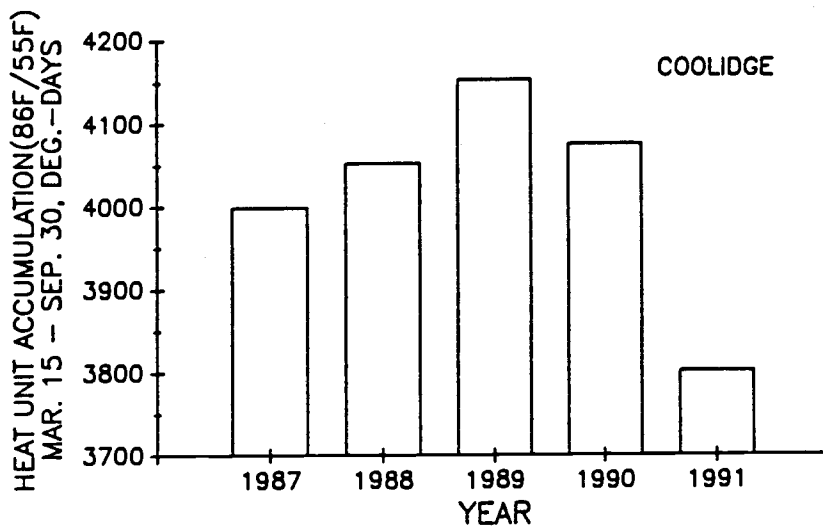
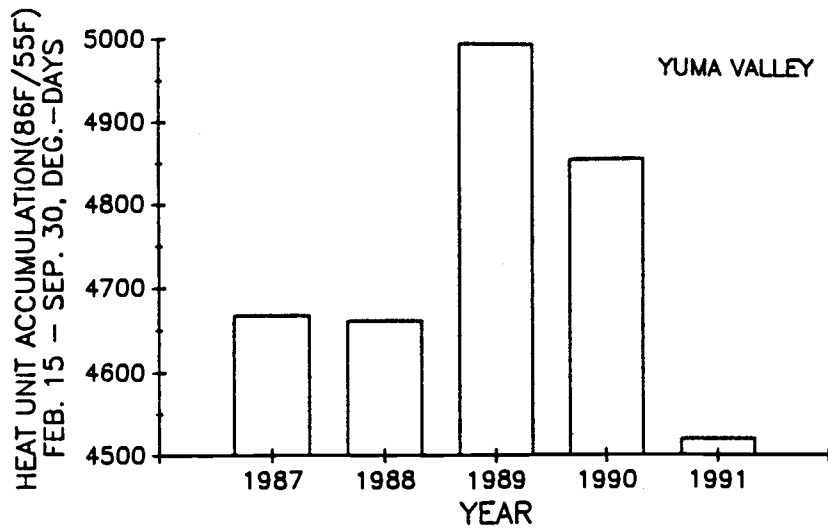


Figure 1. Total heat unit (86F/55F) accumulation for each of the past 5 growing seasons at Yuma Valley, Coolidge and Safford.

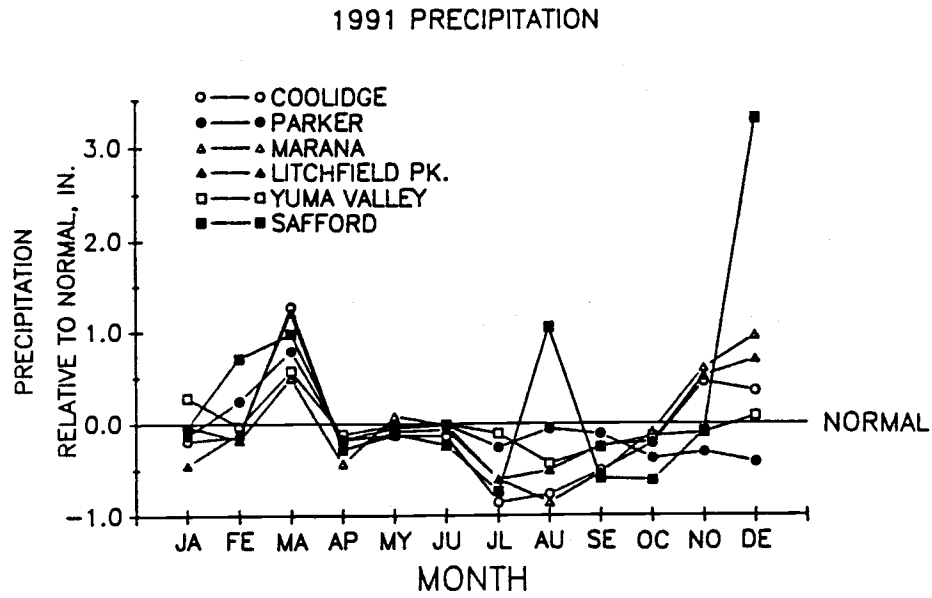


Figure 2. Monthly precipitation relative to normal for Coolidge, Parker, Marana, Litchfield Park, Yuma Valley and Safford in 1991.

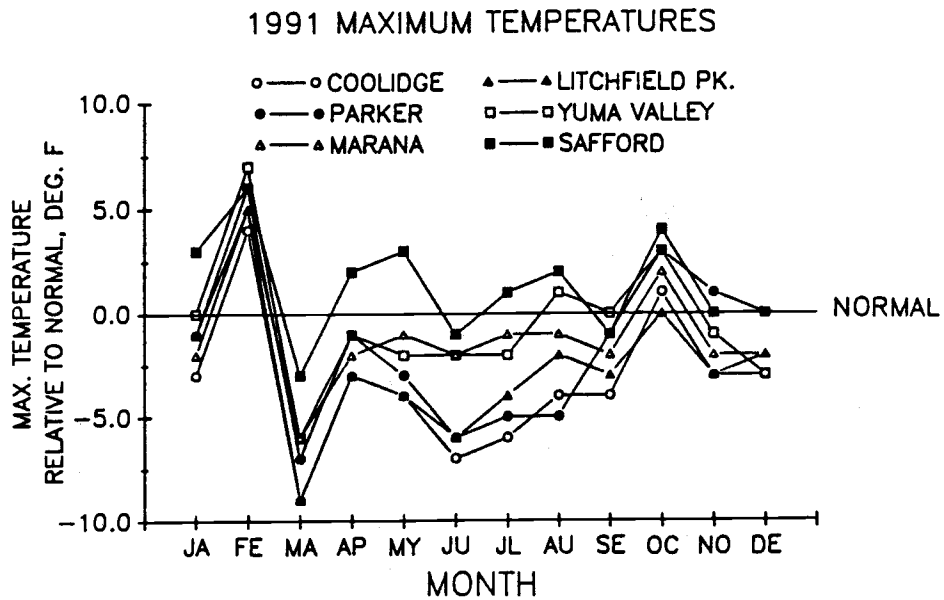


Figure 3. Monthly maximum temperature relative to normal for Coolidge, Parker, Marana, Litchfield Park, Yuma Valley and Safford for 1991.

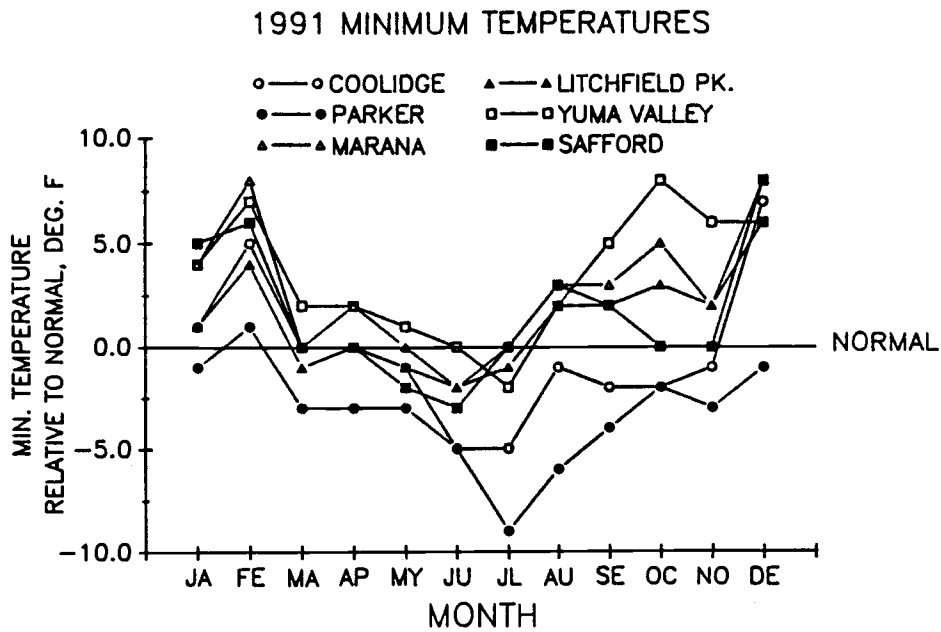


Figure 4. Monthly minimum temperature relative to normal for Coolidge, Parker, Marana, Litchfield Park, Yuma Valley and Safford in 1991.

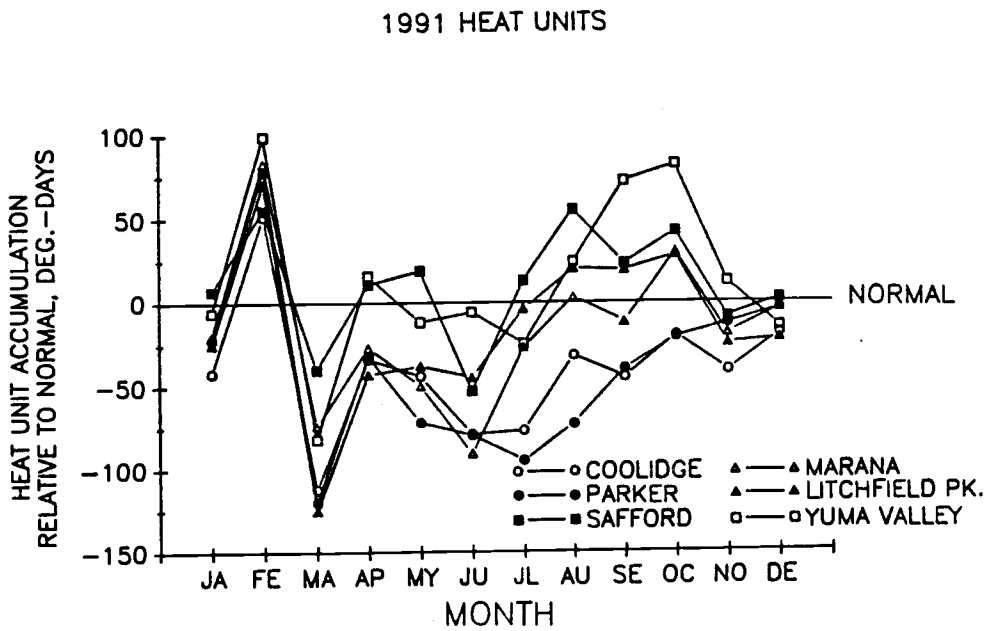


Figure 5. Monthly heat unit (86F/55F) accumulation relative to normal for Coolidge, Parker, Marana, Litchfield Park, Yuma Valley and Safford in 1991.