

1993 Weather Conditions

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Abstract

Abnormally high January and February rainfall will certainly be the most remember meteorological feature of 1993. This rainfall led to extensive flooding along the Gila River and its tributaries, and delayed field preparation in many areas. However, once the winter rains ended, weather conditions proved very favorable for cotton production. Warm, dry spring weather helped get the cotton crop off to a good start. Moderate summer temperatures and a late monsoon provided excellent weather conditions for setting fruit. The relatively short monsoon period was followed by an extended period of mild, dry weather which provided excellent conditions for finishing the crop. The only blemish on the fall weather pattern was a period of heavy rainfall in mid-November which delayed field operations in much of central Arizona.

Introduction

The 1993 growing season proved to be an excellent one for most Arizona cotton producers. The most remembered meteorological feature of 1993 was the record winter rainfall that produced extensive flooding and delayed land preparation in many areas. However, following this period of heavy January and February rainfall, weather conditions proved quite favorable for cotton production for the remainder of the growing season. In this report we reexamine weather conditions during 1993 using information obtained from the Arizona Meteorological Network (AZMET).

Methods

Weather information collected from six AZMET stations--Coolidge, Litchfield Park, Marana, Parker, Safford and Yuma Valley--were selected for evaluation in this review. The selected locations range in elevation from 120' (Yuma Valley) to 2955' above sea level (Safford) and 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 thresholds, respectively), precipitation (Ppt), maximum temperature (Tx) and minimum temperature (Tn) were summarized for each location and compared against weather records observed in recent years (HU only) and long-term normals (30-year means). Since long-term normals are not available for AZMET stations, normals for the nearest NOAA Cooperative Observer Station were used for comparison against normal.

Growing Season Heat Unit Accumulation: Comparison With Recent Years

The traditional means of determining the length of a growing season is to count the number of days between the last spring frost and the first fall frost. Such an approach often poorly represents the length of a growing season for a particular crop since the thermal requirements of the crop are not taken into consideration. A more representative means of assessing growing season length is to examine total HU accumulation during the time period when the crop is being produced. Heat unit (also commonly referred to as growing degree days) systems utilize temperature data

to estimate crop growth and development. Silvertooth et al. (1991) have shown that the HU system using upper and lower thermal limits of 86 F and 55 F, respectively can predict growth and development of cotton quite accurately.

Figure 1 provides the total HU accumulation from legal first planting date through 30 September for Yuma Valley, Coolidge and Safford for each of the past seven years. The 1993 growing season proved to be relatively warm at the higher elevation locations of Safford and Coolidge and near normal at Yuma Valley. Heat unit accumulation at Coolidge was quite close to 1992 levels and less than 100 HUs below the totals recorded in the record hot year of 1989. At Safford, HU accumulation exceeded 1992 totals by approximately 80 HUs and came within 50 HUs of the record total set in 1989.

HU accumulation at Yuma Valley was similar to levels recorded in 1990 and nearly 200 HUs below the total recorded during the 1989 season. The cause of this lower HU accumulation was the absence of extended periods of hot summer weather -- particularly warm nights -- which were more common in 1992 and 1989.

The 1993 Growing Season: Comparison To Normal

The overall pattern of seasonal weather conditions is best observed by comparing various weather parameters against their respective long-term normals. In this section, monthly totals (Ppt and HU) or monthly means (Tx and Tn) are compared against long-term normals for six locations -- Coolidge, Litchfield Park, Marana, Parker, Safford and Yuma Valley. The four figures referenced in this discussion depict the deviation of a particular weather variable from normal. Data points located above the zero line (normal) represent above normal conditions; data below the line, a below normal condition.

Precipitation (Ppt)

The most prominent and remembered meteorological feature of 1993 was the abundance of rainfall during the first two months of the year (Figure 2). Rainfall during both January and February was well above normal across much of the state and produced significant flooding along Gila River and its major tributaries. January rainfall was particularly heavy in all cotton production areas. Most locations received 50% or more of the normal annual Ppt in that month alone. The heaviest rainfall was reported in the Coolidge and Marana areas with both locations reporting January Ppt totals in excess of 4.5" above normal.

The above normal Ppt pattern continued through February at all locations. The Ppt levels were not, however, as excessive as January levels with most locations reporting Ppt values that were in the 0.5" to 1.5" above normal range.

The wet weather pattern ended in early March and dry weather was the rule through most of the planting season. The only exception to this dry weather occurred during the last week of March when a storm system brought considerable rain to much of the region. This storm and its associated rainfall produced some germination problems in early planted fields in western and west-central Arizona.

The dry weather pattern continued through June across the entire region. Rainfall totals remained near normal or at below normal levels for this entire period at all locations. Dry weather continued through the first month of the monsoon (July) at all locations except Coolidge. Two locations -- Safford and Marana -- reported very low July Ppt -- more than 1.0" below normal. July rainfall at Coolidge was about 0.8" above normal.

The monsoon brought above normal August Ppt to Safford, Marana, Litchfield Park and Coolidge. The rainfall was particularly heavy at Safford and Marana; both locations reported monthly Ppt totals in excess of 2" above normal. Only locations along the Colorado River -- Yuma Valley and Parker -- reported below normal Ppt during the month.

Dry weather returned to most locations in September and October. All locations reported normal to below normal Ppt in September. This trend continued into October with the exception of Litchfield Park where October Ppt was slightly above normal.

A strong mid-November storm system brought the year's last significant Ppt. This storm dropped large amounts of Ppt in Pinal and Maricopa Counties and significant Ppt elsewhere. As a result, November Ppt levels ranged from near normal at Parker and Safford to well above normal at Coolidge and Litchfield Park. The year ended on a dry note with all locations reporting below normal Ppt in December.

Maximum Temperatures (Tx)

Maximum temperatures averaged below normal for much of 1993 (Figure 3). The cloudy, wet weather of January and February produced below normal Tx at all locations with the exception of Safford. Normal to slightly above normal Tx were observed at Safford during these first two months.

Above normal Tx were observed across much of the region during the spring planting period. All locations except Coolidge reported above normal Tx in March and all locations reported above normal Tx in April and May. This warm weather combined with the dry spring weather to produce excellent early season growing conditions in most cotton production areas.

Relatively cool temperatures were observed at most locations during the hot summer months. Daytime temperatures were below normal from June through August at Litchfield Park, Parker and Coolidge, while normal to slightly below normal daytime temperatures were the rule in Yuma Valley and Marana. Only Safford reported above normal daytime temperatures during the summer months.

Daytime temperatures approached normal levels at most locations in September. Only Safford, which reported above normal daytime temperatures, and Coolidge, which reported below normal daytime temperatures, deviated from this trend. Normal daytime temperature conditions were again the rule in October at Safford, Marana, Yuma Valley and Parker. In contrast, Coolidge and Litchfield Park reported cool October daytime temperatures, averaging 3F and 4F below normal, respectively.

November brought much cooler daytime temperatures at all locations except Safford. Most locations reported Tx that were 3-5 F below normal. Slightly above normal temperatures were observed at Safford.

Daytime temperatures approached normal levels at all locations in December. The warmest location was again Safford where temperatures averaged 3F above normal. The coolest location proved to be Yuma Valley where daytime temperatures averaged 2F below normal.

Minimum Temperatures (Tn)

The cloudy, wet weather of January and February produced relatively warm Tn conditions across the region (Figure 4). All locations reported above normal Tn in January and all locations except Parker reported above normal Tn in February.

Normal to above normal nighttime temperatures continued during the spring months due to the extended period of warm, dry weather. Only Parker reported below normal Tn during these months.

June brought near normal Tn at most locations and the lack of monsoon activity in July produced normal to below normal Tn at most locations. Two locations -- Coolidge and Litchfield Park proved exceptionally cool at night in July -- both locations reported Tn of 5F below normal for the month.

August brought more variation in night temperature. Safford and Marana reported above normal Tn to go along with their high Ppt totals. In contrast, Parker reported below normal night temperatures. Near normal conditions were evident at the remaining locations.

The near normal nighttime temperature pattern continued into September at Safford, Coolidge Marana and Litchfield Park. However, the two western Arizona locations -- Yuma Valley and Parker -- exhibited differing nighttime temperature patterns. September Tn averaged above normal in Yuma Valley and below normal at Parker.

Minimum temperatures remained within 2F of normal at most locations for the remainder of 1993. The lone exception to this trend was Parker where Tn averaged 3F below normal.

Heat Unit (HU) Accumulation

Normal values of HU accumulation were observed at all locations in January (Figure 5) due to the cloudy, wet weather which produced warm nights. February proved a little less wet and somewhat cooler with all locations reporting below normal HU accumulation.

Above normal spring temperatures produced above normal HU accumulation at all locations for the months of March, April and May. This warm early season period produced an excellent start for the 1993 cotton crop.

The above normal spring temperature pattern was followed by moderate to cool summer weather. The cool summer nighttime temperatures were particularly notable. A result of this relatively cool summer weather was a reduction in HU accumulation to normal or below normal levels at most locations. The only exceptions occurred in August and September in Yuma Valley and Safford where HU accumulations were slightly above normal.

Normal to below normal levels of HU accumulation continued through the fall at most locations. Only Yuma Valley produced above normal HU accumulations in October while no locations reported above normal levels in November. Heat unit accumulation was mixed in December with Safford and Marana reporting slightly above normal levels and the remaining locations reporting below normal levels.

References

Silvertooth, J.C., P.W. Brown and J.E. Malcuit. 1991. Basic cotton development patterns. Cotton: A College of Agriculture Report. J. Silvertooth and M. Bantlin (ed.). Series P-87. The University of Arizona, Tucson, AZ. p. 126-132.

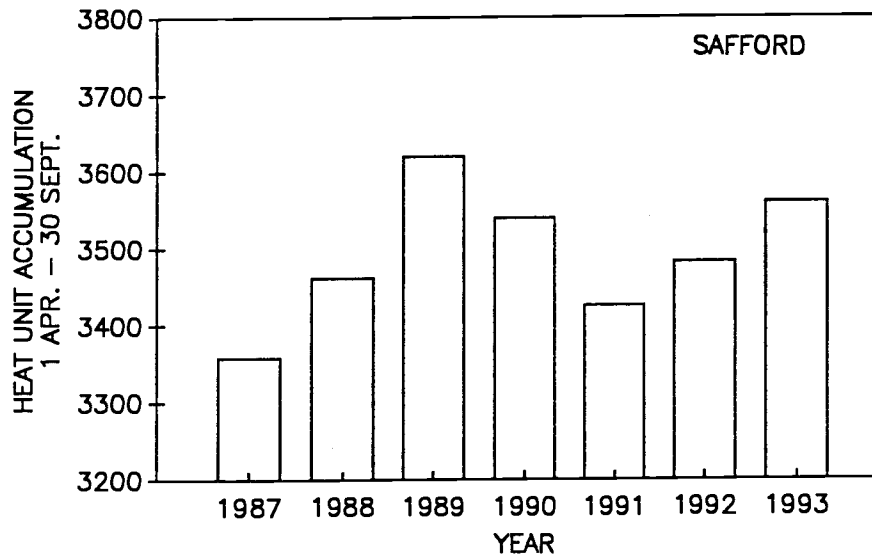
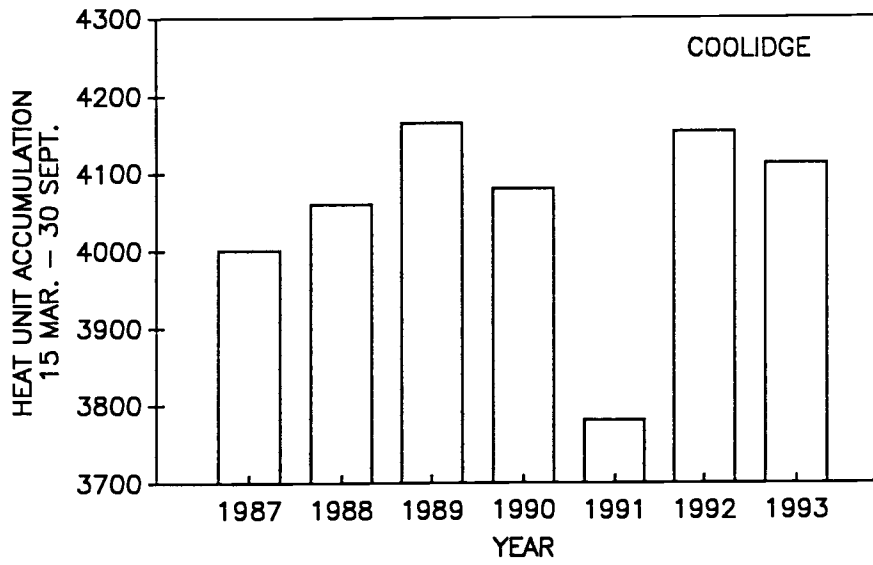
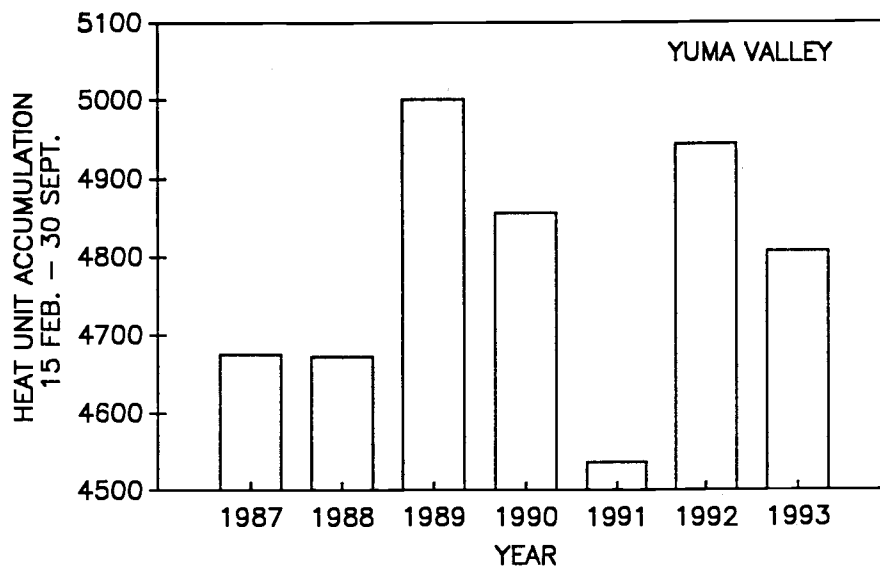


Figure 1. Total heat unit (86F/55F) accumulation for each of the past seven growing seasons at Yuma Valley, Coolidge and Safford.

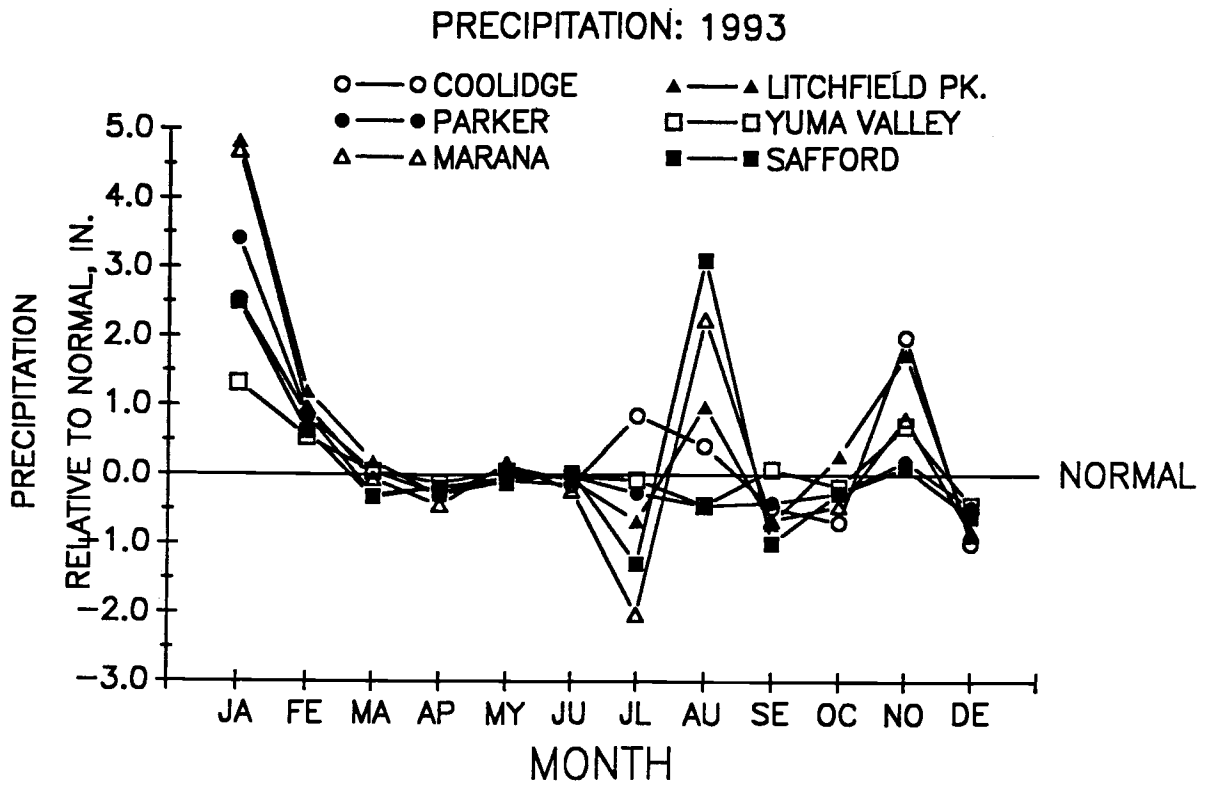


Figure 2. Monthly precipitation relative to normal for Coolidge, Parker, Marana, Litchfield Park, Yuma Valley and Safford in 1993.

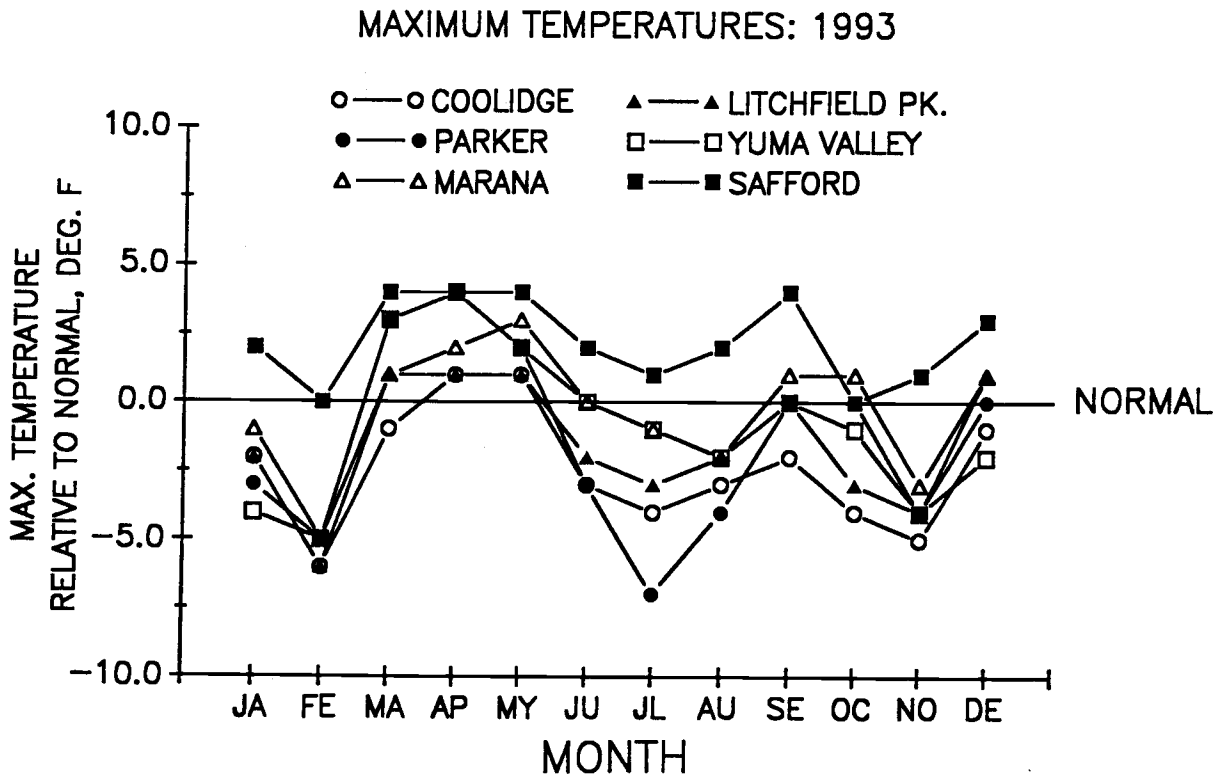


Figure 3. Monthly maximum temperature relative to normal for Coolidge, Parker, Marana, Litchfield Park, Yuma Valley and Safford in 1993.

MINIMUM TEMPERATURES: 1993

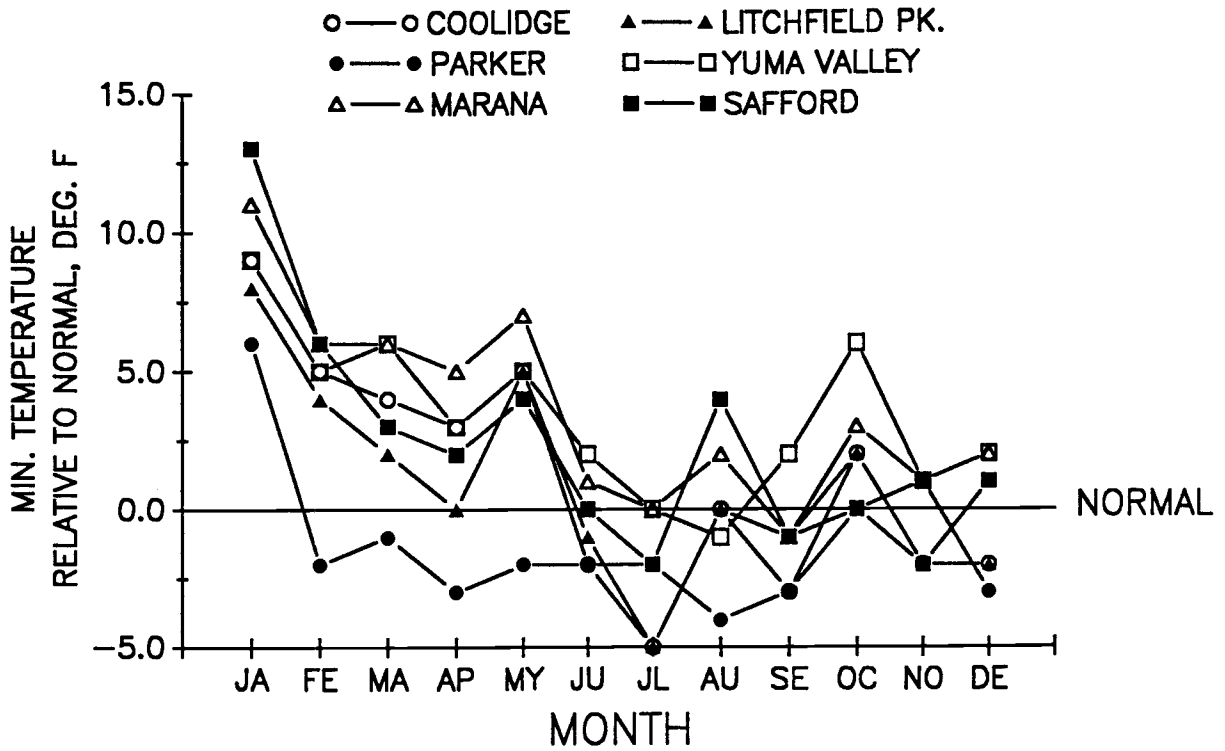


Figure 4. Monthly minimum temperature relative to normal for Coolidge, Parker, Marana, Litchfield Park, Yuma Valley and Safford in 1993.

HEAT UNITS: 1993

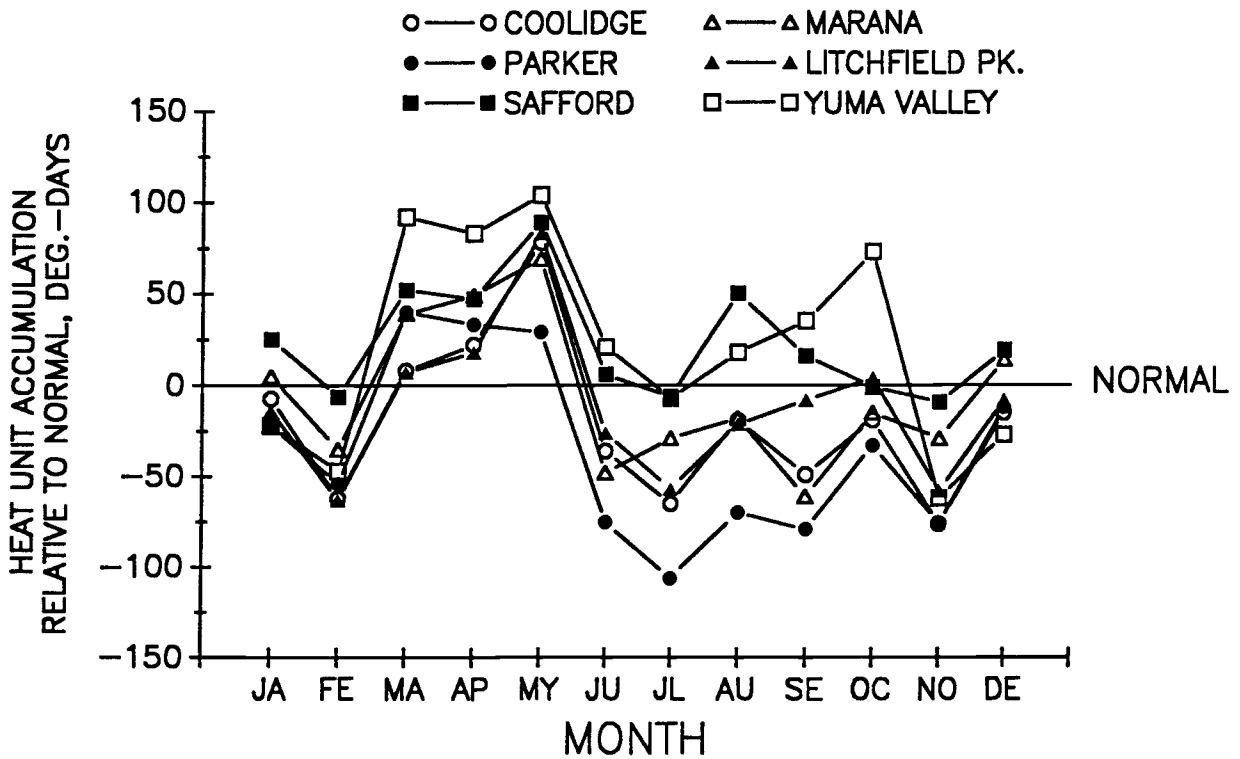


Figure 5. Monthly heat unit (86F/55F) accumulation relative to normal for Coolidge, Parker, Marana, Litchfield Park, Yuma Valley and Safford in 1993.