

**A GOOD COTTON PLANTING FORECAST:  
PIMA COUNTY**

**Paul Brown**

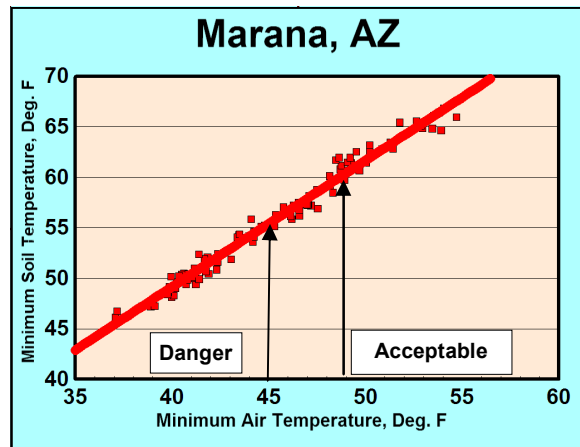
**Extension Specialist, Biometeorology**

Low soil temperature can adversely impact germination of cotton. Research examining the effect of cold temperatures on germination and stand establishment reveals that chill injury slows germination, alters normal root development and causes cell damage that can render seedlings more susceptible to disease. Additional studies have shown that chill damage is more severe when cold temperatures occur early (first 24 hrs) in the germination process. Cold soils begin to impact germination when soil temperatures at seed depth decrease into the upper 50s°F, and severe damage can result when temperatures decline below 55°F. Given these research findings, growers are encouraged not to plant cotton until soil temperatures at seeding depth remain above 60°F throughout the entire 24-hour day.

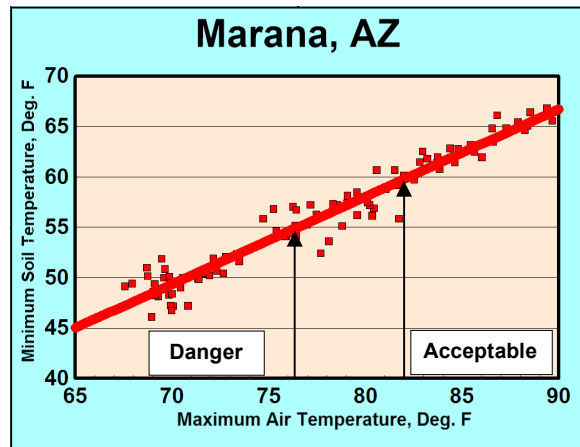
Soil temperatures at planting depth are heavily influenced by current weather conditions because the seed zone rests in close proximity to the atmosphere and the thin layer of overlying soil has a limited capacity to retain heat. Changes in weather conditions can therefore have a rapid and pronounced impact on soil temperatures at seeding depth. The Arizona Meteorological Network (AZMET) has been collecting air and soil temperature data in central Arizona for 25 years. This data set reveals that minimum soil temperatures at seeding depth do not approach the recommended planting temperature of 60°F until minimum air temperatures remain in the upper 40s°F or higher (Fig. 1a). Similarly, minimum soil temperatures approach 60°F only after maximum air temperatures rise into the low 80°F range (Fig. 1b).

The relationships presented in Figures 1a & 1b provide clear guidance on what constitutes a good and bad weather forecast for planting cotton in central

Arizona. A good forecast would be clear skies with highs in the low 80s and lows in the upper 40s (~48°F) or higher. This optimal forecast should and maximum air temperatures that lead to produce minimum soil temperatures of 60°F or higher. A forecast that could foretell trouble with germination and stand establishment would be highs below 75°F and lows in the lower 40s or colder. Such conditions could produce dangerously low soil temperatures (< 55°F). Cloudy daytime conditions



**a**



**b**

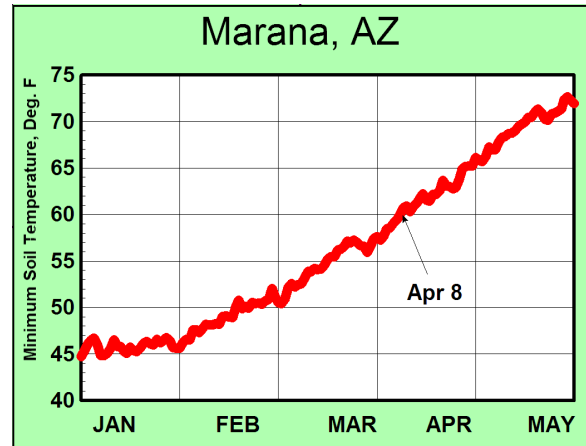
**Figure 1. Relationships between minimum soil temperature and minimum air temperature (a) and maximum air temperature (b) during the spring in Marana. The ranges of minimum acceptable and dangerously low soil temperatures are indicated.**

make any forecast less desirable since lower levels of solar radiation reduce daytime heating of the soil. Likewise, a forecast calling for any precipitation is a poor forecast due to concerns related to soil crusting and increased surface evaporation which can reduce soil temperatures.

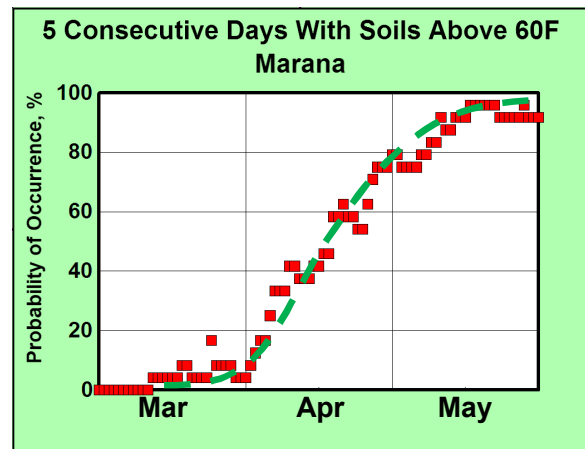
Soil temperatures increase steadily during the spring in central Arizona and typically approach acceptable levels for planting by early April (Fig. 2a). Figure 2b provides the probability of having five consecutive days with minimum soil temperatures above 60°F at Marana during the spring. The probability of occurrence increases from ~10% at the beginning of April to ~80% by the end of the month. The University of Arizona has long recommended using heat unit (HU) based planting windows to target the planting of various cotton maturity groups. These planting windows are provided in Table 1 along with the calendar dates associated with these HU ranges. All windows open when the annual accumulation of HUs totals 400 which is typically the earliest growers would consider planting. The terminal HU values for the planting windows are more important than the opening values as they represent the latest dates growers should consider planting a given maturity class. Planting later than the recommended ending date will delay flowering and push more of the primary bloom curve into the period when heat stress can negatively impact fruit retention and yield.

**Table 1. Heat unit (HU) based planting windows for early, medium and full season cotton varieties. Average opening and closing calendar dates for Pima County are included.**

Maturity	HUs After 1 January	Calendar Dates
Full	400-700	Mar 19 – Apr 16
Medium	400-800	Mar 19 – Apr 24
Short	400-1000	Mar 19 – May 7



a



b

**Figure 2. Long term average values of minimum soil temperature measured at a 4” depth for Marana (a). Arrow indicates date when minimum soil temperatures, on average, reach acceptable levels for planting. Probability of having five consecutive days with minimum 4” soil temperatures above 60°F during the spring at Marana (b).**