Chilling-Hour Requirements of Fruit Crops

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What Is a Chilling Requirement and Why Is It Important?

Many temperate, deciduous fruiting plants require a chilling period in order to break dormancy, grow, and fruit normally. This is why choosing species and varieties that are satisfied by the climatic conditions in a particular geographic location is important to achieve the best results.

Plants begin to enter a resting period, called dormancy, once temperatures fall below 50°F for an extended period of time. Some species, and varieties within a species, may react to reduced day lengths as well as temperatures. Aboveground growth ceases, and leaf fall occurs, signaling an entry into dormancy. Hormonal changes in the plant, especially a marked decrease in growth-promoting hormones, prepare it for the oncoming cold. Once into dormancy, chilling accumulation starts and continues until the requirement of the plant is satisfied. After the required amount of chilling accumulation has occurred, growth-promoting hormones begin to increase, preparing the plant for the onset of warmer temperatures.

Stages of Dormancy

Fruit crops go through three main physiological stages during dormancy. The first stage in the dormancy process is **acclimation**, which is the ability to adjust to climate change. Acclimation begins after the plant has ripened its crop and growth has stopped, which is usually late summer into early fall. In order to reach full acclimation, a period of cool weather is required before the first freeze. Acclimation occurs mainly during October and November, although it can begin earlier, especially if the plant is responsive to decreases in day length.

The second stage of dormancy is the ability to survive particular climatic adversities, especially freezing temperatures. This stage generally occurs from December through February. During winter, there are two distinct types of dormancy: **endo-dormancy** and **eco-dormancy**. Endo-dormancy is the period during which the plant is accumulating its chilling hours the most. Until the plant satisfies its need for cold, it will not break bud, even if temperatures warm. Once the chilling requirement for a plant has been satisfied, it enters into eco-dormancy (also called quiescence). In this stage, the plant is prohibited from growing by the cold temperatures of winter. But once warmer temperatures become more common, the plant transitions to the third stage.

The third stage is called **deacclimation**. Deacclimation is the process of breaking dormancy and readjusting to warmer temperatures. This process is caused by periods of temperatures above 40°F and occurs fairly quickly. Growing-degree days accrue just like chilling hours and eventually lead to bud break once enough heat is accumulated. Deacclimation usually occurs in the spring, but warm temperatures in winter can cause early deacclimation, leading to severe damage when cold weather returns, especially in plants with low chilling-hour and growing-degree-day requirements.

Fulfillment of Chilling Hour Requirement

Typically, temperatures between 32°F and 50°F can help fulfill the chilling requirement of many plants, but the most efficient temperatures for satisfying a plant's need for cold are between 32°F and 45°F. When temperatures dip below 32°F, very little, if any, chilling is received by the plant. Conversely, when temperatures exceed 60–70°F for extended periods, chilling can be negated. Interestingly, leaf and fruit buds on the same plant can have different chilling requirements (**Figure 1**). Insufficient chilling can lead to various problems, including delayed foliation, reduced fruit set, and poor fruit quality.

Some fruit plants have a high chill-hour requirement, whereas others have low to no chill-hour requirements (**Table 1**).

Figure 1. From left to right: Springhigh, Jewel, and O'Neal southern highbush blueberries. Notice that O'Neal has no leaves, but Springhigh and Jewel do. This is likely because O'Neal did not get the required chilling hours for leaf buds to emerge. Photo taken in Poplarville, Mississippi, in 2016.

Table 1. Average chilling-hour requirements for various fruit and nut crops common in Mississippi. Actual hours needed depends on variety.

Fruit Crop	Chilling Hours Required
Apples	200–1,000
Blackberry	200–600
Blueberry	150–700
Citrus	0–100
Fig	100–200
Grape	100–600
Peach	200–800
Pear	400–900
Pecan	300–500
Persimmon	200–400
Plum	400–700
Pomegranate	100–200
Strawberry	200–400

Models to Estimate Chilling

Different models exist to estimate chilling. One model defines a chill hour as each hour below 45°F starting on October 1. This works for locations where temperatures below 32°F are rare. Another model uses the number of hours spent between 32°F and 45°F, which are then summed to get the total number of chill hours for a season. Other models exist, and different species may require different models.

The most accurate measurement of chill hours is from a device within the field where a plant is growing. However, the cost of the equipment required to measure chill hours can be too high for some growers. Therefore, MSU Extension created a free, web-based application that uses actual weather data from the nearest weather station to help Mississippi fruit growers estimate chill-hour accumulation for a particular location. This information can help growers assess the growing conditions that impact plant physiology and prepare for events in the upcoming season. The application is available at ***https://webapps.msucares.com/chill_hours/*** (**Figure 2**). Even though data used by this application is based on actual measurements, results should be considered as general guidelines and not as exact values because weather varies from location to location.

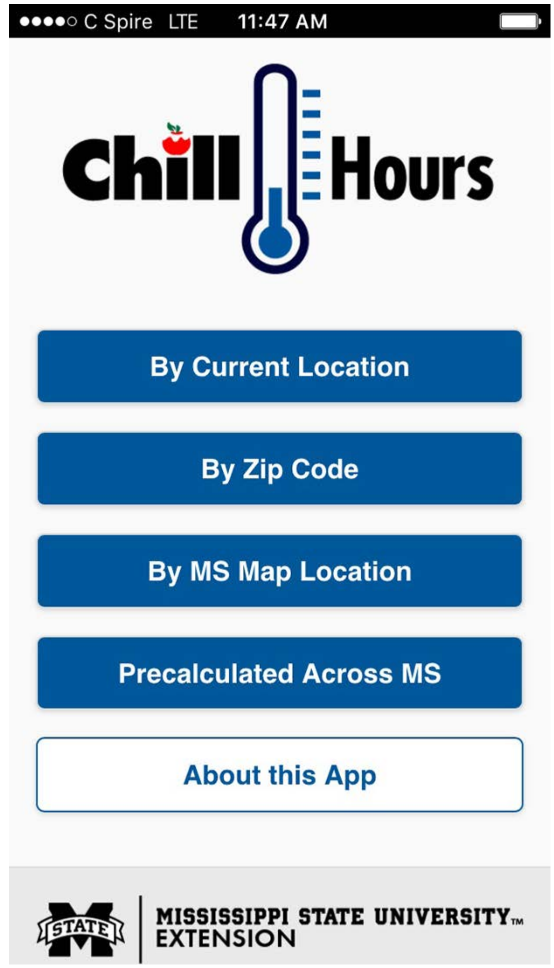

Figure 2. Home page of the Chill Hours app as shown on a smartphone. Users can find locations of interest by selecting from the easy-to-use prompt buttons.

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By **Eric T. Stafne**, Associate Extension and Research Professor, Fruit Crops, Coastal Research and Extension Center.

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