A Web-Based Chill Hours App for Fruit Growers

Abstract

Many fruit plants have a chill hour requirement for breaking dormancy. Various models estimate chilling, but two models are commonly used for fruit crops. From 2000 to 2016, chill hour data were collected by Mississippi State University experiment station employees as well as by local fruit producers; however, the number of participants in the process dwindled over time. To address this issue, we developed a mobile-friendly web application to interface with Weather Underground data. From these data, fruit growers can assess growing conditions that affect plant physiology and prepare for events in the upcoming season. Extension professionals can introduce the app to fruit growers in their areas.

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Introduction

Choosing species and cultivars adapted to the climatic conditions in a particular location is paramount for successful growth (Luedeling & Brown, 2011). Often, deciduous fruit plants that grow in the temperate zone require cold temperatures to break dormancy and proceed with normal growth (Byrne & Bacon, 1992; Jones & Brennan, 2009; Krewer & NeSmith, 2006; Luedeling, Zhang, & Girvetz, 2009). This cold requirement is termed *chill hours*, which refers to the number of hours within a certain temperature range. Fruit plants have different chill hour requirements, with some needing a high number of chill hours (e.g., apples, cherries) and others needing only a low number of chill hours or none at all (e.g., peaches, blueberries, grapes). Plants start entering the fall dormancy period once temperatures go below 50°F for several days (Powell, Dozier, Williams, & Himelrick, 2002). Leaf fall and cessation of aboveground growth indicate entry into dormancy, and hormonal changes in the plant prepare it for the oncoming cold of late fall and winter. Chill hour accumulation starts at this time and continues until the requirement of the plant is satisfied, after which the plant begins growth or enters a quiescent phase until warmer temperatures occur (Powell et al., 2002).

In general, depending on species and cultivar, temperatures between 32°F and 50°F can satisfy the chill hour requirement, but temperatures between 32°F and 45°F are considered optimal. Various models can be used to estimate chill hour accumulation, but two models are commonly used for fruit crops in Mississippi and other fruit-

growing areas. For one model, each hour below 45°F is counted as a chill hour (Krewer & NeSmith, 2006). For the other model, hours between 32°F and 45°F are counted as chill hours (Weinberger, 1950). Other, more complex models exist, and cultivating different species may require using different models (Luedeling et al., 2009), but the two basic models satisfy the needs of many growers.

Filling a Need

From 2000 to 2016, chill hour accumulation data were collected by Mississippi State University experiment station employees as well as by local growers, reported to the Extension fruit specialist, and then disseminated to all interested growers via various methods (email, telephone, blog, etc.). However, the number of participants in this process dwindled over time due to equipment failure, loss of interest, retirement, and other issues. By 2016, participants from only one location were reporting on a regular basis. Because Mississippi has diverse regions, one location was not representative for all growers. Thus, a new solution needed to be developed, but it had to be one without a high investment cost. Our answer was to create the Chill Hours app.

Constructing and Implementing the Application

Apps are becoming more popular in Extension because of their accessibility and portability (Beckerman & Sadof, 2013; Dvorak, Franke-Dvorak, & Price, 2012; Fulcher et al., 2013; Kobayashi, 2013). They can address difficult-to-solve issues in new ways and better serve stakeholder needs with decision-support tools (Drill, 2012; Dvorak, McNeill, & Hardy, 2016). Jones, Doll, and Taylor (2014) recommended developing apps that target specific tasks and are simple to use. Some examples of Extension-created apps are described in articles by Beckerman and Sadof (2013), Dietz and Dickson (2013), Dvorak et al. (2012), Dvorak et al. (2016), Fulcher et al. (2013), and Sutherin, Lombard, and St. Hilaire (2013).

We wrote the Chill Hours app (Figure 1) as a mobile-friendly web application instead a native iOS or Android app. Doing so allowed the app to be accessible from devices other than mobile phones and tablets. Because databases of climate and weather data are readily available online, it only made sense to use existing resources rather than re-create them. Through hypertext preprocessor, the app connects to the Weather Underground application program interface (https://www.wunderground.com) to access nearby weather stations and to retrieve historical data for a specific weather station. Retrieving the data from Weather Underground occurs on a day-by-day basis and causes the app to take some time to compute the chill hours for the two models over a whole season. To save time, a map of preselected weather stations across the state was added (Figure 2). Every night, data are retrieved from Weather Underground for these stations and stored in a database for fast access via the state map feature. Because the app references Weather Underground data, it can be used anywhere, not just in Mississippi. The addition of mechanisms to speed up the app and to add graphs of chill hours along with other new features are being planned for a future version.

Figure 1.

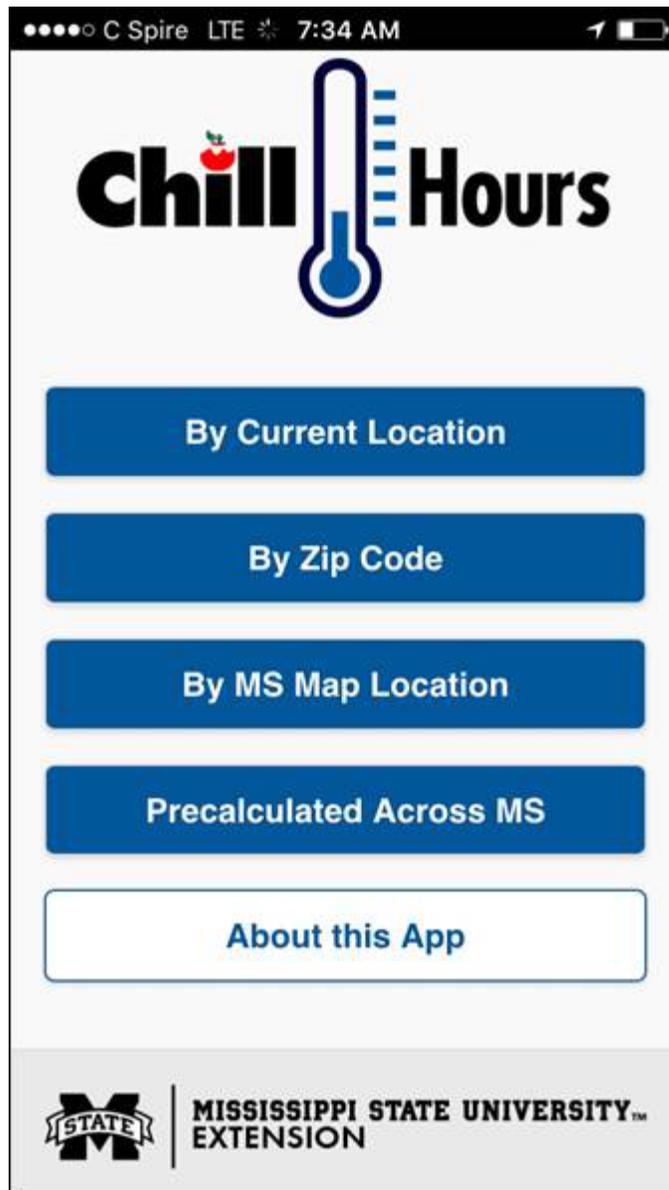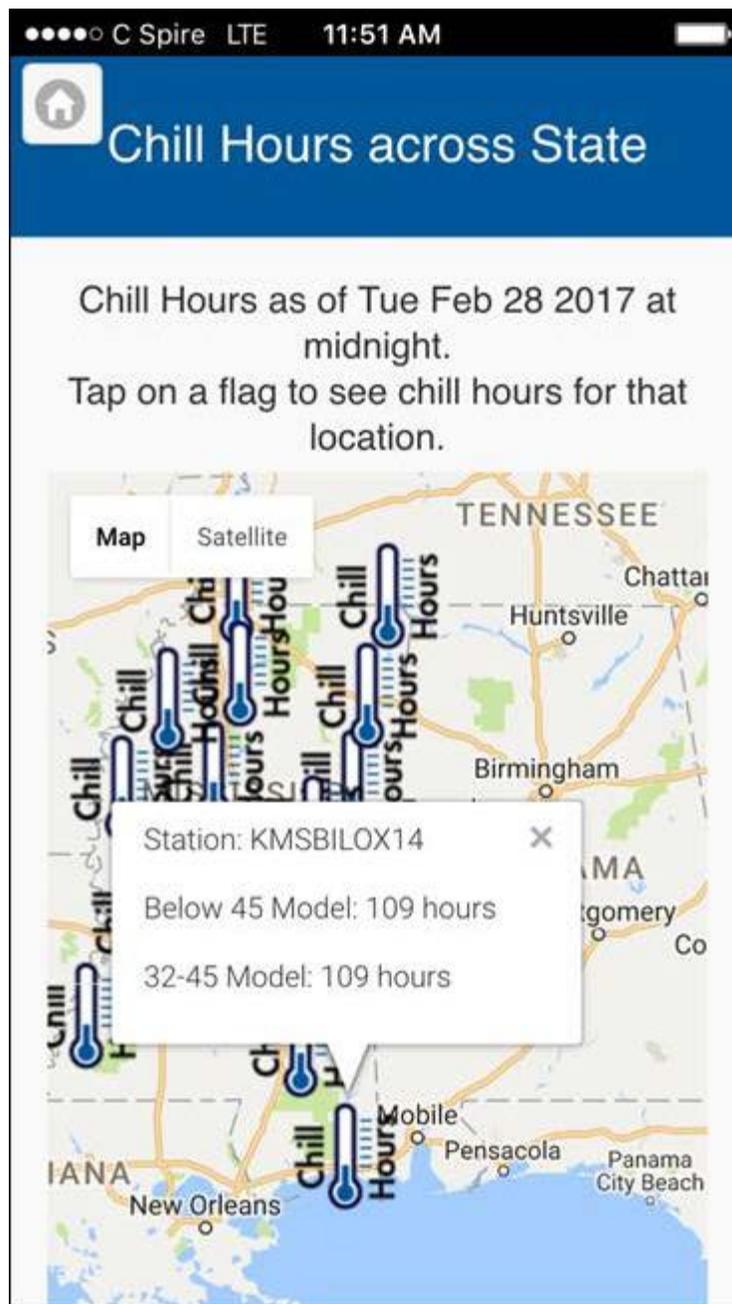Home Page Interface for Chill Hours App

Figure 2.

Prepopulated Map That Allows for Quicker Access to Chill Hour Calculations

Implementation

Weather can be different from one field to the next; therefore, the most accurate measurement of chill hours is from a dedicated field instrument within a location of interest. Even though the Chill Hours app relies on data from Weather Underground, the results given should be used only as an estimate and not as a definitive measurement. The Chill Hours app was designed to assist Mississippi fruit growers in evaluating weather conditions and to help them prepare for the upcoming season. As noted, however, the app can be used anywhere. Extension professionals can introduce the app to fruit growers in their areas. The Chill Hours app is free and is available at https://webapps.msucares.com/chill_hours.

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