Developing a Phenology Model for California Pistachios: Website Development

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Introduction:
Understanding how both winter chill and growing season temperatures affect pistachio bloom, set and maturation is becoming more important for increasing present and ensuring future productivity. An accurate method of quantifying the accumulation of both winter chill and spring heat, both critical to dormancy breaking, would facilitate using the dormancy breaking oil or bloom enhancing boron spray applications now used. In the future an accurate method of quantifying chill and heat would provide an early warning of local climate change, allowing the pistachio industry to adapt with new management techniques and new varieties.

Pistachios are temperate climate deciduous trees that evolved in climates with distinct seasons and have "dormancy requirements" that allow them to track the passing of winter to know when conditions are safe for bloom. Like a sleeping person, trees need both enough "sleep" (winter cold) and a loud enough "alarm clock" (spring heat) to wake up. Currently bloom prediction is based solely on winter chill accumulation. There are no horticultural model based on both chill and heat accumulation for a Mediterranean climate like that of California.

A project funded by the California Department of Food and Agriculture Specialty Crop Block Grant Program and led by graduate student Katherine Jarvis-Shean with collaborators in the Brown, DeJong, and Zhang labs at UC Davis is developing a mixed model for pistachios, almonds and walnuts. Specifically they are integrating the effects of winter and spring temperatures and other environmental variables to mathematically model when pistachios, almonds and walnuts bloom and leaf-out, and how well they'll bloom under future conditions.

This project will:
1) Create a mathematical model and a user-interface for the California pistachio, almond and walnut tree growers to predict the timing of bloom, pollen issue and leaf-out.
2) Predict the impacts of climate change on growing conditions for these nut crops in California.

Once developed, this model will be available online as an interactive website similar to the weather webpage now on the Fruit and Nut Research and Information Center website: http://fruitsandnuts.ucdavis.edu/Weather_Services/.   Eventually the website will also include a BloomCast program which will enable growers to more accurately determine date of bloom for their orchards. The current and future funding received from the California Pistachio Research Board is supporting the development of this website.

Methods:
To create a better bloom and leaf-out timing model for California, Ms. Jarvis-Shean and collaborators are working with existing models and historic data, and collecting new, more detailed data to create an original model. They are monitoring bloom and leaf-out in six orchards each of pistachio, almond and walnut spanning Central Valley microclimates. At each site, they are collecting temperature and relative humidity information as well as measuring bloom and leaf-out.   These data sets will be correlated to develop the most accurate model for predicting bloom and leaf-out. The model will require at least three years to fully develop and test. However, the website, funded by the California Pistachio Research Board is already being developed.

Progress and Projected Results:
A grower interface website for the project has already been constructed this fall with funding from California Pistachio Research Board. Its current format provides information to growers about the goals of the project and the methods we are taking to meet them. As our modeling research through the CDFA grant progresses, more and more applicable information will be available through this site. By the end of spring 2011, growers will be able to come to this site to track the progress towards bloom and leaf-out in their area based on our latest mixed models. Similar to the current chill accumulation webpage at http://fruitsandnuts.ucdavis.edu/Weather_Services/ growers will be able to access the nearest CIMIS station to find the dormancy portion that has been completed, and based on that, when their trees are predicted to bloom. As the website is being developed it will also include an interactive page allowing growers to give feedback on the accuracy and precision of the developing by comparing the websites' bloom projections with observations from their orchards.

Once a model has been developed and verified for California, temperature projections for California under different emission scenarios for mid- and end-of-century conditions will be plugged into the model. By projecting the amount of winter chilling and spring heat that will be available in the future, and accurately modeling the requirements of current cultivars, we will be able to project which cultivars are most suitable for cultivation in specific areas in the future. These projections can also be used to direct future pistachio breeding programs.

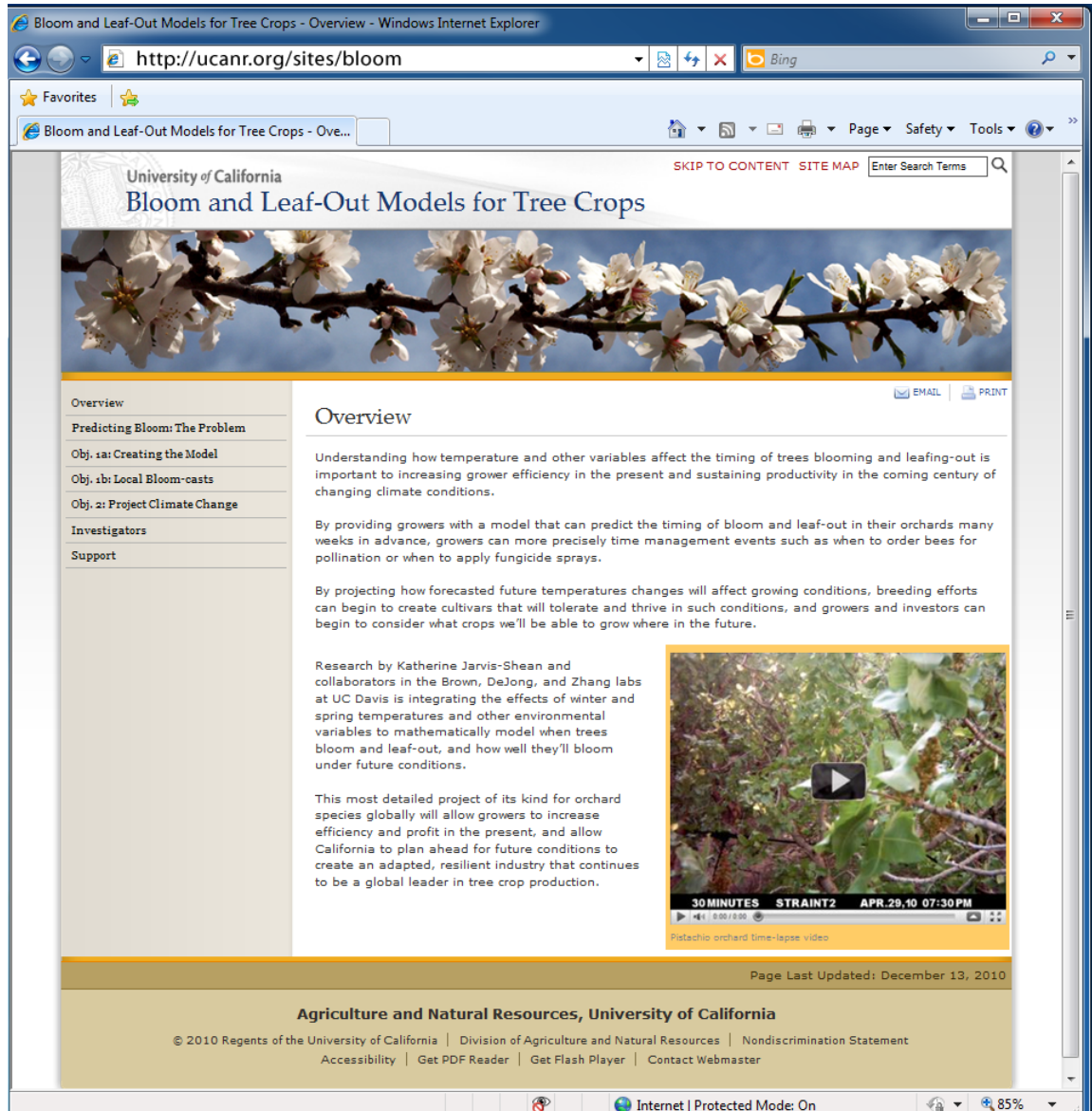We thank the California Pistachio Research Board for their support.

Fig. 1. Home page of the website being developed for this project.

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