EFITA WCCA CIGR
2013 Conference
TORINO, ITALY
Sustainable Agriculture through ICT innovation

AgroClimate Decision Support System: From Web-based Solutions to Mobile Apps

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ABSTRACT

AgroClimate is a web-based system developed to help the agricultural industry in the southeastern USA to reduce risks associated with climate variability. It includes climate related information and dynamic application tools that interact with a climate and crop database system. Information available includes seasonal climate monitoring and forecasts combined with risk management tools for a range of crops, forestry, pasture, and livestock. More recently it has been expanded to include decision-aids based on real time weather monitoring and short-term weather forecast. This expansion prompted the development and adaptation of existing tools to mobile phones. Decisions targeted for mobile phone applications are related to application of fungicides in high value crops such as strawberry and citrus, irrigation scheduling, and tracking of growing degree-days and accumulation of chill hours.

Keywords: Climate variability, weather, risk, decision support, ICT, USA

1. INTRODUCTION

Weather describes conditions in the atmosphere that are happening today or over a short period of time. Decisions made by farmers based on weather monitoring and forecasting are tactical decisions such as applying agrochemicals, and planting or harvesting a crop. Climate describes the long-term weather patterns for a specific area and time of the year. The average amount of annual or monthly rainfall or average temperature during winter or summer months, are examples of climatological information for a given location (Fraisse et al., 2012). The approach used to mitigate risks associated with seasonal climate variability focuses primarily on techniques such as shifting planting dates, changing crop varieties, and cultural practices (Fraisse et al., 2009). *AgroClimate* (http://www.agroclimate.org) (Fraisse et al. 2006) is a web-based system developed to help the agricultural industry in the southeastern USA to reduce risks associated with climate variability. It includes climate related information and dynamic application tools that interact with a climate and crop database system. Information available includes seasonal climate monitoring and forecasts combined with risk management tools for a range of crops, forestry, pasture, and livestock. The system was developed to allow easy

C. Fraisse, J. Andreis, W. Pavan. "AgroClimate Decision Support System: From Web-based Solutions to Mobile Apps". EFITA-WCCA-CIGR Conference "Sustainable Agriculture through ICT Innovation", Turin, Italy, 24-27 June 2013.

expansion of topic areas, number of commodities, and risk management tools available for users at different locations in the Southeast. *AgroClimate* is currently being replicated and adapted by growers' cooperatives in Paraguay and Brazil.

The expansion of the *AgroClimate* system to include decision-aids based on real time weather monitoring and short-term weather forecast has prompted the development and adaptation of existing tools to mobile phones. The use of mobile phones in agricultural areas is causing a revolution in the way information is provided to farmers around the world, including in developing countries where Information and communications technologies (ICTs) have spread rapidly in the recent years. There has been considerable interest in the potential role ICTs, particularly mobile phones, have begun to play in the marketing of agricultural inputs and outputs and also in providing information with the potential to help increase production and/or reduce risks. In terms of weather information, major providers of weather information in many countries have developed specific applications for mobile phones that provide weather monitoring and forecast to customers with access to the Internet. However, weather information by itself may not increase farmers' profits or reduce production risks associated with climate variability or extreme events such as freezes, droughts, and excess rainfall. Weather and climate information must be associated with a decision or "solution" customized to a particular commodity and cropping system. To fill this gap researchers at University of Florida, U.S.A. and University of Passo Fundo, Brazil are cooperating to develop solutions delivered via mobile phones.

2. MOBILE AGROCLIMATE

Mobile phones are an effective way to reach farmers at the time tactical decisions are made in the field and nicely complement information and tools available in the web that provide a more in depth analysis of climate-related risks and can be used as planning tools for strategic decision making.

Decisions targeted for mobile phone applications in the *AgroClimate* system are related to application of fungicides in high value crops such as strawberry and citrus, irrigation scheduling, and tracking of growing degree-days and accumulation of chill hours.

2.1 Strawberry Advisory System

The Strawberry Advisory System (SAS) (Pavan et al., 2010) is one of the AgroClimate tools available for mobile phones. It provides farmers with real time information about disease risks and the need or not to apply fungicides. Strawberries are one of the most valuable crops in Florida. Our experience with strawberry growers has shown that during dry years they can reduce the number of fungicide applications by as much as 50% without any losses in yield or quality of the fruit. During its first year of testing (2009/10), the system saved over 10 applications of fungicide for a group of growers that signed-up for the test. The savings in fungicide and application costs during that

season amounted to about US $750 per ha. It not only increased profits but also reduced the environmental impact of the activity. SAS was a main driver for the development of mobile *AgroClimate* applications. E-mail and Short Message Service technology (SMS) were tested during the 2009/10 strawberry season aiming at a rapid communication with producers and extension agents. The system automatically sends SMS messages and e-mails to registered users whenever the calculated infection index crosses the moderate and high-risk thresholds. SAS has been enthusiastically received by farmers and is now used in more than half of the strawberry production area in Florida. It is also being expanded to South Carolina and North Carolina under a grant of the U.S. Department of Agriculture. SAS prompted our team to make the development of mobile phone-based alert systems an important component of the University of Florida - IFAS climate extension program. Initially we developed HTML-based applications that are still in operation and available on http://AgroClimate.org/Mobile.

2.2 Citrus Copper Residue Calculator

Copper fungicides are commonly used for protective applications against foliar fungal and bacterial diseases in citrus groves. Management of these products must be finely balanced between disease prevention, application costs, fruit blemishes caused by copper phytotoxicity, and toxic accumulation of copper in the soil. The traditional schedule for copper sprays in Florida is an every 21-day post-bloom application. However, our computer simulation analysis showed that this traditional schedule is inefficient and leaves the grove unprotected in wet years and applies unnecessary copper sprays in dry years. In order to facilitate the copper management for the citrus growers, an 'easy-to-use' internet-based decision support system was developed (Zortea et al., 2013). More recently this system has been adapted to mobile phones in order to facilitate the evaluation of fruit protection and need or not to schedule copper applications in the field.

2.3 Smart Irrigation Tools

More recently we started developing native smartphone apps aimed at helping growers in the southeastern USA schedule irrigation for citrus, cotton, strawberry, and urban lawns. Apps are being developed for both iOS and Android operating systems. Apple (xCode/iOS SDK) and Google (Android SDK) allow the developers to build the project, from the programming logic to the user's interface. Each platform has specific characteristics and programming languages, (i.e.,Objective C for iOS and Java for Android). Apps will have the same structure and use Google Maps API to present weather stations in a map view and access the database for calculations through WebServices in the *AgroClimate* server. We expect the development of native smartphone applications to become mainstream as growers in the USA and abroad increasingly update their equipment to smartphones with Internet access.

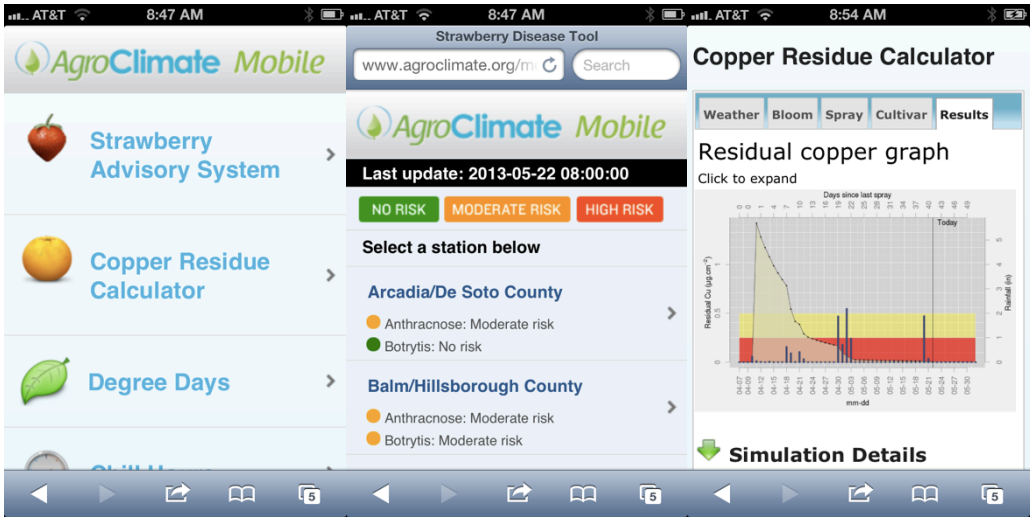

Figure 1. Initial HTML-based AgroClimate applications were developed to help growers decide about fungicide applications and track growing degree-days and chill hours accumulation.

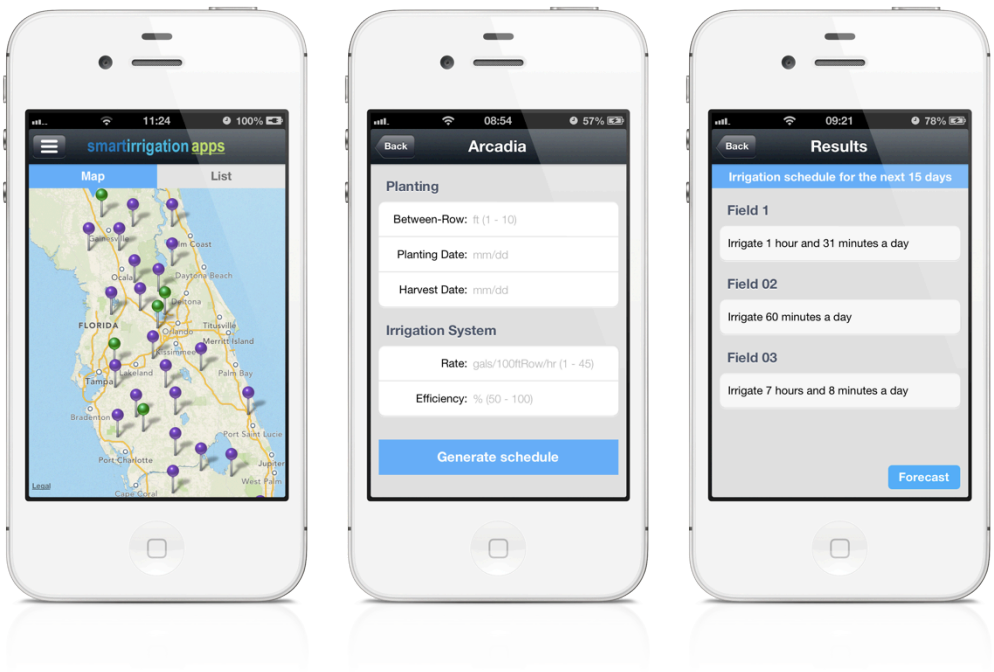

Figure 2. Smart irrigation tools are being developed for both iOS and Android operating systems targeting strawberry, citrus, cotton and turf grass.

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3. CONCLUSIONS

It is one of our main goals in the *AgroClimate* system to invest in the development of mobile apps to provide weather and climate-based decision support aids to the agricultural industry. In spite of the fact that most farmers currently don't own smartphones, we firmly believe that a significant number of farmers across the world will soon upgrade their equipment and services. To enhance our probability of success in making weather and climate information useful to the agriculture industry we consistently use participatory approaches in the development of decision-aid tools. We incorporate farmers and extension agents into the development process through focus groups, app piloting, and continued review. The participatory processes enhances legitimacy of the *AgroClimate* project and provide many additional useful benefits. In addition to being useful for feedback and dissemination, they have provided a measure of accountability and transparency (Breuer et al., 2009). Through participatory processes, stakeholders have better "buy-in" and some measure of ownership of the project. They also tend to nurture equality, by placing researchers and stakeholders on a level playing field.

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