Development of a smartphone application (app) to facilitate implementation of IPM practices in strawberry production

Final Report

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Extension Proposal

Principal Investigators

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Objectives

Release Version 1.1 of a mobile application (app) in 2015 that will assist strawberry growers implement pathology AND entomology-related IPM practices.

Justification and Description:

Strawberry growers are trying to cope with a variety of challenges during the production season. Among them, diseases and pests are the major issues, both of which need to be managed to produce fruit of high quality. Although many resources are available to growers that help them make good management decisions, such as spray guides, extension publications, resistance management guides, online photo galleries, extension and research books, newsletters etc, there is no one resource that brings key elements together. Most IPM related questions come up in the field when the farmer, crop advisor, or specialist encounters a problem. But in many cases the necessary resources for problem identification and management are not available at that time. The spray guide might be in the pesticide shed, the computer in the office, searching the internet is too cumbersome on the smartphone, and extension brochures are filed away. That may lead to a delay or even neglect of critical action. Mobile phones today have become a necessity in human being life. It treated as a vital instrument carried by individual to be

informed and connected with the world. To data, there are more than 160 million smartphone users in the US, and the number may reach up to 200 million by the year 2016. However, there are only a few agricultural apps available. Two phytopathological apps, *Turf MD* and *Tomato MD* sponsored by American Phytopathological Society (APS) have been developed and released recently. These apps offer only diagnostic keys supported by pictures and text. To our knowledge there is no phone app available that provides comprehensive IPM information for a specific crop.

We are in the process of developing a smartphone application (app) that will offer an integrated approach for disease management. The funds requested in this grant will go towards funding a student to help with the programming and data entry to add the insect/mite portion to the app. The app is called MyIPM and is specifically designed in support of growers in southern states but many features will also be of use for growers worldwide. We will release Version 1.0 in January 2015 (see timeline). Version 1.0 covers the disease portion of MyIPM for strawberry:

- The **main page** (Fig. 1A) lets the user choose between a diagnostic tool, the opportunity to learn more about single diseases (pictures, epidemiology, biological control, conventional control and more), active ingredients, trade names, fungicide resistance basics, podcasts, and a tool to send pictures and text to one or more local specialist.

- When selecting a **disease**, there are four components: "**summary**" featuring information in a nut shell; a '**2-min audio**' featuring the most important things to know about the topic for the producer recorded by regional specialists; "**photos**" featuring macroscopic and microscopic pictures, and "**more**" featuring symptoms and signs, chemical control, fungicide resistance issues in the Eastern U.S., and non-chemical control options (Fig. 1A-D). For the 2-min audio we recruited the experts of the particular diseases (Natalia Peres at UFL for anthracnose fruit and crown rot, and charcoal rot, Bill Turecheck at USDA for angular leaf spot, leaf blights, red stele, and Verticillium wilt, Dave Gadoury at Cornell for powdery mildew and Frank Louws at NC State for gray mold, Botrytis crown rot, and Phytophthora crown rot).

- "**Active ingredients**" will have a sortable list of currently registered active ingredients, their color coded FRAC codes and efficacy values for each disease separately. Labeled trade names for a specific active ingredient can be listed by clicking the active ingredient name (Fig. 2A). Consumer, worker, and environmental toxicity data is displayed next to efficacy data (not shown in figure) and is based on the Environmental Impact Quotient (EIQ) equation (http://nysipm.cornell.edu/publications/eiq/equation.asp; http://www.nysipm.cornell.edu/EIQCalc/input.php). This feature allows the user to use an effective and less risky fungicide looking at side-by-side data.

- "**trade names**" will be sortable and PHI, REI, and toxicity information will be featured (Fig. 2B).

- "**fungicide resistance**" covers FAQs, instructions for collecting and mailing gray mold samples for resistance profiling (a service offered by the Schnabe lab) and a description of the situation in the eastern U.S. are available (Fig. 2C). There will also be a 2-min audio about the basics of fungicide resistance evolution and management by Dr. Schnabel.

- "**Podcasts**" (audio recordings) of experts recorded at production meetings or conferences) are available to learn more about IPM related issues. All talks can be searched by key words, titles, authors, and years. This feature may be popular among growers during car trips for example (Fig. 3A-C).

- "**Texting state agents and specialists**" via phone number with pictures and text documenting a problem is one of things we are most excited about. The specialist will have to sign up with the app administrator (Dr. Schnabel). Growers will only be able to contact the own-state specialists and a black list will be available to block phone numbers if there is misuse. This feature is still under development but we anticipate completion by October 2014.

Based on funding support from the USDA Southern Region IPM program (ending at the end of 2014) we will be able to release Version 1.0 with the above features by January 2015. Prior to release we will have three select regional experts review the app content for accuracy (Powell Smith, Phil Brannen, and Frank Louws).
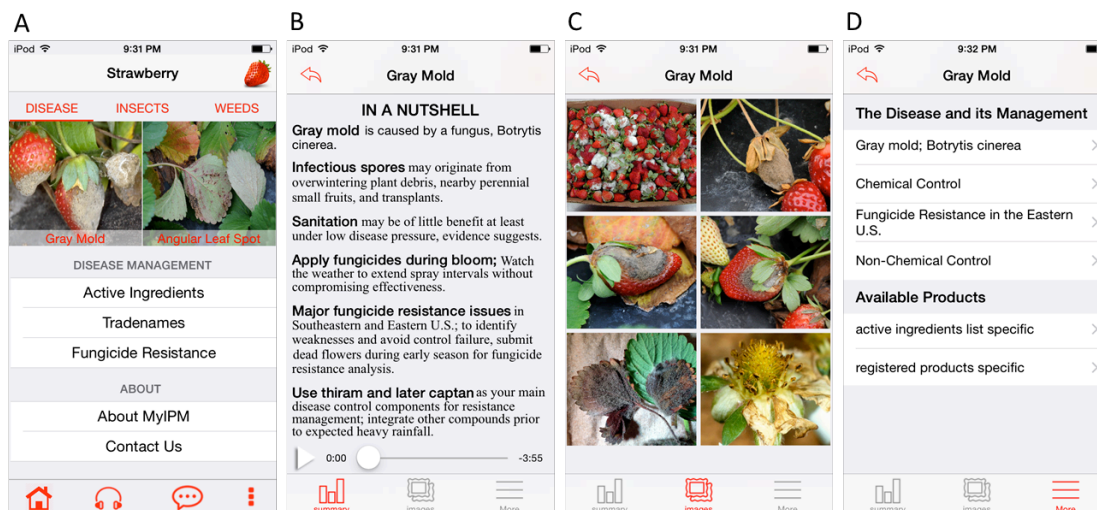
Figure 1. Disease Pages for gray mold of MyIPM (when selecting 'Gray Mold' on main page). A = main page of MyIPM. B = information in a nutshell plus a 2-min audio from an expert. C = zoomable high solution images of gray mold. D = more information about gray mold and biological, cultural, and chemical management options.

Figure 2. Active ingredients color coded by FRAC codes, their efficacy (0 to 5), trade names, rate per acre, PHI, REI. A = active ingredients page of gray mold. B = trade names page of gray mold (note the user can slide the second and third columns from right to left). C = fungicide resistance page featuring FAQs and generally information.
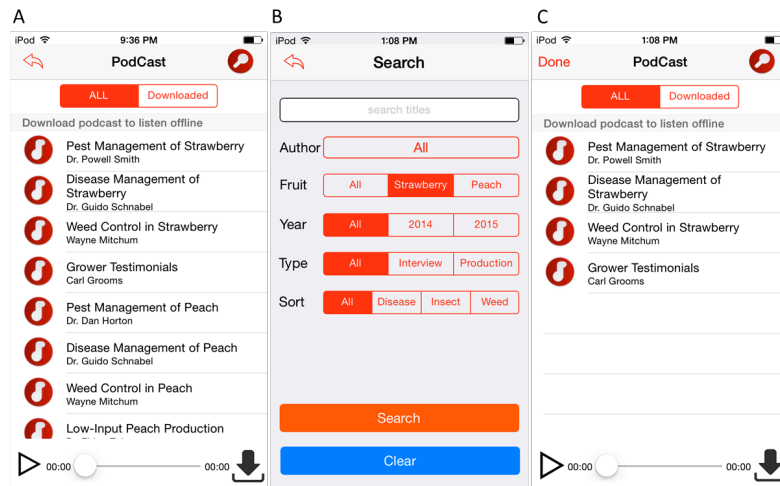
Figure 3. Podcasts searchable by author, topic or type. A = podcasts page of MyIPM. B = searchable podcasts by author, fruit, year, type, and discipline. C = search results when entering 'strawberry' in searchbox.

The funds requested in this proposal will enable us to add insects and mites to MyIPM, including diagnostics and associated specific information (in a Nutshell, Pest Management details and 2-min audios), trade names, active ingredients, and tool and include active ingredient and trade name lists for Version 1.1. We anticipate there to be about 10 to 12 insects/mites to be included and that again we can recruit regional experts for providing 2-min audios and pictures. Hanna Burrack and Powell Smith have already agreed to working with us as consultants on the entomology part of MyIPM. The active ingredients, efficacy, PHI, rate, REI and trade name data for our external database will come from the Southern Spray Guide. Toxicity data from the Cornell website.
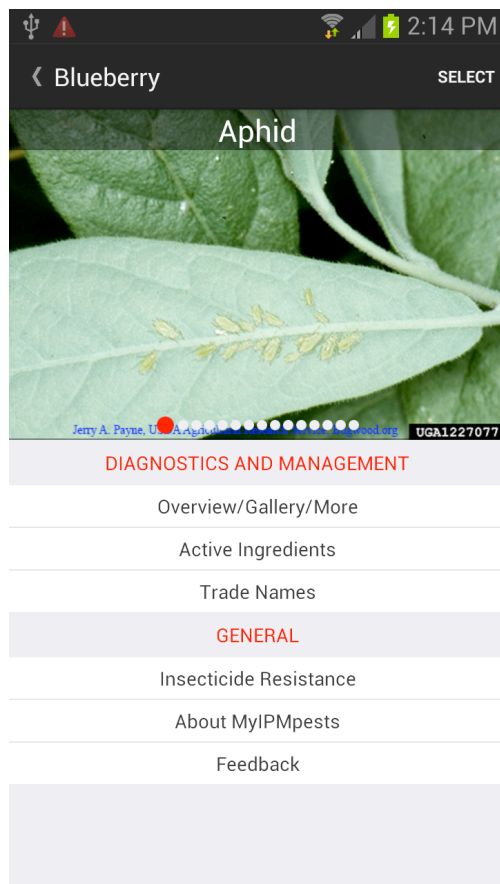
Sustainability of MyIPM. Dr. Schnabel has full access to the authoring tool, which allows ALL data, text and pictures to be changed. He has committed to keep MyIPM up to date as part of his extension responsibilities. Updating data, text and figures online through the authoring tool will not require grant funds.

Future plans (not proposed under this grant) include an abiotic (nutritional deficits, temperature damage, phytotoxicity symptoms, etc) diagnostics tool and a statement for each disease pest or abiotic symptom that it can be confused with y and z. When the

different disciplines (diseases, insects/mites, and abiotics) are programmed and populated with data and when all is tested and retested and works well, we can move into using the same programming structure to add more fruit crops (that would be version 2.0 and up).

Results and Conclusions

We completed the strawberry disease section of MyIPM and added Fusarium wilt disease using the SRSFC funds. For 13 diseases growers and specialists can now retrieve Diagnostics and Management information, including an overview screen, picture gallery, details on biology and epidemiology, an interactive active ingredient table, and an interactive trade name table. The General part also included principles of resistance management, information about MyIPM and its creators, and an option to contact Dr. Schnabel. As of November 2015, the MyIPM android version has been downloaded 600 times with an average rating of 4.31 out of 5 and the iOS version has been downloaded 300 times with an average rating of 5 out of 5. Most users are from North America, but significant downloads are from Australia, Mexico, Marocco, Spain, Poland and England.

The funds were also used to start working on an insect version of MyIPM for strawberry, blueberry and peach A draft for blueberries was created but is not yet published (see picture on left). This new app will cover blueberries, strawberries and peaches.

Impact Statement

   The excellent ratings of this product mentioned above speak for themselves and signal favorable assessment by the end user. In addition, we have gotten several grower and specialist testimonies:

"The app is great for both peaches and strawberries. I will definitely be using it in the fields."
Pete Wilson, Cotton Hills Farms, Lowrys, SC

"Only one of it's kind I have seen, and it is long overdue"
Jon Clements, Fruit Extension Specialist, University of Massachusetts

I just wanted to let you know how excited we are about this app you have developed. We heard your presentation in Savannah and Ethan couldn't stop talking about how helpful it will be for spraying. Now it's going to be so much easier to rotate our modes of action and choose effective pesticides that are the least toxic. Consumers are concerned about the effects of pesticides and so are we, so it's nice to have a tool that will help us use them responsibly. Thanks so much for all you do for growers.
Frankie Johnson, strawberry farmer

Dr Schnabel, I'm a vegetable grower in the Salinas valley and would like to see if there is anything that could be of use in the way of a similar app like what you have for berries.
William Hopkins, vegetable grower, CA