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## Biological Control

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## Web-based outreach for orchard management decision-makers



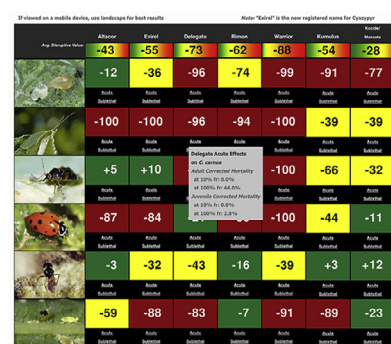
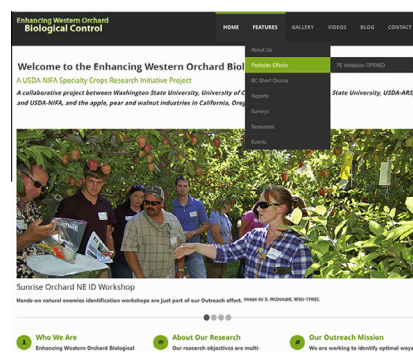
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## HIGHLIGHTS

- Online information transfer is needed to supplement extension education programs.
- The project website and videos increased in popularity over time.
- Social media proved to be impractical and unpopular with stakeholders.
- OPENED is an interactive database of pesticide effects on natural enemies.
- Online decision tools are available to give more sustainable management choices.

## GRAPHICAL ABSTRACT



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## ABSTRACT

The traditional role of extension has been to provide the bridge between research-generated knowledge and technology to stakeholders through instruction, practical demonstrations, and developing applications of existing, improved or novel practices and technology. However, the number of educators and extension specialists has been decreasing and their roles changing, while stakeholder groups have become more dependent on timely information to cope with rapid changes in management programs. These circumstances necessitate a change in the way information delivery occurs. A key component of the outreach objective in this project was to develop web-based tools to speed the dissemination of research information to decision-makers. Web-based outreach is intended to supplement, but not replace, extension personnel. Hands-on training and direct interaction with the stakeholders is still necessary to insure that relevant information is not just delivered but understood. Here we discuss how our web-based outreach integrates with traditional training as well as other digital information sources available into the future.

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## 1. Introduction

Cooperative Extension has undergone a significant broadening of its programs and client base since its inception in 1914 and especially since the later part of the 20th century (Vine et al., 1963; Ratchford, 1984; Urbanowitz and Wilcox, 2013). Whereas

the initial focus was on agriculture, 4H, and rural development, it now includes additional areas such as urban family and community development, consumer science and youth development (Diekmann et al., 2012; Warner et al., 1998). The increased activity in new program areas and with more diverse clientele has paralleled a decrease in federal and state funding for extension. In the past, the primary focus of Cooperative Extension in agriculture was to provide farmers with research-based information through a network of county-based agents and university-based specialists.

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As the number of extension personnel has declined, service areas have increased along with an increasing demand for a broader knowledge base. The traditional information transfer model used by extension was to have researchers share results with university-based specialists who then interpreted, summarized and delivered the information to county-based agents for wider public dissemination through vehicles such as demonstration projects, stakeholder meetings and newsletters. A drawback with this model is its high cost in terms of personnel time and travel, especially when extension budgets and the workforce are shrinking. One way to address the loss of funding is to include outreach objectives within research grants. This is only a short-term solution because once the grant has completed, extension in most cases does not have the capacity to sustain programming that was developed during the grant. Another problem is that the traditional model is estimated to take seven years to go from information transfer to implementation of new technology or practices in agriculture (Alston et al., 1995). This lag time is too long to respond to problems such as invasive pests or diseases that require fast turnaround on knowledge delivery. With the Internet being more accessible even in rural communities (Bonlander, 2013; Horrigan, 2010), the use of web-based programs provides an effective solution to help speed the delivery of research-based knowledge, educational materials, training, and decision support systems (Jones et al., 2009). While face-to-face meetings and on-site instruction are the long-time favorites of both extension and the agricultural community, in reality they are too costly to be the primary form of outreach in the current funding climate. Electronic forms of information make outreach more cost effective and more responsive to emerging issues (Jones et al., 2009; Schneider et al., 2011; Trede and Whitaker, 1998). Therefore, one objective of our Specialty Crop Research Initiative (SCRI) project focused much of its outreach programming on the development of web-based components containing new information generated by the researchers, such as visual guides, multi-media and interactive information tools requiring little or no maintenance that would be useful well beyond the completion of the project. A more complete explanation about all project objectives and their execution can be found in the introductory article of this issue (Jones et al., 2016a,b).

## 2. Stakeholders and information transfer

At the project onset, Pacific Northwest growers, orchard managers and crop consultants with responsibilities in apple, pear and walnut were surveyed to determine how they preferred to receive information and if they accessed the Internet looking for this information. The majority of pear growers (93% in Oregon and 82% in Washington) indicated that they use computers for farm business and 75% regularly access the Internet to acquire farming information (Goldberger et al., 2016). These results meet or exceed state and national means from concurrent NASS surveys on farm computer usage and ownership (NASS, 2009, 2013). Washington apple growers and crop consultants had a difference of opinion about their preferences in receiving farm management information. Although the majority of both groups preferred face-to-face delivery methods, nearly 60% of the consultants also accessed web resources compared to about 36% of growers (Gadino, 2012). A similar pattern of correlation was seen for NASS data on California farmers and our survey data from California walnut growers (Goldberger et al., 2016).

Based on participant preferences from our surveys (Gadino, 2012; Goldberger et al., 2016) and suggestions from the literature (Kallioranta et al., 2006; Kinsey, 2010; Ray, 2007), we launched a broad spectrum of Internet resources including a dedicated pro-

ject website, a blog, and several forms of social media. The purpose of the website was to inform stakeholders about the project and keep them updated about its progress and new information that was being generated. The blog and other social media sites were employed for a more direct interaction with stakeholders and to promote latest research findings and outreach events with links to more detailed information on the project website.

## 3. The project website

### 3.1. Website content

The content of the project's website was geared toward stakeholders (growers and crop consultants) and the scientific community by delivering basic, newly generated and synthesized information on enhancing biological control in orchards (<http://enhancedbiocontrol.org>). Upon entering the website, visitors were presented with a short synopsis about the project, spotlights of featured content and a revolving slideshow of project related events and information. The website was easily navigated using the menu at the top of the page (Fig. 1). The majority of the project output fell under the Features heading. From there, visitors could get more detailed information about the project members and objectives or follow the project's progress by browsing through or downloading annual reports, survey results, lists of presentations, posters, and articles published in scientific journals and trade magazines. Synthesized results from the pesticide effects studies were also located under this heading (see Section 3.2 below), as well as a section with downloadable resources for identifying natural enemies. The remainder of the content fell under the separate menu headings galleries (natural enemies image galleries) and videos (topic sortable video gallery) making access to these resources more visible.

The website also served as a hub for advertisement and registration for the two-day interactive short course on orchard biological control offered in 2012 (Gadino et al., 2016). After the short course was completed the advertisement page was converted to a resource page hosting downloadable course materials and viewable presentations ([http://enhancedbiocontrol.org/BC\\_SC.html](http://enhancedbiocontrol.org/BC_SC.html)).

### 3.2. Pesticide effects information and OPENED

A major focus of the project website was to educate stakeholders about the newly discovered sublethal effects of certain pesticides on natural enemies (Mills et al., 2016) and to deliver this information in a fashion that would help them in their pest management decision-making process. Visitors to the website learn about sublethal effects of pesticides through the lens of limitations on population growth. The research results were summarized in an interactive table showing impacts on overall population growth for each pesticide-natural enemy combination (<http://enhancedbiocontrol.org/PE.html>). The table was color-coded for better visualization of the effect ratings (Fig. 2). Visitors mouse-click (desktop or laptop browser) or touch (tablet or smartphone browser) a table cell to view more detailed information, such as acute toxicity or individual sublethal effects for a specific pesticide on a specific natural enemy.

The initial idea to compare project information of sublethal pesticide effects on natural enemies with other similar available data led to the development of the Orchard Pesticide Effects on Natural Enemies Database (OPENED; <http://enhancedbiocontrol.org/opened/>). In OPENED, pesticide toxicity ratings for selected pesticides and natural enemies relevant in orchards in the Pacific

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