Journal of Extension
www.joe.org

April 2012
Volume 50 Number 2
Article Number 2FEA10

Return to Current Issue

Extension Leads Multi-Agency Team in Suppressing a Pest in the West

Diana Roberts
Area Agronomist
Washington State University Extension
Spokane, Washington
robertsd@wsu.edu

Sujaya Rao
Entomologist
Oregon State University
Corvallis, Oregon
sujaya@oregonstate.edu

Abstract: Team leadership by Extension personnel in coordinating regulatory efforts, research, and farmer education culminated in rapid suppression of the cereal leaf beetle pest in the West. The Western Cereal Leaf Beetle Team, consisting of 37 federal, state, and university personnel from seven states and two Canadian Provinces, tracked the pest, assessed its economic impact, and implemented a biological control program. They were successful largely due to the simultaneous education of growers on biological control and pesticide use. Program success followed Extension's commitment to an integrated approach, communication, and rapid dissemination of results between team members and the grower community.

Introduction

Dr. R. James Cook, a nationally renowned USDA scientist, asked during a visit to a cereal leaf beetle (CLB) field insectary in Washington State, "Why is Extension involved in this biological control project? Isn't that the purview of the USDA (United States Department of Agriculture)?"

Dr. Cook raised this question because USDA-APHIS (Animal and Plant Health Inspection Service) typically takes responsibility for large-scale, biological control projects in the United States (US).

However, in this western CLB biological control project, an Extension faculty member took the lead in coordinating the efforts of state, federal, and university personnel that culminated in successful suppression of the pest within 9 years of its inadvertent introduction into Washington and Oregon. While team efforts were focused on a cereal pest, the program is a model for Extension leadership in effective, regional programming.

The Problem Addressed

The cereal leaf beetle *Oulema melanopus* (Coleoptera: Chrysomelidae) is a serious pest of cereal crops and forage grasses (Morrill, 1995). Both adults and larvae feed on the foliage, causing considerable damage (Royce & Simko, 2000). CLB, a native of Eurasia, was first detected in the US in Michigan in 1962 (Castro & Guyer, 1963). Chemical eradication of the pest proved futile, but classical biological control using parasitoids from Eurasia was successful in Midwestern and eastern states (Dysart, Maltby, & Brunson, 1973). CLB spread westward and reached Montana (Blodgett, Tharp, & Kephart, 2004) and Utah (Hodgson & Evans, 2007) in the 1980's. It was first reported in Idaho in 1992 (B. Simko, Idaho State Department of Agriculture, personal communication, September 22, 2005), and in Oregon and Washington in 1999 (Rao, Cossé, Bartelt, & Zilkowski, 2003). The pest now occurs in western Canada from the Creston Valley of British Columbia to southern Alberta, southwestern Saskatchewan, and northwestern Manitoba (L. Dosdall, University of Edmonton, personal communication, April 12, 2010). Through 2010, statewide surveys in California have had no findings for CLB (M. Lubinski, California Department of Food and Agriculture, personal communication, April 14, 2011).

The Solution

State and federal agencies, university researchers, and Extension educators formed the Western Cereal Leaf Beetle Team (Hirnyck & Daniels, 2009) in 1999. However, team members struggled to coordinate pest management efforts. In 2004, an Extension faculty member from Washington State University (WSU) assumed the team leadership. Before long, the multi-agency team included 37 individuals representing seven states (Washington, Utah, Montana, Oregon, Idaho, Colorado, and California) plus two Canadian Provinces (Saskatchewan and Alberta) (Table 1).

Table 1.
Agencies Involved in the Management of Cereal Leaf Beetle in Western North America

Agency Category	Agency Name	Primary Team Function
Federal - USA	USDA-APHIS	Provided CLB biocontrol manual.
	USDA-APHIS-PPQ (Plant Protection & Quarantine) in MT, OR,	Conducted CLB surveys at state level and insecticide use survey in OR.

	and WA.	
Federal - Canada	Agriculture Canada	Conducted CLB surveys in Provinces.
State Departments	California Department of Food and Agriculture	Conducted annual surveys in California.
	Colorado Department of Agriculture	Reared egg parasitoids.
	Idaho State Department of Agriculture (ISDA)	Collaborated on CLB surveys, maintaining insectaries, releasing parasitoids, and collecting adult CLB for egg parasitoid rearing. ODA partnered with WSU on foreign exploration for parasitoids.
	Montana Department of Agriculture (MDA)	
	Oregon Department of Agriculture (ODA)	
	Washington State Department of Agriculture (WSDA)	
Land Grant University - departmental faculty	Montana State University (MSU)	Conducted CLB economic threshold studies.
	Oregon State University	Conducted host range and pheromone research.
	Washington State University	Conducted wheat yield loss studies and insecticide studies, maintained quarantine insectary, and conducted foreign exploration for parasitoids.
	Utah State University (USU)	Made the first releases of CLB parasitoids in the western US. Determined the phenology of CLB.
	University of Idaho (UI)	Maintained parasitoid insectaries
Land Grant University - Extension	Oregon State University Extension	Provided farmer education in Oregon, collaborated on insectary management.
	Washington State University Extension	Provided team leadership, farmer education. Coordinated CLB insectaries and biocontrol release in WA.

Provincial University	University of Alberta	Coordinated CLB surveys and biological control work in Canadian provinces.
Private Industry	Oregon Hay and Forage Association	Collaborated on CLB surveys and monitoring in Oregon.
	Quebbeman's Crop Monitoring	

Communication

Strong, effective, and frequent communication was crucial for coordinating work across such a large region and diverse agencies. The Extension team leader facilitated an in-person team meeting in 2004, which rejuvenated the energy of the group, and scheduled regular teleconferences to enhance communication between members. The team leader also established an email listserv that facilitated rapid dissemination of information. In addition, the team leader organized annual meetings for team members to meet in person, review progress, and coordinate future activities.

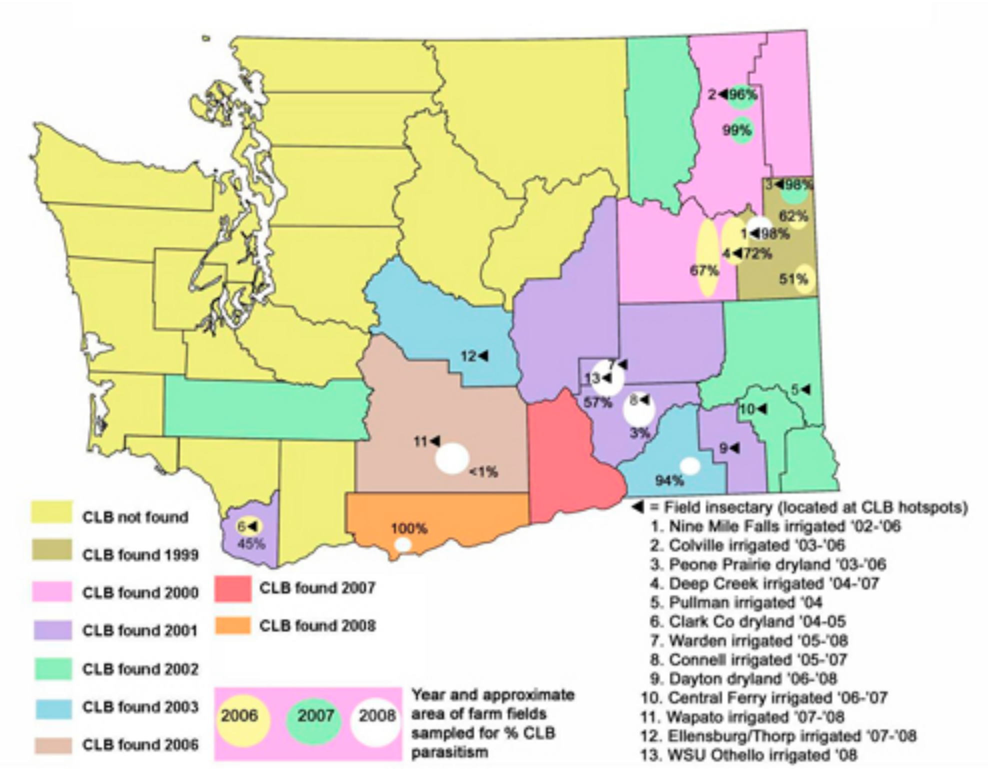
Team Collaboration

The Western CLB Team collaborated closely in order to maximize efficiency and avoid duplication of effort. Members implemented the following integrated pest management (IPM) tactics against the pest, details of which are available in their archive at <http://clbarchive.wsu.edu> (Roberts, Vyhnanek, & Rao, 2012).

Monitoring Pest Movement in the Region

The pest spread rapidly, and the Department of Agriculture and /or USDA-APHIS in each state conducted annual surveys for the pest in each county (Figure 1). They communicated new sightings to team members and growers via reports and maps.

Figure 1.
Summary of Cereal Leaf Beetle Movement and Parasitism Levels in Commercial Grain Fields in Washington State



Development of a Monitoring Tool

Researchers at Oregon State University (OSU) evaluated the aggregation pheromone of CLB and determined that it has potential as a monitoring tool, especially in the spring, when over-wintering beetles move into new fields. However, due to rapid biological management of the pest, demand for the pheromone was too low to warrant its commercial development.

Assessment of Pest Impact

Economic Threshold

Researchers at MSU estimated the economic threshold of CLB as three eggs or larvae per plant up to boot stage in spring cereals. After the boot stage, one egg or larva per flag leaf caused a yield loss of five-six bushels/acre.

Pest Impact

WSU researchers determined that CLB caused 25% yield loss in spring wheat. They conducted replicated yield loss trials in irrigated spring wheat to determine optimal times for insecticide applications against CLB.

Host Range

Oregon has over 500,000 acres in grass seed production. Many grass growers also raise cereals, and they were concerned about the impact of CLB on their grass crops. A host range study conducted by OSU researchers, in collaboration with industry personnel, demonstrated that newly seeded grass stands were especially at risk (Rao, Quebbeman, & Walenta, 2004) and warranted careful inspection.

Pest Phenology

A researcher from USU sampled grain fields weekly to determine the development of CLB throughout the season. He correlated CLB phenology with crop infestation, and defined the optimal timing of parasitoid releases.

Management of the Pest

Introduction of Biological Control Agents

In Utah, Montana, Idaho, Washington, and Oregon, a biological control program was initiated soon after CLB detection (USDA-APHIS-PPQ, 1994). Two parasitoids were used, an egg parasitoid, *Anaphes flavipes* (Förster) (Hymenoptera: Mymaridae) and a larval parasitoid, *Tetrastichus julis* (Walker) (Hymenoptera: Eulophidae). The egg parasitoid was mass-reared by Colorado Department of Agriculture personnel in Palisade, Colorado, and released at field insectaries where it was expected to have the greatest impact. Larval parasitoids were collected from eastern and Midwestern states and released into insectaries at Experiment Stations and growers' fields. The Canadian provinces observed the larval parasitoid moving into the region naturally, along with the pest host (L. Dosdall, University of Edmonton, personal communication, April 12, 2010).

Team members collected samples of CLB each spring to determine parasitism levels in the insectaries and in farm fields beyond the insectaries (Figure 1) as the parasitoids multiplied and moved further afield. Once *T. julis* established itself at an insectary, team members moved the parasitoid to new insectaries within each state.

While *A. flavipes* established in Treasure County, Montana, it did not thrive elsewhere. On learning that this parasitoid had not been of prime importance in the Midwest (F Stehr, Michigan State University, personal communication, January 13, 2010), the team discontinued its release.

The team maintained a database of locations where *T. julis* was established (Figure 1). This became a resource for grower decisions on insecticide applications. In general, *T. julis* parasitism levels above 70% indicated the wasp would keep the pest below economic infestations. When the parasitism level was around 50% and there was an economic infestation, the recommendation was that growers spray field borders and leave the rest of the field unsprayed so the wasp could continue to multiply.

Foreign Exploration for New Biocontrols

Researchers from WSU and the ODA engaged in foreign exploration for detection of additional CLB parasitoids. They identified and imported the egg parasitoid, *Anaphes nipponicus*, from China to determine if it would establish in the West. However, studies at WSU showed this species to be poorly adapted to Pacific Northwest (PNW) conditions and better suited to warmer areas.

Protection of the Biocontrols

In addition, WSU researchers tested selective aphicides for their toxic impact on the CLB parasitoids so farmers would have an aphid management tool that would not harm the beneficial insects.

Grower Education and Program Adoption

From the outset, Extension educators in Oregon and Washington State taught farmers about CLB identification, biology, and IPM control methods via workshops, newsletters, web pages, and trade journals. At field days, farmers learned how to dissect CLB larvae for detection of the parasitoid. Extension taught farmers to submit CLB larvae to diagnostic labs and to base their spray decisions on the levels of parasitism in their samples. They also taught farmers to apply pesticides in a way (leaving unsprayed areas in every field) that minimized negative impacts on the CLB parasitoids.

This proactive communication via Extension was novel to regional biocontrol programs and was vital to the project's success because it enabled growers across the region to learn about CLB before it reached their farms. For instance, on a field tour in Whitman County, Washington, in 2005, farmers who had never seen CLB adults or damage symptoms identified the insect immediately on walking into an infested field.

Assessment of Program Impacts

The Extension-led team assessed the program in several ways.

Extension Education

In a 2007 Internet survey of eastern Washington farmers, 60% of respondents had used Extension education in farm decision-making regarding CLB management. In addition, 80% of respondents identified email updates on CLB management as their preferred learning method.

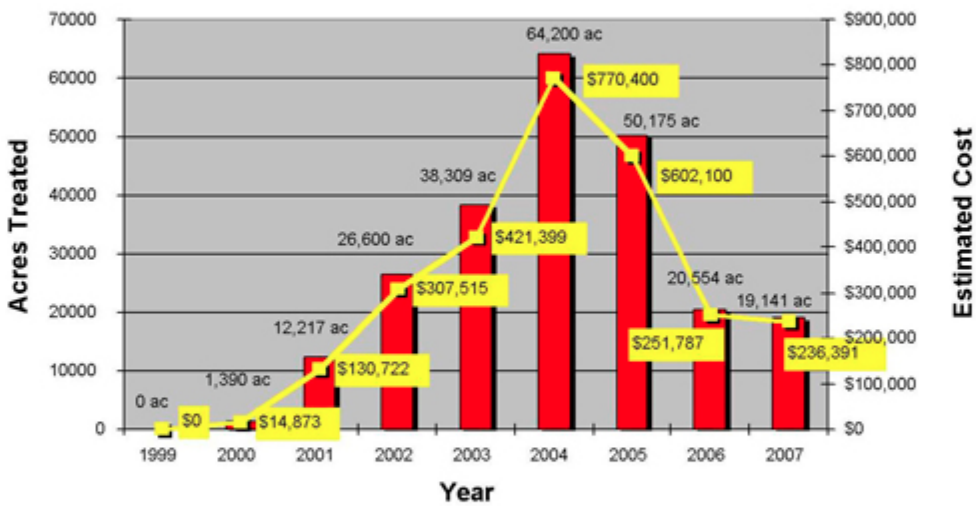
Economic Benefits

The Extension-led biological control effort resulted in major economic benefits to the region. Based on WSU yield loss data, CLB could cause losses worth $39 million per year to the spring wheat crop (25% loss from 20 million bushels at $7.89/bu in 2007) in Washington State alone (Washington State Agricultural Statistics Service, 2007). However, a 2007 survey found that because of the proactive biocontrol project and successful establishment and spread of the larval parasitoid, only 12% of dryland farmers in eastern Washington ever experienced damaging infestations of CLB. Washington State farmers thus save a potential $6.6 million per year in spray costs ($15/acre over 440,000 acres of spring wheat grown annually [Washington State Agricultural Statistics Service, 2007]).

Insecticide Use

USDA-APHIS-PPQ and Extension personnel conducted an annual survey of agri-chemical suppliers and growers to determine the extent and cost of insecticide applications against CLB in Oregon (Figure 2). The peak year for spraying for CLB was 2004, when 64,200 acres were treated. By 2007, the treated area was down by 45,058 acres (70%). This reduction followed adoption of biocontrol by farmers in the most severely affected counties as parasitism levels in CLB exceeded 90%.

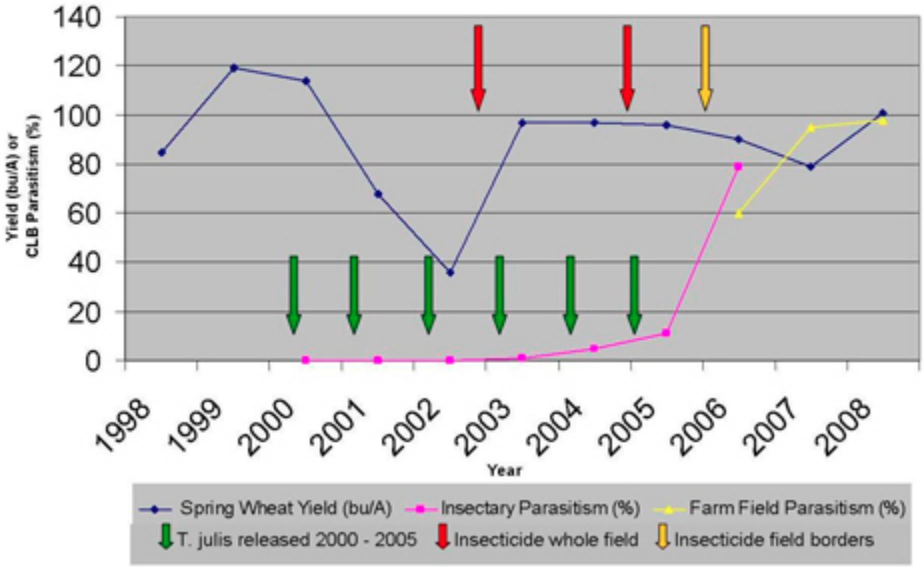
Figure 2.
Insecticide Use for Cereal Leaf Beetle Control in Oregon



Transition Time to Biocontrol

A farmer at Nine Mile Falls, Washington, who managed the first Washington insectary, kept track of his crop yields and insecticide applications. These data highlighted how he switched from chemical control of CLB in 2003 to complete dependence on the larval parasitoid of CLB by 2007 (Figure 3). In 2001 and 2002, before the CLB parasitoid had multiplied, CLB infestations reduced his yields (frost damage exacerbated loss in 2002). Therefore, he applied insecticide to whole fields in 2003 and 2005. By 2006, dissections of CLB larvae showed parasitism levels were high in the insectary and adjacent fields, so he used insecticide only on field borders. By 2007, he was using no chemicals for control of CLB on his farm.

Figure 3.
Farmer Transition from Insecticide to Biological Control of Cereal Leaf Beetle at Nine Mile Falls, Washington



Within 9 years, in most cereal-producing regions of Oregon and Washington, the larval parasitoid, *T. julis* had attained equilibrium with CLB (Figure 1). It had dispersed also to adjacent regions in Canada, following the natural movement of CLB. Western Canada recently began a formal biocontrol program, but surveys have also shown the larval parasitoid moving in along with the CLB host (L. Dosdall, University of Edmonton, personal communication, April 12, 2010).

Key Elements Leading to Program Success

Collaboration and Integrative Approach

Successful management of CLB was facilitated by the multi-agency nature of the Western CLB Team, the adoption of an integrated research and management approach, and cooperation across state and international borders. The team designed and implemented plans by drawing on the wide knowledge base and expertise of its members. The diversity of team members also enabled the Western CLB Team to tap into a variety of funding sources for research and implementation of biological control and other IPM tactics. These included:

- Federal sources—USDA-APHIS and USDA-CSREES-GSCSS (Cooperative States Research, Education and Extension Service-Grass Seed Cropping System for a Sustainable Agriculture),
- State agriculture departments,
- Commodity groups that are not traditional sponsors of such projects—the Washington Grain Commission, Oregon Forage and Hay Commission, and the Oregon Wheat Commission.

Leadership by Extension

Extension faculty engaged farmers in planning and implementation of important program elements. Farmer cooperators provided input on selection of appropriate locations for insectaries; some managed the insectaries themselves, and others conducted on-farm tests of oats as modified insectaries. Farmers also served as an informal advisory group for the project. When USDA-APHIS recommended releasing only one species per insectary to promote their successful survival and reproduction without competition, Washington farmer advisors advocated for a "survival of the fittest" approach. In Washington State, co-releasing the egg and larval parasitoids at the insectaries enabled the most successful bioagent to multiply and spread from several sites simultaneously. The larval parasitoid thus achieved equilibrium with the pest faster than if it were released at only half the insectaries.

In Washington and Oregon, Extension faculty provided farmers with proactive education to reduce unnecessary insecticide applications. They sent out timely updates on CLB via email listservs (Neufeld et al., 2007) and news releases in the media and trade magazines. Where farmers were able to submit samples of CLB larvae for parasitism assays, they knew quickly (usually within 24 hours) the levels of parasitism in their fields so they were able to make informed management decisions about spraying. These responses contrasted sharply with those in states that lacked Extension participation and education, where farmers continued to use insecticides against CLB despite the existence of thriving parasitoid populations in neighboring field insectaries.

In Washington State, CLB infestations occurred initially in irrigated areas in the easternmost counties and subsequently in the Columbia Basin. Due to the proactive implementation of CLB biocontrol and education by WSU Extension, farmers in the dryland areas sustained little economic damage, and minimal insecticide spraying occurred before the parasitoids reached equilibrium with the pest. In the irrigated Columbia Basin where insecticides are used frequently in potato crops, farmers may need to sustain some damage from CLB while the parasitoid reaches effective levels. However, even in this region, the larval parasitoid has spread beyond insectaries and increased its level of parasitism.

Farmers in Washington wanted to know how they could increase *T. julis* populations on their farms. In 2007, WSU Extension conducted a study on four farms to test the concept of using oats as a combination trap crop and modified insectary. Seeding an oat strip 30 to 60 ft wide between winter and spring wheat showed potential as a CLB trap crop, which could remain unsprayed as a modified insectary. The farmer who had managed the first CLB insectary planted an oat strip, trap crop/insectary again in 2008. While collecting CLB larvae to check their parasitism level, he made a comment that reflected his satisfaction with the CLB biological control project, "Who would have thought 2 years ago that it would take 2 people (a whole) hour to collect 50 CLB larvae in this field (that previously had a heavy infestation)!"

Conclusion

Traditionally, federal and state agencies have taken responsibility for handling incursions of new insect pests likely to spread across a region, while Extension has led delivery of local, educational programs that follow research on a topic—hence Dr. Jim Cook's question on Extension involvement in this CLB project. However, for biological control to be effective, timely grower education and cooperation is critical. Extension's strengths in rapid information dissemination and networking, as demonstrated in the project reported here, enabled many farmers across the PNW to adopt biocontrol strategies before crop loss from CLB ever reached economic thresholds.

References

Blodgett, S., Tharp, C. I., & Kephart, K. (2004). *Cereal leaf beetle*. Montana State University Extension Publication MT200406AG. Retrieved from: http://msuextension.org/

Castro, T. R, & Guyer, G. E. (1963). Notes on the biology, distribution and potential importance of *Oulema melanopus* (L.) in the Midwest. Proceedings North Central. Branch. Entomological. Society of America. 9: 175 (abstr. No. 294). Retrieved from: http://www.entsoc.org/

Dysart, R. J., Maltby, L., & Brunson, M. H. (1973). Larval parasites of *Oulema melanopus* (L.) in Europe and their colonization in the United States. *Entomophaga* 18:133-167.

Hirnyck, R. E., & Daniels, C. H. (2009). Pacific Northwest pest management workgroup: Leveraging partnerships across large geographic regions. *Journal of Extension* [on-line], 47(4) Article 4IAW6. Available at: http://www.joe.org/joe/2009august/iw6.php

Hodgson E. W., & Evans, E. W. (2007) *Cereal leaf beetle*. Utah State University Pest Fact Sheet, ENT-84-07PR. Retrieved from: http://extension.usu.edu/

Morrill, W. L. (1995). *Insect pests of small grains*. APS Press, St Paul, MN.

Neufeld, J. D., Reddy, S. J., Miller, J. S., Shock, C. A., Jensen, L., Olsen, N. L., Bohl, W., Hopkins, B., & Shock, C. C. (2007) Rapid dlivery of regional pest alerts using an interactive Internet site. *Journal of Extension* [On-line], 45(5) Article 5IAW5. Available at: http://www.joe.org/joe/2007october/iw5.php

Rao, S., Cossé, A. A., Bartelt, R. J., & Zilkowski, B. W. (2003). Aggregation pheromone of the cereal leaf beetle: field evaluation and emission rates. *Journal of Chemical Ecology* 29:2165-2175.

Rao, S., Quebbeman, B. M., & Walenta, D. L. (2004). Host range of cereal leaf beetle, and emerging pest in Oregon. *In* Young, W.C., Ed., 2003 *Seed production research*, Oregon State University Publication, Ext/Crs 123:50-51. Retrieved from: http://extension.oregonstate.edu/

Roberts, D. E., Vyhnanek, K., & Rao, S. (2012). Multi-agency team uses university archival tool to conserve vital project information. *Journal of Extension* [On-line] 50(2) Article 2TOT8. Available at: http://www.joe.org/joe/2012april/tt8.php

Royce, L. A., & Simko, B. (2000). *Cereal leaf beetle: Identification, control, and California quarantine alert*. Oregon State University Extension Service. EM 8762. Retrieved from: http://extension.oregonstate.edu/

USDA-APHIS-PPQ. (1994). Biological control of cereal leaf beetle project manual. Retrieved from: http://clbarchive.wsu.edu

Washington State Agricultural Statistics Service. (2007). Retrieved from: http://quickstats.nass.usda.gov/
