

## Western Integrated Pest Management Center

### Annual Progress Report

**Title:** New emerging pest in the Pacific Northwest: potato tuberworm biology and biological options

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**Reporting period:** Nov. 2005 – Sept. 2006

#### Problem statement:

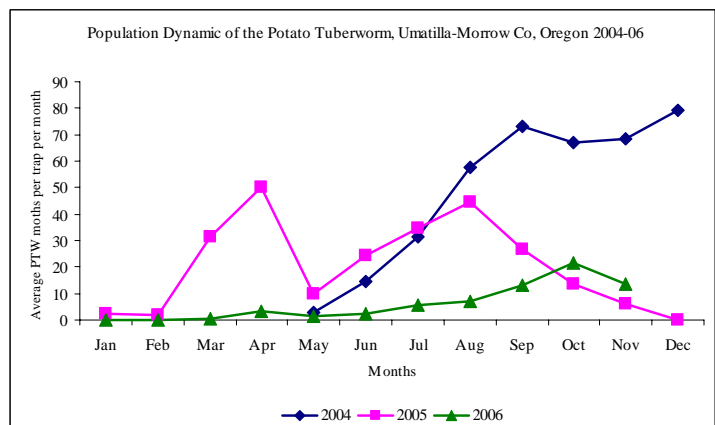
This project addresses a serious and emerging pest in Oregon, Washington, and other major potato-growing states across the northern U.S. The potato tuber moth or potato tuberworm (PTW) *Phthorimaea operculella* (Zeller) (Lepidoptera: Gelechiidae) is one of the most important pests that infest potato worldwide. It was first detected in Oregon in 2002, with a handful of reports of minor damage. In 2003, several fields were completely lost due to PTW, resulting in an economic loss of approximately \$2 million. This economic loss has increased substantially in 2004 and 2005, due to increased PTW densities in areas already infested, range expansion, damage, and the cost contributed to control measures.

#### Project objectives:

1. Determine PTW (a) overwintering stage(s), locations, and length; (b) hosts used for oviposition, overwintering, and feeding
2. Assess PTW parasitoids and predators
3. Communicate with industry extensively about this pest

#### Background information:

Although in 2004 and 2005 high numbers of PTW were found throughout the year, the 2006 growing season turned out to be substantially different. So far PTW numbers have been lower than counts from the previous two years. A previous study (Lal 1987) suggested that the severity of PTW damage the next growing season was primarily dependent upon its ability to overwinter in larger numbers; this statement may hold true in the Columbia Basin since last winter may have reduced PTW overwintering populations. However, this pest is still present and well established in the area. Will the population of PTW be different the next growing season? We cannot



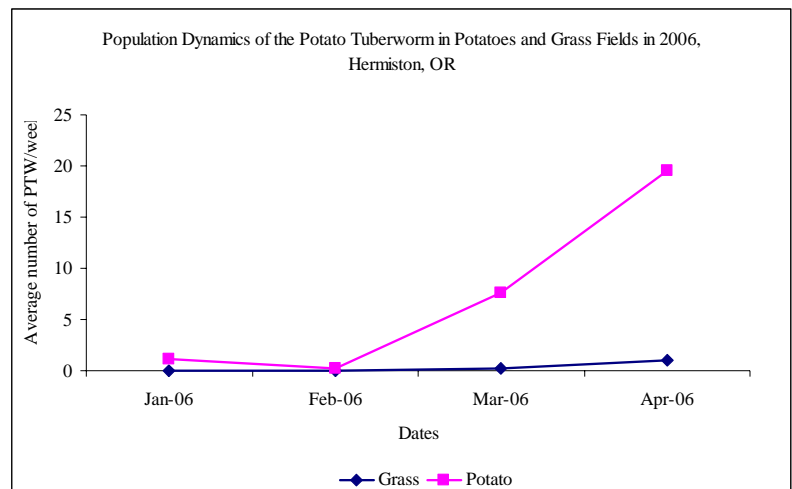
predict at this time, although current numbers are on the rise. We should continue the effort to track the development of this pest to adequately control it in the future.

### Accomplishments:

- A preliminary study of overwintering biology of PTW was conducted in late winter and early spring of 2006. Studies of overwintering biology included pheromone trapping, sampling soil, potato tubers, and debris in the field.
- A study designed to determine how cold temperatures affect survival and development of PTW eggs, larvae, pupae, and adults is nearing completion. Freshly laid eggs, larvae, pupae, and adults were raised in a controlled rearing room. The experiment consisted on exposing each stage to varying lengths of cold temperatures. This experiment produced information on the effect of temperature on the survival of each stage. Laboratory work is expected to be complete in late spring 2007. Preliminary results are presented.
- PTW larvae were brought from the field into the laboratory and checked for the presence of parasitoids. We recovered parasitic wasps that were submitted to the Museum of Entomology in Corvallis for identification. Species identification is pending.
- Information on PTW and results of the season's research were disseminated through numerous scientific and extension presentations. Information was published in trade journal articles, newsletters, the Washington State Potato Commission's *Potato Progress*, and an OSU web page <http://oregonstate.edu/Dept/hermiston/>. A Tri-State publication is expected to be in press early next year.

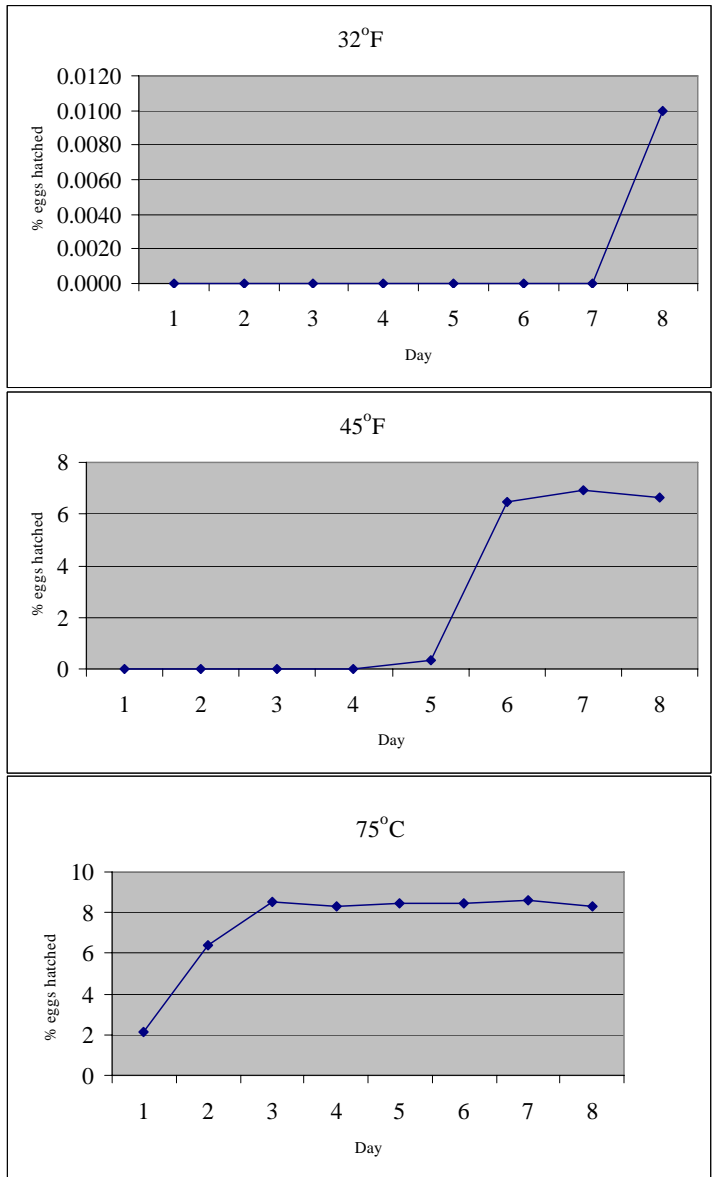
### Results:

**Overwintering.** In the fall 2004-winter 05, larvae, pupae, and adults could all be found; however, in fall 2005-winter 06 none of these stages were found. Besides checking plant debris and tubers, we also took over 100 soil samples around a previously heavily infested area and we did not recover any PTW stage. In the summer of 2006, we built walk-in cages (Washington State Potato Commission on Pesticide Registration funding) which contained 6 potato plants each; different densities of PTW adults were released (0, 1.5, 3.5 moths per plant). At the end of the season, mining and tuber damage was estimated. Moths were left inside cages to determine whether their offspring survive winter. Data from this experiment will be available in the summer of 2007. Pheromone trapping indicated that most PTW adult emergence occurred in fields that had been planted in potatoes the year before. Further research to examine both the location and stage of overwintering is occurring this winter.



**Effect of cold temperatures on PTW survival.** The laboratory experiment examining the effect of cold temperature on survivorship in PTW is nearing completion. We examined the

survivorship of eggs, larvae, pupae, and adults at 3 different temperatures (32, 45, and 75 °F) exposed 0, 5, 10, and 15 days at those temperatures. For each life stage, 1000 individuals were placed at each of those temperatures (i.e. 1000 eggs, 1000 larvae, 1000 pupae, 1000 adults). Then, after one week, Petri dishes containing 10 individuals of each life stage were removed from each chamber and placed at room temperature (75°F). Petri dishes were monitored daily to determine how many individuals survived and developed. Problems with the colony prevented the completion of the project. A new colony was started during the 2006 summer thanks to the aid of cooperators (Lerry Lacey, USDA, Yakima, WA). We expect to complete this part of our research by the end of May 2007. Data collected and analyzed so far show that eggs can survive exposure to 45°F; eggs developed into first instar larvae at room temperature in less than five days after 5 days of confinement at 45°F; 70% of the eggs hatched. At the coldest temperatures tested (32°F), only 0.01% of the eggs hatched. At the warmest temperature tested (75°F), eggs hatched in less than 2 days; approximately 82% percent of the eggs hatched. This work has important implications for storage since we do not know if PTW will survive in tubers in commercial storage conditions (potatoes are stored at 45°F). Based on data collected so far, eggs kept at temperatures below 45°F will survive, although it will take several months to become adults at this temperature



**PTW eggs were exposed at various temperatures for 5 days and then brought to room temperature**

**PTW parasitoids in Washington and Oregon.**

In 2005, although hundreds of PTW larvae were collected in the field and brought into the laboratory, no parasitoids emerged. In 2006, several larvae were found parasitized. Samples were collected and stored in alcohol at 70%. Samples were sent to the Museum of Entomology at Corvallis for identification, which is still pending. This information is promising for future steps towards augmentation of natural enemies.

**Communication/Extension.** Information on PTW and results of the season's research were disseminated through scientific and extension presentations, trade journal articles, newsletter, and numerous interactions with growers and other members of the potato industry. The details are listed below.

### **Literature Cited**

Lal L (1987) Winter survival of the potato tuber moth, *Phthorimaea opeculella* (Zeller), in potato fields in India. *Crop Res.* 27: 111-117.

### **PUBLICATIONS (2005-06)**

#### **Refereed In Preparation: 1**

DeBano, S. and S.I. Rondon. Biology and ecology of the potato tuberworm strain in the Columbia Basin. (*To be submitted to Environ. Entomol.*).

#### **Non-Refereed Journals and Proceedings: 2**

DeBano S., G. Clough, N. David, P. Hamm, A. Jensen, A. Scheiber, D. Wooster, and S.I. Rondon. 2006. Research on the development, biology, and control of potato tuberworm in the Columbia Basin conducted at OSU's Hermiston Agricultural Research and Extension Center. *In Proc. Washington State Potato Conference.* Moses Lake, WA. Pp 13-38.

Rondon S.I., S. DeBano, G. Clough, A. Jensen, and P. Hamm. 2006. Biología y manejo de la polilla de la papa en el noroeste de los Estados Unidos. *In Proc. Washington State Potato Conference.* Moses Lake, WA. Pp 139-141.

#### **Trade Journal Publications: 3**

Scientists review potato tuber moth research: world potato congress. *Potato country.* Nov. 2006. Pp 6-8.

Potato tuberworm: PNW taking proactive measure to stop threat by William Schaefer (Idaho correspondent). *Spudman.* April 2006. Pp 14-17.

Get the dirt on tuberworm: combine chemical, mechanical controls to fight profit-robbing potato pest by Vicky Boyd. *The Grower.* 39 (7): 18-20.

#### **Newsletter Articles: 3**

Rondon S.I., P.B. Hamm, and A. Jensen. 2006. Population dynamics of the potato tuberworm in eastern Washington/Oregon. *Potato Progress* Vol. 6, No 9. <http://potatoes.com>

Rondon S.I., and P.B. Hamm. Aug. 2006. Trapping potato pests in Oregon: leafhoppers, tuberworm and aphids. *PNW Veg. Team Newsletter (OR, ID, WA).* [http://mtvernon.wsu.edu/path\\_team/currentnewlet.htm](http://mtvernon.wsu.edu/path_team/currentnewlet.htm).

Rondon S.I. 2005. Report from the new extension entomologist. Nov. Crop and Soil News/Notes. Oregon State University Extension Service. Vol. 19, No 6. <http://cropandsoil.oregonstate.edu/newsnotes/>.

## **PRESENTATIONS (Presentations were made by 1<sup>st</sup> author)**

### **Scientific Conferences (National): 4**

Rondon S.I., G. Clough, S. DeBano, P.B. Hamm, and N. David. 2006. New emerging pest in the Pacific Northwest: the invasive potato tuberworm. Entomol. Soc. of Amer. Dec. 10-13. Indianapolis, IN. Section. Oral Session.

Clough G., S.I. Rondon, S. DeBano, N. David, and P.B. Hamm. 2006. Use of cultural and chemical practices to reduce tuber damage from the potato tuberworm in the Columbia Basin. Entomol. Soc. of Amer. Dec. 10-13. Indianapolis, IN. Section. Poster Session.

Rondon S.I., S. DeBano, G. Clough. 2006. Integrated Pest Management program to control the invasive potato tuberworm in the Columbia basin. Potato Association of America. Solanaceae 2006. Jul. 23-27. Madison, Wisconsin. Oral Session.

Rondon S.I., S. DeBano, G. Clough, P. Hamm and A. Jensen. 2006. Integrating pest management practices in eastern Oregon: potato tuber moth case study. 5<sup>th</sup> National IPM Symposium. Apr. 4-6. St. Louis, Mo. Poster Session.

### **Scientific Conferences (Regional): 2**

Rondon S.I. 2006. Status of the potato tuberworm, *Phthorimaea operculella* (Zeller) (Lepidoptera: Gelechiidae) in the Columbia Basin. 6<sup>th</sup> World Potato Congress. Aug. 20-26. Boise, ID. Guest Speaker.

Rondon S.I., S. DeBano, G. Clough, P.B. Hamm, and A. Jensen. 2006. 90<sup>th</sup> Annual Meeting of the Pacific Branch, Entomol. Soc. of Amer. Mar. 5-8. Maui, Hawaii. Oral Session.

## **Extension Conferences**

### **Guest Speaker: 10**

New potato pests in Oregon and Washington. Portland, OR. *In* Northwest minor crops IPM Symposium. Aug. 14-17, 2006 (approx. 50 people)

ID training session: potato tuberworm, beet leafhopper, aphids. Hermiston, OR. May 5, 2006 (9 people).

Biological control for garden insect pests. Master garden group. Pendleton, OR. May 2, 2006. (10 people).

Biology and management of the potato tuberworm. Union Co. Commercial and certified Seed Potato Producers. Baker City, OR. Mar. 14, 2006. (aprox. 25 people).

Population characteristics and an economic threshold for the potato tuber moth in the Pacific Northwest: basic tools for an integrated management program. Washington State Potato Commission Proposal Seminar (2<sup>nd</sup> round). Pullman, WA. Feb. 16, 2006. (aprox. 60 people)

Biology and management of the potato tuber moth. 45<sup>th</sup> Washington State Potato Conference and Trade Show. Potato Production Workshop in Spanish. Moses Lake, WA. Feb. 7, 2006. (aprox. 180 people)

Biology and management of a new pest in NE Oregon, the potato tuber moth. Union Co. Agricultural Service Center. La Grande, OR. Feb. 1, 2006. (aprox. 80 people)

Population characteristics of the potato tuber moth in the Pacific Northwest. Washington State Commission for Pesticide Registration. Portland, Jan. 10, 2006. (aprox. 20 people)

Population characteristics and an economic threshold for the potato tuber moth in the Pacific Northwest: basic tools for an integrated management program. Washington State Potato Commission Grant Proposal Seminar (1<sup>st</sup> round). Moses Lake, WA. Dec. 12, 2005. (aprox. 80 people)

Importance of insect identification on pest management decisions. Farm Fair. Dec. 1–2, 2005. Hermiston, OR. (aprox. 120 people)

## **WebPages**

Entomology lab webpage. [http://cropandsoil.oregonstate.edu/entomology\\_lab/](http://cropandsoil.oregonstate.edu/entomology_lab/). Webmaster S.I Rondon & Bryan Wilson.

Hamm P.B., and S.I. Rondon. 2006. Trap reports: Potato Updates (leafhoppers, potato tuberworm and aphids) <http://oregonstate.edu/Dept/hermiston/TrapReports.php>

Potato Information Exchange (PIE) – Pest Management Section <http://oregonstate.edu/potatoes/ipm/index.htm>  
Webmaster S.I. Rondon & Bryan Wilson. Other sections: I. Vales, J. McMoran, & A. Mosley