Determining the Potential for Release of Lepidopteran Parasitoids from pesticide limitations enable biologically-based IPM Caneberries.

WRIPM 2005-41530-03267 Project Report (Final)

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The orange tortrix (*Argyrotaenia franciscana* Fernald) is a leafroller that has been a principle contaminant in machine harvested caneberries since the advent of broad spectrum pesticides in the 1950's. Many fields, however experience little or no risk of orange tortrix larval contamination, and this is believed to be due to normally very low endemic populations that are held in check by natural enemies.

Pheromone traps are used to monitor the local relative population pressure by trapping male moths, and can signal areas with medium and high risk. However, such traps currently do not signal the best time to treat the larval stage, which can become suddenly apparent at or near the beginning of harvest (especially for red raspberry), when control is problematic due to application restrictions and pre-entry intervals. Also, broad spectrum treatments will kill or repel natural enemies and result in long term increases in leafroller populations, creating the need for more treatments later on. Our goal for this project is to study and better understand the development and phenology of the leafroller pests and their natural enemies, particularly the parasitic or parasitoid wasps, so that selective and, if required, broad spectrum pesticides can be used without triggering long-term build-up of the leafrollers.

Objectives for 2005 of this project include 1) determining the incidence, timing and activity levels of the key natural enemies of the leafroller complex in a wide range of caneberry field locations that vary in the amounts and timing of pesticide disturbances, and 2) assist the design of improved management programs for leafrollers in caneberries.

Results to Date:

Sampling of caneberry fields began in early April 2005. The first fields surveyed consisted of a group of 75 fields under a long-term leafroller monitoring project (29 in Oregon and 46 in Washington). Each of these fields was monitored with OT pheromone traps and timed inspections for leafroller larvae every 7 days until the end of September 2005. Over the course of the spring, 55 additional fields in Oregon were added to this group for monitoring. Of these 55 fields, 48 fields were then monitored on a continuous basis until September if they contained leafroller infestations or had management characteristics that were useful for the comparisons stated above in 'Objective 1'. In addition to these caneberry fields, 20 blueberry fields were monitored and assessed for leafrollers and parasitism. Table 1 summarizes the characteristics of the caneberry fields monitored.

A total of 4,004 insect larva samples were collected and reared in a controlled environment growth chamber. A total of 3,852 of these specimens were leafrollers. Of the leafroller specimens, 2,209 developed into a moth, 694 produced parasitoids, and 950 died of unknown causes. The 3,852 leafroller specimens consisted of 2,228 orange tortrix (OT) individuals, 1,276 oblique banded leafroller (OBLR), 130 carnation tortrix, and 40 individuals of other leafroller species.

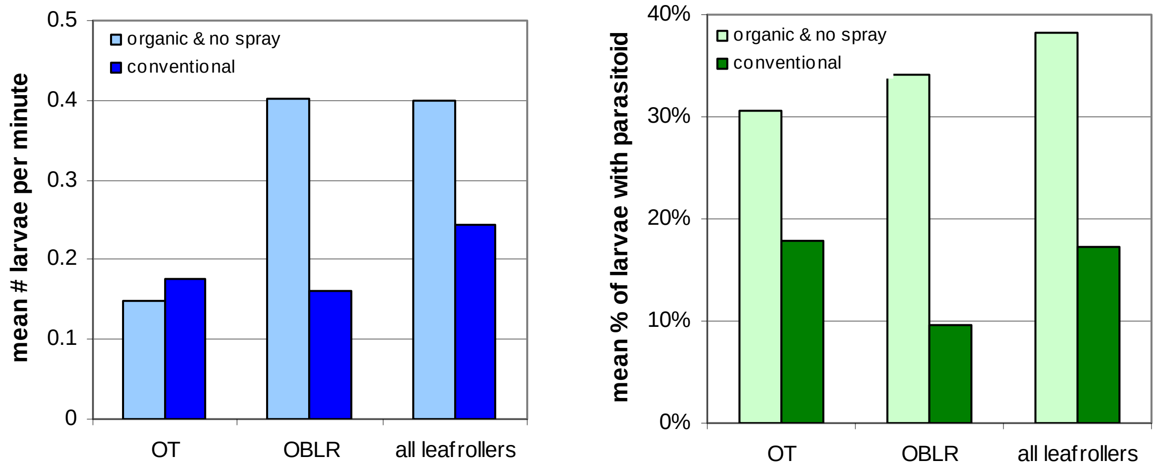
Table 1. Berry type, geographic zone and pesticide use intensity of sampled fields.

Region[a]	Raspberry		Marion-berry		Evergreen blackberry		Other blackberry		Boysen-berry		All caneberries	
	org[b]	conv	org	conv	org	conv	org	conv	org	conv	org	conv
Lower Willamette	11	6	0	8	0	0	2	0	0	0	13	14
Mid Willamette	4	0	6	11	0	6	1	10	0	3	11	30
Upper Willamette	0	40	0	5	0	8	0	1	0	1	0	55
All regions together	15	46	6	24	0	14	3	11	0	4	24	99

a – ‘lower’ fields are in vicinity of Eugene to Albany, ‘mid’ fields are in vicinity of Salem and Woodburn, and ‘upper’ fields are near Portland and SE Washington.
b – ‘org’ refers to organic systems and/or no pesticide usage, ‘conv’ refers to conventional and/or higher pesticide usage

Since the raspberry fields in all regions pooled provide the best comparison of low to high pesticide usage for a single berry type, the mean number of OT, OBLR and total leafroller larvae collected per minute, and the relative percentage of these larvae that were parasitized, were compared (Fig. 1). The percentage parasitism was consistently higher for all leafroller types in the organic and no spray fields, and OBLR infestations were higher in the organic and no spray fields.

Figure 1. Mean number of leafroller larvae collected per minute between low pesticide and high pesticide raspberry fields on sampling dates when larvae were present in these fields, and the relative percentage parasitism of these larvae in these two field types.



The highest parasitism in OT and leafrollers overall was by *Apanteles aristoteliae* Viereck, representing 48.9% of the parasitized OT specimens and 31.8% of all parasitized leafroller specimens (Table 2). The taxa *A. aristoteliae*, *Meteorus argyrotaeniae* Johanson, and species in the tribe Campoplegini comprised 87.9% of the parasitized OT specimens, and 73.2% of all parasitized leafroller specimens.

Table 2. Abundance measures of parasitoid taxa found in OT, OBLR and all leafrollers.

Parasitoid Taxon	Host					
	OT		OBLR		All leafrollers	
	# reared	% parasitism	# reared	% parasitism	# reared	% parasitism
Apanteles aristoteliae	202	11.95	0	0.0	221	7.69
Meteorus argyrotaeniae	73	4.32	8	0.88	93	3.24
Campoplegini*	88	5.2	64	7.07	194	6.75
Stictopisthes sp.	9	0.53	0	0.0	14	0.49
*Phytodietus vulgaris**	7	0.41	1	0.11	9	0.31
Glypta sp.*	7	0.41	24	2.65	31	1.08
Oncophanes americanus	1	0.06	7	0.77	11	0.38
Other Ichneumonidae*	5	0.29	16	1.77	27	0.94
Tachinidae†	1	0.06	25	2.76	27	0.94
Brachymeria sp.**	0	0	7	0.77	10	0.35
Others	8	0.47	12	1.33	25	0.87
Unidentified	12	0.71	11	1.22	32	1.11
Totals	413	24.42	175	19.34	694	24.14

* wasp taxa with an asterisk are in the Family Icheumonidae (Order Hymenoptera), those without an asterisk are in the Family Braconidae

† this family are flies in the order Diptera

** Family Chalcidae

The efficiency of the timed leafroller larvae inspection method mentioned above was assessed by comparing it to other methods. None of these other methods, including a 'sentinel cup' method, various shaking/beating/drop cloth methods, and use of a leaf blower, proved superior to timed leaf inspections.

The working hypothesis of higher rates of parasitism in fields with lower pesticide usage, which was seen in an earlier MS Thesis study by L. Coop, is supported in this preliminary analysis of pooled dates (Fig. 1). The next step for processing these leafroller parasitoid data from the 2005 season will involve the analysis of the peak times of leafroller and parasitoid activity as they relate to caneberry management activities, particularly pesticide applications. This information will then be used to produce a calendar of recommended scouting activities and updated guidelines for leafroller management in caneberries.

A preliminary list of recommended IPM practices for leafrollers in caneberries, after this first year study, include the following:

1) From mid-March through harvest, monitor leafroller moth incidence (pressure) using pheromone traps that should be placed within fields having a history of outbreaks, 1 trap/5 acres. High moth counts (15-25 moths/week or higher) should be followed up with larval leafroller searches and possible sprays if needed.
2) Beginning in mid-May (April if prior year infestations were high), larvae should be sampled by 15 minute timed searches for leafrolls and examining them for orange tortrix (tan or light-green bodies and head capsules) and OBLR (bright green bodies and black head capsules), and knowing how to distinguish these from other types of caterpillars that seldom if ever are pests in mature caneberries (e. g. wintermoth, cutworms, loopers, carnation tortrix).
3) Be aware that leafrollers are not a pest in hand-picked caneberries, if this is an option.
4) Insecticides, if required, should be selected in part based on activity with regard to leafrollers vs. parasitoids and predators, which are the primary biological control agents and should not be disturbed if possible. Preference should be made for compounds in this order, from former rather than latter: IGRs (Tebufenozide), Bt (Bacillus thuringiensis), Spinosads, short-residual broad-spectrum compounds, other broad-spectrum compounds. All labeled warnings and restrictions such as pre-harvest intervals, bloom restrictions, etc. must be observed.
5) Timing of insecticides targeted at newly hatched (spring generation) larvae should make use of degree-day models, such as at the website http://pnwpest.org/cgi-bin/ddmodel.pl?spp=otm, especially to avoid treating too early, when few if any eggs have been deposited or hatched.
6) Natural biological control can be supported, in addition to avoiding unnecessary and non-selective insecticide treatments, by allowing some uncompetitive or otherwise neutral weeds to grow and bloom, to provide nectar sources parasitoids require.
7) Overwintering survival of leafrollers can be greatly reduced by postponing post-harvest tying of primocanes and field sanitation practices until after leaf-fall.

Additional studies that are part of this 4-year project will include producing, implementing, and supporting phenological models of the major pests and parasitoids involved, building a database and filling gaps in our knowledge of pesticide toxicity effects on important parasitoids in this system, conducting studies of alternative leafroller contaminant removal methods at harvest, and finding alternative hosts, nectar sources, overwinter sites, and other means to enhance and conserve natural biological control of leafrollers, and to emphasize the use and timing of alternative and selective pesticides less harmful to leafroller natural enemies. Together these technologies may provide the tools to reduce high populations down to low endemic levels, and to maintain leafrollers at pre-economic threshold levels by promoting IPM and conservation biological control in caneberries.