OPVC FINAL PROJECT REPORT: *2016* **PROJECT YEAR**: *1 of 1*

1.**OPVC REPORT COVER PAGE (1 page)**

Project Title: *Monitoring and Reporting Insect Pests in Cole Crops and Sweet Corn (VegNet) 2016*

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Total Project Funding: $ 21, 465

Budget History:

Item	**Year 1:**
Salaries	$10, 244
Benefits	$6, 441
Wages (summer assistant)	$2, 400
Benefits	$192
Equipment	---
Supplies	$768
Travel	$1440
Plot Fees	---
Other	---
Total	$21,465

2. EXECUTIVE SUMMARY

This year, we commemorate 20 years of OSU's VegNet (1996-2016). VegNet has become a well-known and utilized resource for processed vegetable growers, researchers, and Ag professionals throughout Oregon. This regional program provides weekly activity reports for common broccoli, cauliflower, sweet corn, and snap bean pests. The main goal of the program is to serve as an early warning and detection network, to inform growers of potential pest outbreaks that may warrant increased field scouting and action. Notable trends from 2016 include extensive Cabbage Looper pressure, a continued increase of Cucumber Beetle species (12-spot and striped), and new Armyworms to be aware of. It is becoming apparent that pest activity can vary widely between field sites. Although the regional average is useful, it should not be the only metric used when considering if and how to treat for pests. The e-newsletter subscriber base continues to grow, and other organizations have expressed interest in emulating the program's success. VegNet was highlighted in a recent video produced by Washington State University, and OSU's Small Farm Program conducted workshop trainings based on existing VegNet methodology.

3. FULL REPORT

3.a. BACKGROUND

As commodity demands for integrated pest management tactics increase, pheromone monitoring provides a useful, cost-effective solution. By funding and utilizing the VegNet program, growers and processors can, in good conscience, claim support for IPM in vegetable crops. The utility of having a regional pest monitoring network applies to a wide range of Ag professionals. Weekly reports are published to provide growers and crop consultants a basis to maintain or intensify field scouting efforts and make informed spray decisions. Processing plants utilize the information as well, and in years past, have collaborated with VegNet to make direct comparisons between trap count numbers seen in the field and actual pest loads received. VegNet reports are easily accessible online, and based on user surveys, the information is considered a "valuable tool" by >90% of respondents.

3.b OBJECTIVES

1. Monitor 10 species of insect pests that affect processed vegetable growers. Provide weekly data reports and issue pest alerts to provide advance warning of potential outbreaks.

2. Collaborate with industry professionals to expand diamondback moth (DBM) monitoring to more sites and investigate possible reasons for the recent increase in DBM activity.

3.c. SIGNIFICANT FINDINGS

- An early detection of Cabbage Looper allowed us to warn growers of probable and intense CL pressure. Cabbage Looper is considered one of the most important pests for cole crops, and larvae also feed on a variety of other hosts including lettuce, peas, celery, tomato, and ornamentals.
- Cucumber Beetles have a wide host range and both adults and larvae can do damage to corn, beans, and cucurbits. The increase of Western Spotted and Striped Cucumber Beetles is concerning due to the lifecycle of the pests, and how they can damage leaf and root tissue, as well as harbor plant pathogens.
- There is increasing concern of Armyworms in the Valley. Both True Armyworm and Western Yellow-striped Armyworm were detected in existing traps for other species. These moths have especially destructive larval habits, as well as a wide host range. It may be wise to include them in future monitoring efforts.

3.d. METHODS

Crop pests were monitored using passive and active sampling techniques (yellow sticky traps, pheromone traps, pan traps, sweep net samples, and leaf pulls). Pheromone traps were baited with lures proven to attract male moths of each targeted species. Monitoring stations were set near sweet corn, broccoli, or cauliflower fields and relocated after harvest if possible. In 2016, we had 13 stations located

at 9 different field sites. Traps were checked every 5-8 days for 22 weeks (Apr 25th – Sept 19th), and maintained as necessary (new lures, mend wire, etc.). Raw data were collected by field technicians and/or the program manager and analyzed weekly. Current trap counts were compared to historical averages and degree-day models to make an informed estimate of pest pressure potential. Weekly reports were sent via e-newsletter, and posted on www.oregonvegetables.com.

For the preliminary test of Diamondback moth larvae sensitivity to insecticides, larvae were collected from four different field sites and placed inside Petri dishes with a small piece of treated red cabbage. Cabbage leaves were dipped until wet with either Z-cypermethrin (Mustang Maxx at 0.025 lb ai/A) or spinosad (Radient at 0.078 lb ai/A) and air dried before placed in the Petri dish. Larval survival was noted after 8, 12, 24, and 48 hours, with another evaluation at 72 hours if necessary (group 5 insecticides can take longer to cause mortality). The trial was conducted 3 times (n_{total}=30).

3.e. RESULTS & DISCUSSION

The success of this program is cumulative; having an extensive data record allows for current year's trap counts to be compared to prior year averages as a way to measure potential pest pressure. For instance, when pheromone traps detect an increased level of adult moths, we consider that to be an 'egg-laying event', and depending on the reproductive biology of the pest species, we can predict that larval damage may be evident in the days or weeks following an event. Conversely, if activity is lower than previous years, it may mean that there is less risk for damage, or that the pest emergence is delayed. In some instances, trends have shifted significantly, and could have consequences for vegetable growers.

3.e.1 – PESTS OF SWEET CORN, SNAP BEAN, and SQUASH

Corn Earworm (*H. zea*) damage was notably low this year, according to concurrent research observations and grower accounts. Flight activity peaked on 25-Jul but the value was influenced by an extreme trap count at one of the sights (MTAG, 40 per day). Interestingly, the same field location is what biased the observed peak in 2015 as well (MTAG 3-Aug, 48.6 per day)(FIG.1). This pattern presents a reminder of how pest activity can vary greatly between sites, and therefore averages should be interpreted with caution. Yet, even if the MTAG site is considered an outlier, the regional average of CEW in late July was 5 moths per day, which is still higher, and earlier, than normal. To our knowledge, elevated trap counts did not reflect as increased CEW damage to sweet corn ears.

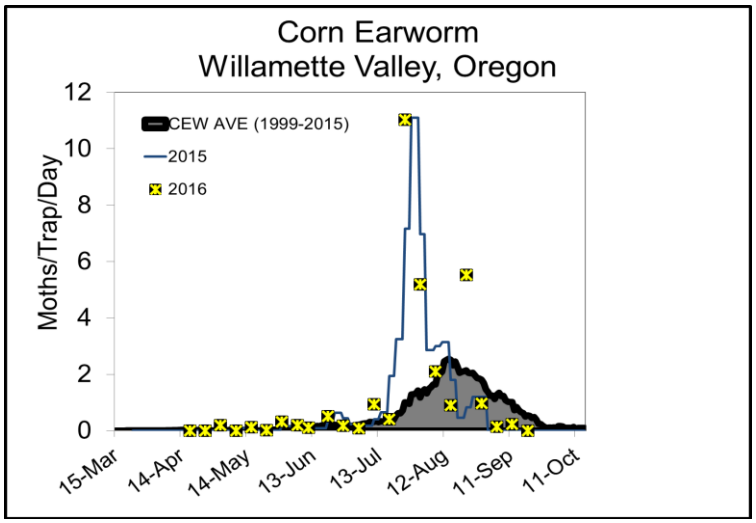

Figure 1. *Corn earworm flight activity was similar to the past few years, but greatly influenced by 1 or 2 locations. Damage to ears was notably low, according to grower reports.*

Black Cutworm (*Agrotis ipsilon*; BCW) is currently being considered as a "new normal" of high levels. That is, the activity pattern of 2016 is consistent with what we have seen since 2012. It is marked by early arrival from southern latitudes and indistinct flight peaks that suggest more than one generation is developing per season. An average of 2 BCW moths per trap per day is now 'common' from late April to early August. In comparison, the activity from 1996-2011 peaked once per season, in late June, and was rarely above 0.8 moths per day. Annual and long range northward dispersal of this species is documented, with estimates nearing 210 miles per day when moths are assisted by jet streams. It is possible that, in addition to arrival each year, BCW could be overwintering here if temperatures are mild enough.

Western Spotted Cucumber Beetle (*Diabrotica undecimpunctata* var. *undecimpunctata;* 12S)
There was an 'outbreak' of 12S beetles in 2011, when 12S beetle counts peaked at 4 beetles per day. This year, numbers ranged from 7 to 9 beetles per day during the peak of the season. Over the past few years (2012-14), we have seen a gradual shift towards earlier emergence of 12S, which allows for a second generation to develop. We know that the year-to-year activity of 12S is greatly influenced by the percentage of overwintering females, so this new trend of 2+ generations may be contributing to population buildup.

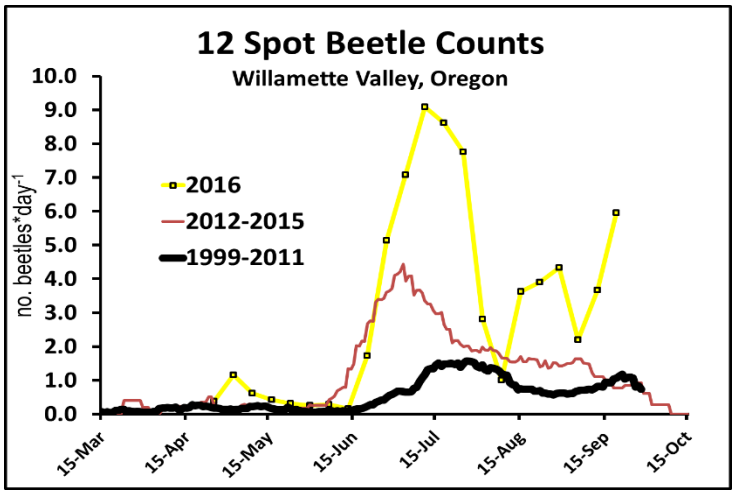

Figure 2. *Contrary to the name, Western Spotted Cucumber beetles have a wide host range including corn, beans, tomatoes, grains, and grasses. Adults can vector pathogens.*

2016 marked the first year we had recorded high numbers of Western Striped Cucumber Beetle (*Acalymma trivittatum*; SCB) and Western Corn Rootworm (*Diabrotica virgifera* var. *virgifera*; WCR) detected. Western corn rootworm is extremely damaging in the Midwest and has been moving westward across the U.S. since 2014. Larvae chew on corn roots, and resemble wireworms but are lighter in color and dark at both ends.

3.e.2 – PESTS OF BROCCOLI and CAULIFLOWER

Cabbage Looper (*Trichoplusia ni*; CL) pressure was much greater this year than last, and in fact, was the highest on record since 2008. One of the biggest factors influencing CL abundance is a specific nuclear polyhedrosis virus. It is considered the most effective natural enemy of CL, and as a result, CL population levels can be quite erratic – bad one year, then manageable for 2 or 3 years – depending on the virus. In the Willamette Valley, there were booms of CL in 2008 and 2010, with peaks of 100 moths and 25 moths caught on average per day per trap, respectively. However, in both cases, the 'outbreak' occurred in just one or 2 weeks, then dipped below normal levels. This was not the case in 2016, where abnormal activity was present season-long (FIG. 3).

We implemented a new warning color and signal word ("ALERT") into the VegNet reports this year to try to differentiate between elevated and rare, intense activity of CL and other pests.

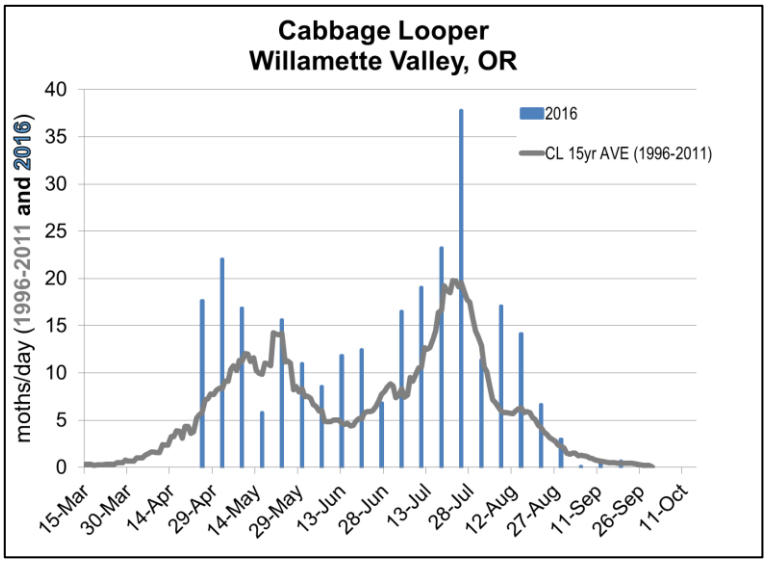

Figure 3. *There are two, overlapping generations of cabbage looper in this region. Loopers can cause extensive damage to brassica crops, and activity was above normal levels for 16 of the 22 monitored weeks.*

3.e.3 – DIAMONDBACK MOTH INVESTIGATIONS

Diamondback Moth (*Plutella xylostella*; DBM) During the middle of the season, from 20-Jun to 8-Aug, DBM trap counts were much lower than they were in 2015. This is an important time for broccoli growers, in order to avoid contamination from DBM pupae before harvest. However, trap numbers increased in the weeks that followed, which is of consequence because DBM adults can overwinter in weedy hosts and field margins. Late season activity of DBM is a concern because of the increasing acreage of fall-seeded brassica crops that could, in theory, provide a 'green bridge', and lead to population buildup.

Diamondback moth is monitored by a different type of trap than other VegNet species. The trap is highly specific, and easy to setup and monitor. Because of very high DBM trap counts in 2015, and disparate values among sites, we proposed a unique objective (2016, Obj. 2) to try to determine possible reasons for increased activity. Unfortunately, the response from industry collaborators was minimal and did not provide any insight into per-field differences. What we do know is that some growers were more affected by DBM than others, which was also the case in 2015.

One possible reason for varying trap counts between locations is the difference of insecticide spray programs. We had heard that some common products were "not working as well as they used to" on DBM, which raises concern of potential insecticide resistance (IR). DBM is highly susceptible to developing IR, which is why it is one of the hardest crucifer pests to manage. We performed a preliminary trial to test efficacy of two different insecticide classes on DBM larvae. Instances of survival are shown for Z-cypermethrin and spinetoram for diamondback and cabbage Looper larvae exposed to a leaf-dip exposure of each product (TBL. 1). Given the low percentages of mortality, there may be reason to suspect resistance to z-cypermethrin in all three of the tested populations of diamondback moth. Effects of spinetoram (a group 5 insecticide) were variable but resulted in higher average mortality overall. Cabbage looper larvae from all tested locations were susceptible to both treatments (100% mortality).

Table 1. Mortality of larval populations after 72 hours.

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Treatment	Population	Diamondback	Cabbage Looper
		% mortality of larvae after 72 hours	
z-cypermethrin (Mustang Maxx)	Mt. Angel	33	100
	St. Louis	33	100
	Corvallis	40	100
spinetoram (RadientTM)	Mt. Angel	83	100
	St. Louis	100	100
	Corvallis	83	100