# The Creepy Crawlers Underground-Symphylan Control

Navneet Kaur, Extension Entomologist and Assistant Professor, Crop and Soil Science
Oregon State University

**2024 Willamette Valley Vegetable Educational Program**

February 7th, 2024

# Symphylans

Classification

Kingdom Animalia (Animals)

Phylum Arthropoda (Arthropods)

Subphylum Myriapoda (Myriapods)

Class Symphyla (Symphylans)

**Garden symphylan, *Scutigerella immaculata* Newport**

# Biology and Ecology

**Description of pest:**

Mature symphylans- White, less than 1/4 – inch in length, 12 pairs of legs, beaded antennae. They live 1 to 3 years

They lay 4-25 eggs in clusters several inches below the surface of the soil surface

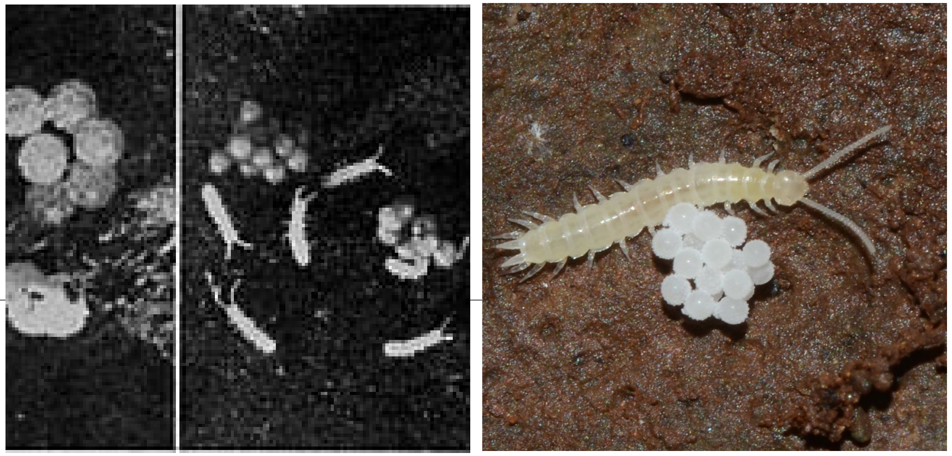
Nymphs- White with 6-11 pairs of legs

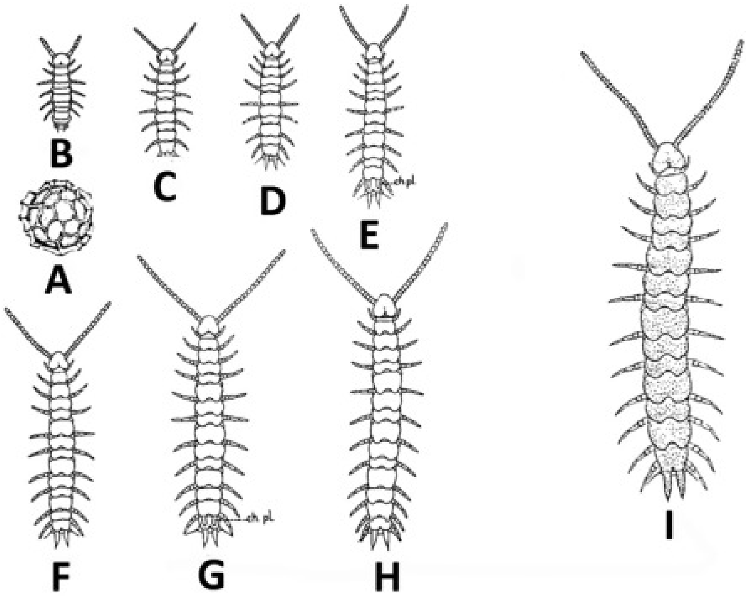
**Life cycle:**

Overwinter in soil as adults

Move up to top 6” of soil when temperatures are above 45°F

Lay eggs April – June in soil crevices. Eggs hatch 2-3 weeks and nymphs become adults in approximately 3 months






Stages of *Scutigerella immaculata*: (A) egg; (B) first instar; (C) second instar; (D), third instar; (E) fourth instar; (F) fifth instar; (G) sixth instar; (H) seventh instar; (I) adult.

No cover image available

Volume 17, Issue 5
1 October 1924



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JOURNAL ARTICLE

# The Garden Centipede, *Scutigerella Immaculata* (Newport), a Pest of Economic Importance in the West

F. H. Wymore

*Journal of Economic Entomology*, Volume 17, Issue 5, 1 October 1924, Pages 520–526,
https://doi.org/10.1093/jee/17.5.520
**Published:** 01 October 1924

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## Abstract

The garden centipede, *Scutigerella immaculate* (Newport), is found widely distributed throughout the world and has been studied by zoologists for many years in relation to the supposedly ancestral characters of insects, chilopods and diplopods. In recent years it has been considered by economic entomologists of California, Oregon and Utah as among the most important and destructive pests in many truck crop sections of these States. In California it is particularly destructive to asparagus shoots and seedlings of beans, peas, melons, etc., the injury being due to the pest's eating numerous small holes in the host. All stages in the life history of the little animals have been found in the intensively cultivated asparagus fields.

Para dichlorobenzene and calcium cyanide as soil fumigants have given encouraging results in controlling the symphylid and other soil pests and more extensive experiments with these chemicals are in progress. In the asparagus fields of the Delta region of the Sacramento River, flooding has proven quite practical as a control in several cases. Best results from flooding have been obtained where the fields were kept thoroughly and continuously covered to a depth of a foot or more for from two to three weeks.

JOURNAL OF ECONOMIC ENTOMOLOGY



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Volume 63, Issue 2
1 April 1970



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JOURNAL ARTICLE

# Distribution of the Garden Symphylan, *Scutigerella immaculata*, in the United States—a 15-Year Survey[1]

Stallard J. Waterhouse Author Notes

*Journal of Economic Entomology*, Volume 63, Issue 2, 1 April 1970, Pages 390–394, https://doi.org/10.1093/jee/63.2.390

**Published:** 01 April 1970 **Article history** ▾

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## Abstract

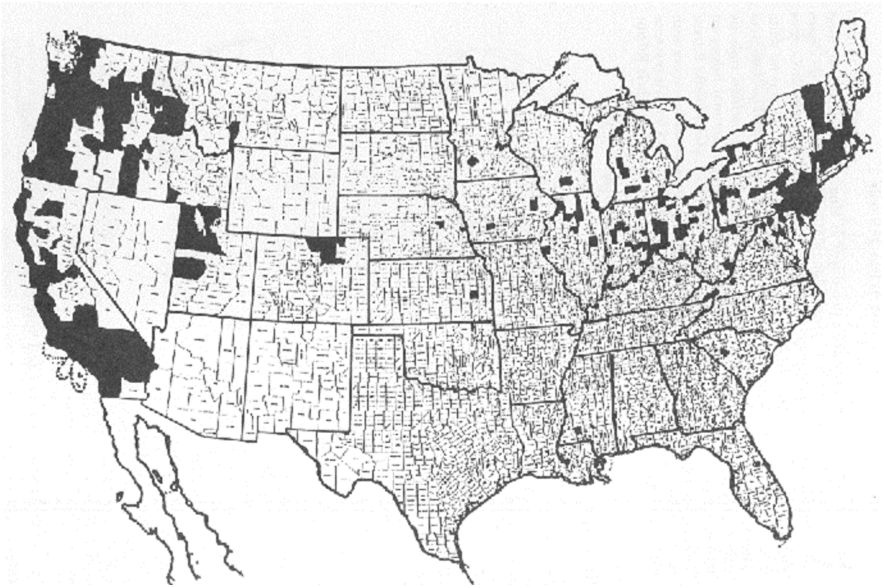
*Scutigerella immaculata* (Newport) is an important soil pest of agriculture in 25 of the 31 States reporting this species. Distribution of *S. immaculata* on the county level for the United States is illustrated and discussed.

**Issue Section:** Articles

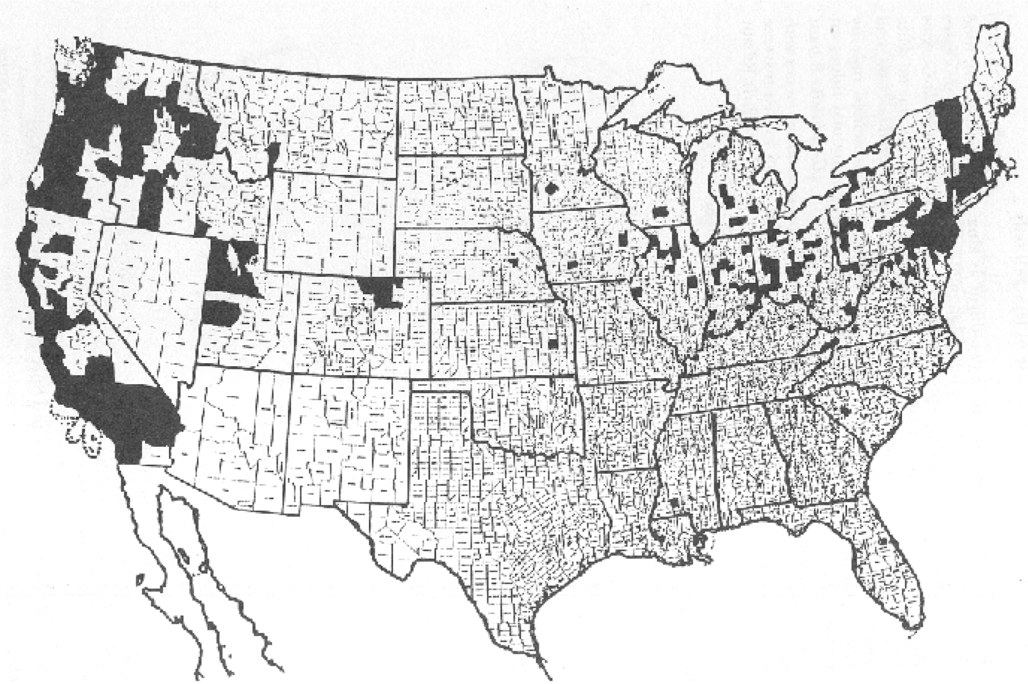
## Author notes

1 Scutigerella: Scutigerellidae.





# Problem- Garden symphylan, *Scutigerella immaculata* Newport



"A serious soil arthropod pest whose root-feeding affects yield potential and survival of several high-value crops in Western Oregon and Washington during crop establishment"

# Host Range

- The garden symphylan (GS) is a pest of vegetable crops, including solanaceous crops, brassicas, leafy greens, cucurbits, beets, and onions
- Broccoli, cabbage, and cauliflower are moderate to highly susceptible to GS damage
- High damage on all specialty seed crops in Willamette Valley - grass grown for seed, vegetable seed crops, and other specialty crops such as hops, peppermint, and strawberries

*Eggplant stunted by garden symphylans.*

*Undamaged eggplant of same age in same field.*

# Challenges

Managing symphylans can be difficult because of their ability to easily move vertically in the soil and evade control measures, the patchy distribution, and the complexity of sampling

Control measures are usually focused on decreasing populations of symphylans in the soil or increasing crop robustness

*Finding an effective balance*

ATTRA

**Symphylans: Soil Pest Management Options**

A Publication of ATTRA - National Sustainable Agriculture Information Service • 1-800-346-9140 • www.attra.ncat.org

By Jon Umble *(Oregon State University)*, Rex Dufour *(NCAT Agriculture Specialist)*, Glenn Fisher *(Oregon State University)*, James Fisher *(USDA/ARS)*, Jim Leap *(University of California, Santa Cruz)*, Mark Van Horn *(University of California, Davis)*

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Garden symphylans are soil-dwelling, centipede-like creatures that feed on plant roots and can cause extensive crop damage. They cause frequent and often misdiagnosed problems in well managed western soils with good tilth. This soil pest may not be familiar to farmers and agricultural consultants.

This document describes the garden symphylan life cycle and the damage symphylans can cause. It includes monitoring techniques to determine whether symphylans are present in the soil and sustainable management options to prevent economic damage.

Garden symphylans (*Scutigerella immaculata* Newport) are small, white, "centipede-like" soil arthropods, common in many agricultural production systems in Oregon, Washington, and California (Berry and Robinson, 1974; Michelbacher, 1935).

They feed on roots and other subterranean plant parts, causing significant crop losses in some cases. Control can be extremely difficult due to symphylans' vertical movement in the soil, the complexity of sampling, and the lack of simple, effective control methods (Umble and Fisher, 2003a).

With the recent spread of organic agriculture and better soil management techniques, crop damage associated with symphylans has become more commonplace. It is ironic that these pests are such a problem on farms that practice good soil management — maintaining soil with good tilth, high organic matter, and low compaction.

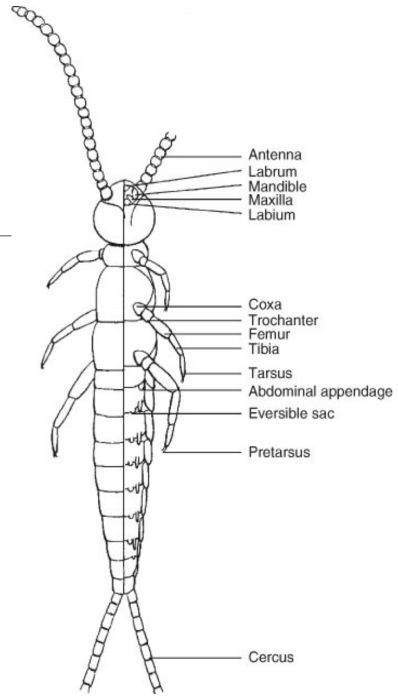
*A garden symphylan is about the size of this letter "I."*

**Damage**

Diagnosing a garden symphylan problem is sometimes difficult, since damage may be exhibited in a number of forms and garden symphylans are not always easy to find, even when their damage is obvious. Economic damage may result from direct feeding on root and tuber

# Management Steps

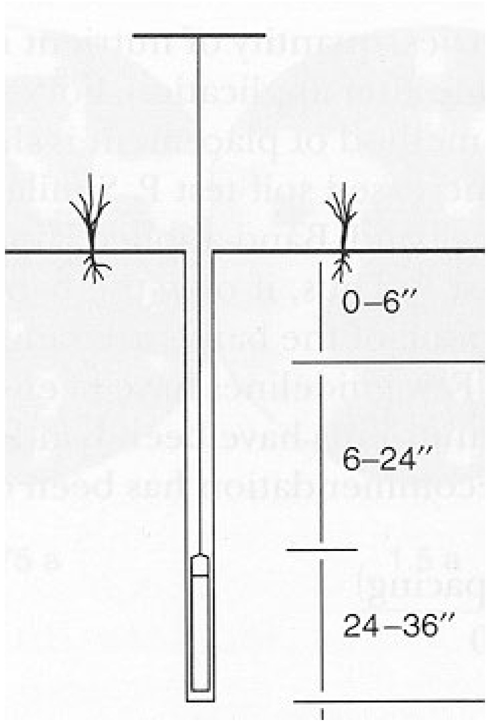
- **Correct Identification, Sampling/ Pest Monitoring**
- Action Thresholds
- Cultural Control- Tillage and Crop Rotation
- Biological Control
- Chemical Control




# Look Alikes

*A symphylan (left) is very similar in appearance to a dipluran (right), but has legs all along its body like a millipede and lacks the dipluran's long rear appendages.*

# Potato Bait Stations Work Well to Determine Symph Infestations




**soil sample**

-time consuming

-can provide absolute density estimates

can be hit or miss

**bait sample**

-faster method

-less variability

Inspect after 2-3 days

**indirect sample**

-vegetation may provide direction to location / intensity of infestation

-too variable to be used w/o direct sampling



# Management Steps

- ➢ Correct Identification, Sampling/ Pest Monitoring
- ➢ **Action Thresholds**
- ➢ Cultural Control- Tillage and Crop Rotation
- ➢ Biological Control
- ➢ Chemical Control

# Action Threshold

Action thresholds for GS are not well established. Damage of susceptible crops such as broccoli and cabbage is often associated with GS counts of **five to ten** per cubic foot of soil.

An action threshold of **3 GS per sample** (cubic foot or "shovelful") is commonly used

# Management Steps

- Correct Identification, Sampling/ Pest Monitoring
- Action Thresholds
- **Cultural Control- Tillage and Crop Rotation**
- **Biological Control**
- Chemical Control

# Tillage, Crop Rotation, and Cover Crops –

Greenhouse “Pot Study” for the evaluation of cover crops or crop rotation options

- 35 adult symphylans/pot  were released at the start of experiment
- 7 reps, RCBD
- Mean Numbers of GS by Host Plant after 8 wks. of release

Umble et al. 2002. Applied Soil Ecology. 59-70

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Available online at www.sciencedirect.com
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Applied Soil Ecology 24 (2003) 151–163

Applied Soil Ecology

www.elsevier.com/locate/apsoil

# Suitability of selected crops and soil for garden symphylan populations (Symphyla, Scutigerellidae: *Scutigerella immaculata* Newport)

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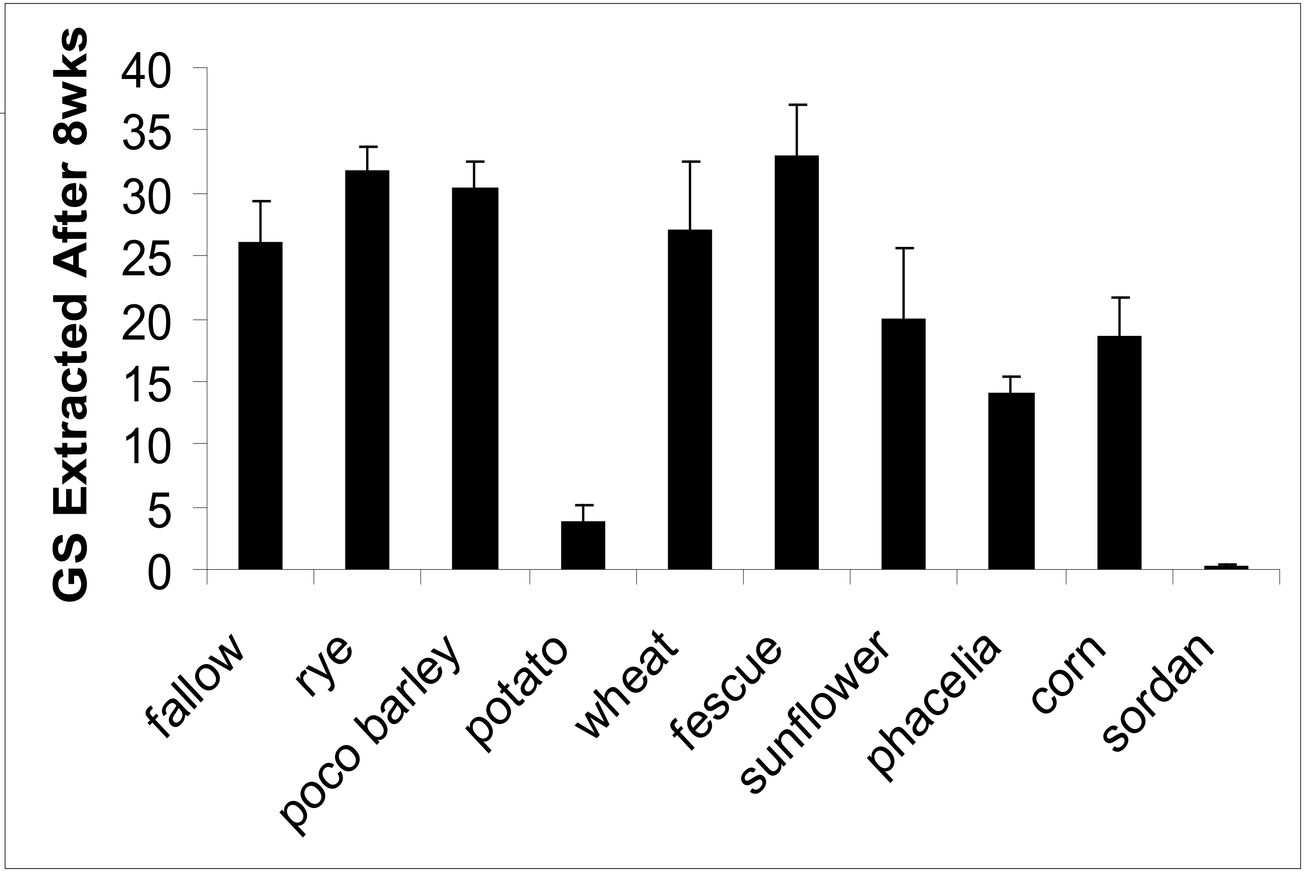
*Department of Crop and Soil Science, Oregon State University, 3017 Agricultural & Life Science Building, Corvallis, OR 97331-7306, USA*

Received 13 December 2002; accepted 16 June 2003

**Abstract**

The suitability of selected crops and soil for the growth of garden symphylan (*Scutigerella immaculata*, Newport) populations was studied in the laboratory and field. In the laboratory, we measured changes in *S. immaculata* population density after 8 weeks from a starting density of 35 in pots of spinach (*Spinacia oleracea* L., var. Bloomsdale Savoy), tomato (*Lycopersicon esculentum* Mill., var. Early Girl), sweet corn (*Zea mays*, L. var. Early Sunglow), potato (*Solanum tuberosum* L., var. Russet Burbank) and soil alone. Population growth was significantly greater on spinach than on tomato, sweet corn, potato or soil alone, and significantly lower on potato than on spinach, corn, tomato or soil alone. In the field, temporal population trends were described by sampling *S. immaculata* twice-weekly through the growing season of sweet corn (var. Early Sunglow) in 2000, and of potato (var. Russet Burbank)/squash (*Cucurbita pepo* L. var. Delicata) and corn/squash rotations in 2001 and 2002. Temporal population trends appeared to be related to the crop species present, with populations decreasing dramatically in 2001 in potatoes (var. Russet Burbank) as compared with sweet corn (var. Early Sunglow) or clean fallow. These results provide evidence that crop rotation may significantly influence *S. immaculata* population densities.
Published by Elsevier B.V.

*Keywords:* Garden symphylan; *Scutigerella immaculata*; Crop rotation; Symphylid; Soil arthropod




**Sordan & Potato drastically reduce GS numbers**

ELSEVIER

Applied Soil Ecology 21 (2002) 59–70

Applied Soil Ecology

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# Effect of cover crops and tillage system on symphylan (Symphlya: *Scutigerella immaculata*, Newport) and *Pergamasus quisquiliarum* Canestrini (Acari: Mesostigmata) populations, and other soil organisms in agricultural soils

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Received 5 April 2000; accepted 20 March 2002

**Abstract**

The garden symphylan (*Scutigerella immaculata*: Newport) is a common myriapod soil pest of vegetable crops in the Pacific Northwest and other regions of the US. Symphylans consume germinating seeds, plant roots, and above-ground plant parts in contact with the soil. Factors regulating symphylan populations in agricultural soil systems are poorly understood, particularly the effects of farming practices such as cover cropping and reduced-tillage.

Cover crops were planted in the fall of 1994 through 1996 and either incorporated into the soil in the spring with tillage or killed with glyphosate and the residue left on the soil surface. Fewer symphylans were recovered with Berlese funnels from soil under cereal cover crops than soil in mustard cover crops, regardless of tillage system. Fewer symphylans were recovered from soil under the spring oat cover crop than soil under the barley cover crop. Eliminating spring tillage may have increased symphylan populations but the effect of reduced tillage on symphylan populations was less important than cover cropping.

Predaceous mites were more abundant in soil under large amounts of cover crop residue but these predators were not correlated with lower populations of symphylans. Spring tillage dramatically reduced populations of *Pergamasus quisquiliarum*, a known predator of symphylans. Cover crops increased both the ratio of predaceous mites to symphylans and the total population of potential prey, thereby, reducing the capacity of predaceous mites to regulate symphylan populations.


*Keywords:* Cover crops; Tillage; *Pergamasus quisquiliarum*; *Scutigerella immaculata* symphylans; Soil invertebrates

- Fewer symphylans were recovered with Berlese funnels from soil under cereal cover crops than mustard cover crops, regardless of tillage system
- Fewer symphylans were recovered from soil under the spring oat cover crop than soil under the barley cover crop
- Effect of reduced tillage was less important than that of cover cropping.

# Chemical Control – Alternatives to OP research

# Lab Bioassays- To Identify Candidate Chemistries

- Screen candidate materials in the laboratory
- Take promising products to the field

INSECTICIDE RESISTANCE AND RESISTANCE MANAGEMENT

**Effects of Direct and Indirect Exposure of Insecticides to Garden Symphylan (Symphyla: Scutigerellidae) in Laboratory Bioassays**

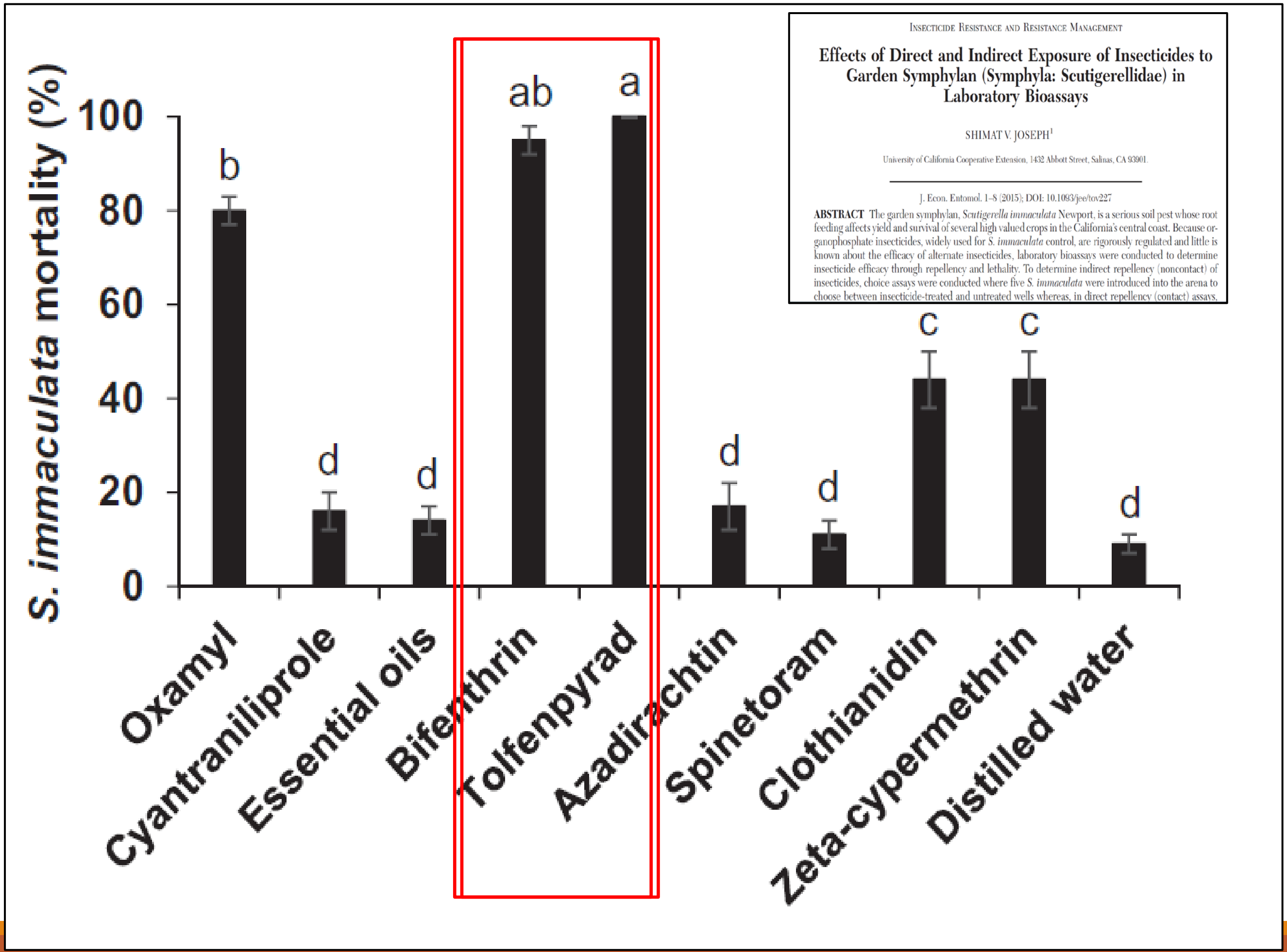
SHIMAT V. JOSEPH[1]

University of California Cooperative Extension, 1432 Abbott Street, Salinas, CA 93901.

J. Econ. Entomol. 1–8 (2015); DOI: 10.1093/jee/tov227

**ABSTRACT** The garden symphylan, *Scutigerella immaculata* Newport, is a serious soil pest whose root feeding affects yield and survival of several high valued crops in the California's central coast. Because organophosphate insecticides, widely used for *S. immaculata* control, are rigorously regulated and little is known about the efficacy of alternate insecticides, laboratory bioassays were conducted to determine insecticide efficacy through repellency and lethality. To determine indirect repellency (noncontact) of insecticides, choice assays were conducted where five *S. immaculata* were introduced into the arena to choose between insecticide-treated and untreated wells whereas, in direct repellency (contact) assays,

# Efficacy of Insecticides on Symphylans using Laboratory Bioassays




INSECTICIDE RESISTANCE AND RESISTANCE MANAGEMENT

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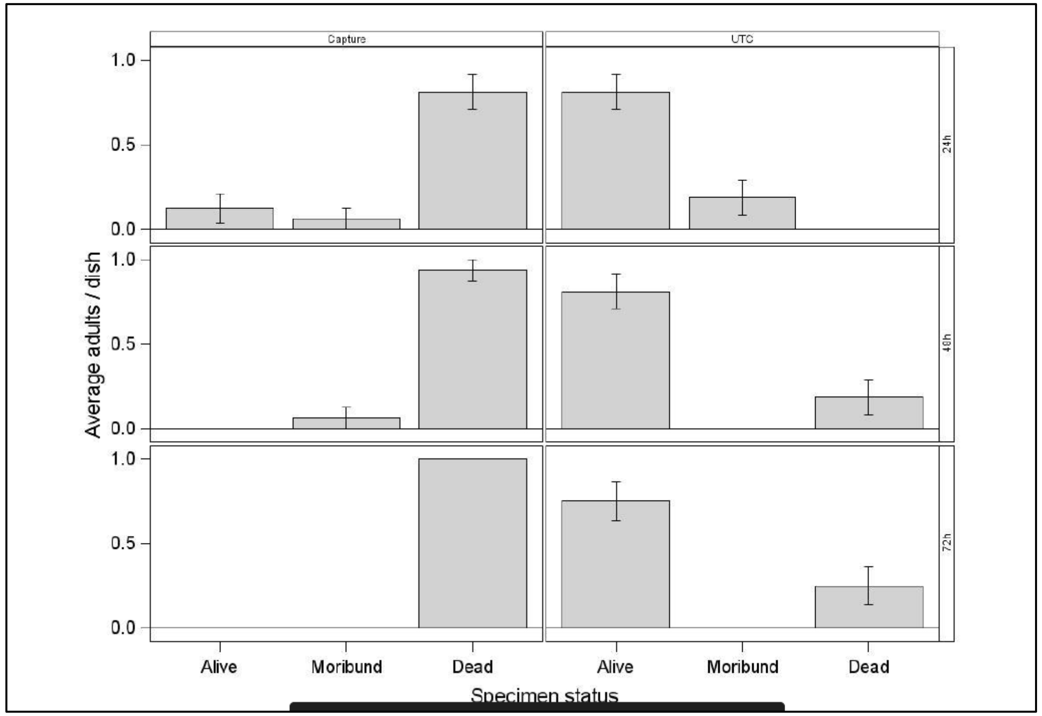



Alejandro Del-Pozo, Ph.D. IPM – Entomology Advisor, 2019

# Capture LFR (Bifenthrin)

Contact insecticide, sodium channel modulators

Broad-spectrum

Liquid, in-furrow or broadcast Restricted Entry Interval (REI) 12hours

Pre-harvest interval varies/narrow

Crop Groups- 1C, 5A, 5B, 6C, 9, and 10

# Torac (Tolfenpyrad)

Contact insecticide that inhibits an organism's energy metabolism

Liquid, ground, and aerial application

REI 12 hr and PHI 1-14 days

Leafy Green, Petiole Vegetable, 1 C and Group 9

| GROUP | 21A | INSECTICIDE |
|---|---|---|

NICHINO AMERICA

NOTIFICATION
71711-31
The applicant has certified that no changes, other than those reported to the Agency have been made to the labeling. The Agency acknowledges this notification by letter dated:
10/10/2017

**TOLFENPYRAD 15EC Insecticide**

**Active Ingredient:**
**Tolfenpyrad**
(4-chloro-3-ethyl-1-methyl-*N*-[4-(*p*-tolyloxy)benzyl]pyrazole-5-carboxamide) ............ **15.0%**
**Other Ingredients*:** ........................................ **85.0%**
**Total** **100.0%**

Contains 1.29 lbs active ingredient per U.S. gallon
*Contains petroleum distillates

# Group 30 Insecticides

IRAC Group 30 is a new mode of action group, acting on the insect nervous system, inhibits the GABA-activated chloride channel, causing hyperexcitation and convulsions

Multiple Group 30 products are commercially available or under development

| | |
|---|---|
| **30**<br><br>**GABA-gated chloride channel allosteric modulators**<br><br>Nerve & muscle action | Broflanilide |
| | Fluxametamide |
| | Isocycloseram |

Source: IRAC MoA Classification v.10.1, December 2021 www.irac-online.org

# Field Efficacy Trail- Spring 2022

- One pre-existing symphylan infested area was identified at OSU's Hyslop Research Farm. A replicated field trial (plot size -30 feet long x 12 feet wide) experiment in a randomized complete block design was set up with four replications

- Plots were treated using a $CO_2$ pressurized backpack sprayer at a spray volume of 20 gal/acre at 22 psi through AM11002 nozzles on April 8, 2022. Upon soil application, treatments were incorporated with tillage into the top 2 inches of soil using a tractor-mounted rototiller

- 'Tillage Radish' was planted at a 8lb/acre seeding rate with a 13-inch row spacing. Seeding depth was approximately 0.5 inches

- Data was recorded on symphylan abundance using the potato bait method by deploying two bait stations per plot at 10, 14, 18, 25, 32, and 39 days after treatment (DAT). Data were analyzed using ANOVA, and means were separated using Fisher's protected LSD ($P \leq 0.05$)

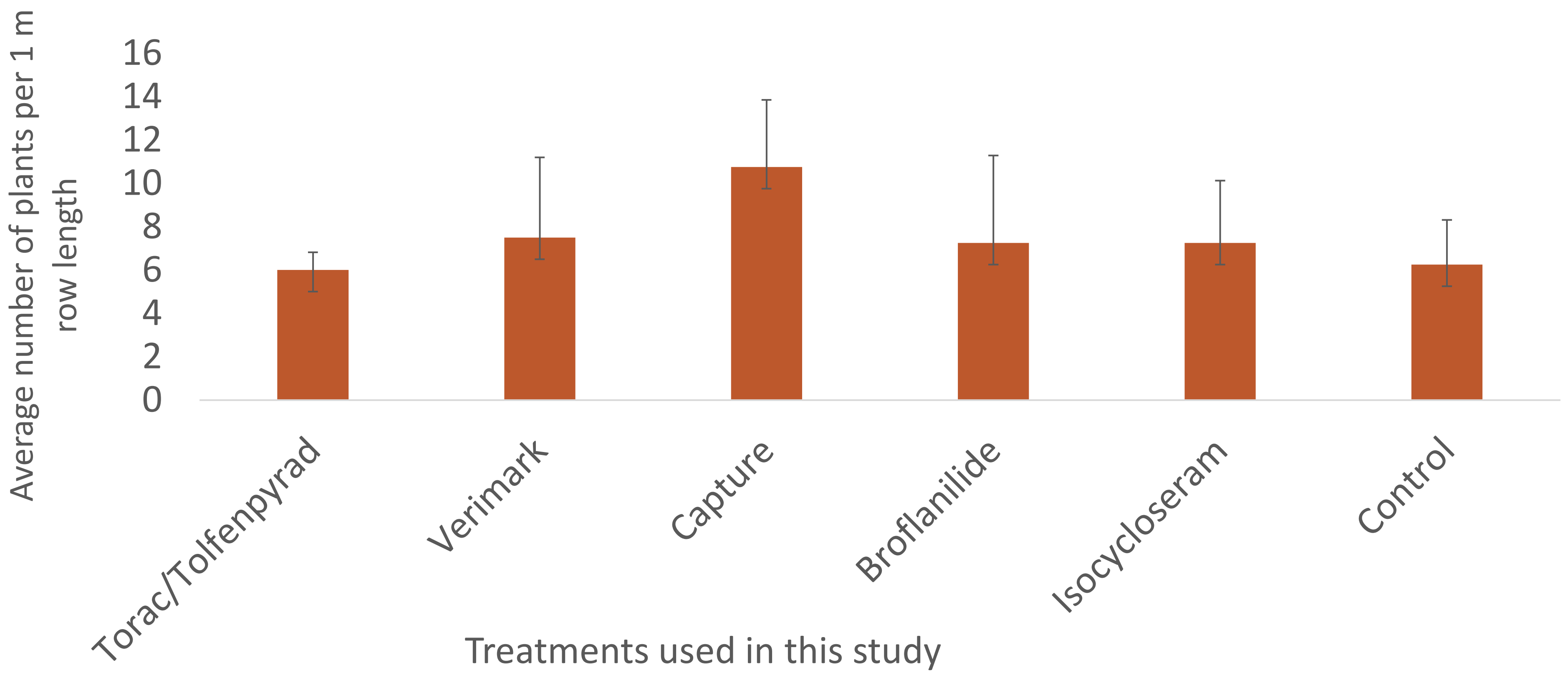
| Trade Name (Active Ingredient) | IRAC Classification |
|---|---|
| Torac (Tolfenpyrad) | Group 21 |
| Verimark (Chlorantraniliprole) | Group 28 |
| Capture LFR (Bifenthrin) | Group 3A |
| BAS4007I (Broflanilide) | Group 30 |
| A21377X (Isocycloseram) | Group 30 |
| Untreated Control | _ |

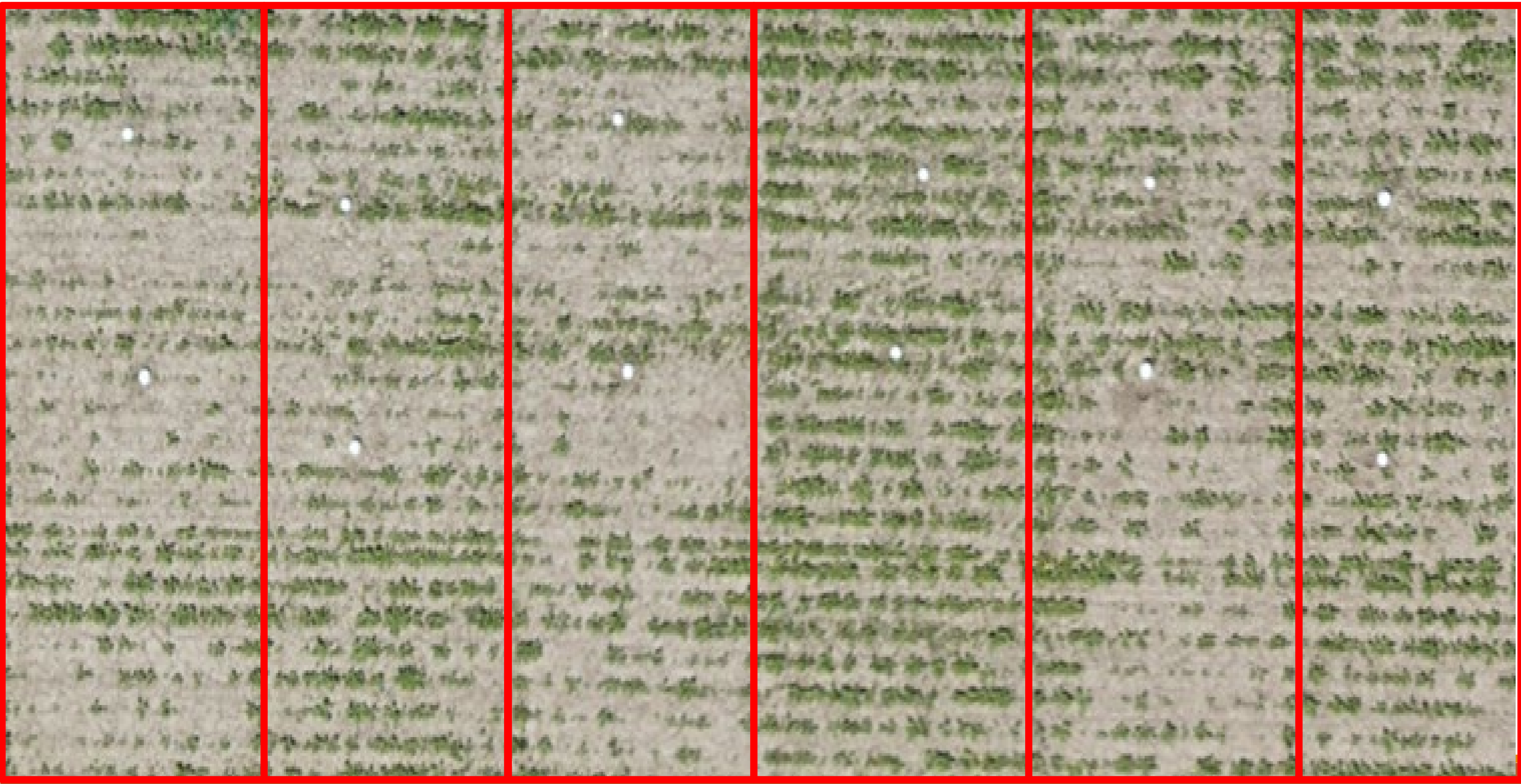
# Results- Spring 2022, Efficacy Trial in Radish

| Treatment | Symphylan Counts per Plot | | | | |
|---|---|---|---|---|---|
| | 10 DAT | 14DAT | 25 DAT | 32DAT | 39DAT |
| Torac/Tolfenpyrad | 1.25 | 0.5 | 1.25 | 0 | 0 |
| Verimark | 1.5 | 0.5 | 3.75 | 1.5 | 0 |
| Capture | 1.25 | 0 | 0.25 | 0 | 0 |
| Broflanilide | 2 | 0 | 10 | 3.25 | 0 |
| Isocycloseram | 2 | 0 | 3.5 | 0.25 | 4 |
| Control | 5.25 | 0.25 | 4.25 | 3 | 0.5 |
| P value | 0.0691 | 0.493 | 0.3722 | 0.1266 | 0.4729 |

- **Capture and other insecticide treatments started out strong but significant reductions were not observed**

# Plant Density





# Field Efficacy Trail- Spring 2023

- One organic commercial field site with symphylan infestation was selected under spinach grown for seed

- Treatments include OMRI products- Seduce (spinosad bait@ low and high rate), No Fly (*Isaria fumosorosea* strain FE 9901), Azaguard (Azadirachtin), and untreated control. 3 replicates, RCBD

- Symphylan abundance using the potato bait method by deploying two bait stations per plot at 10, 14, 18, 25, 32, and 39 days after treatment (DAT). Data were analyzed using ANOVA, and means were separated using Fisher's protected LSD ($P \leq 0.05$)

# Spinach Seed-Spring 2023

- Dry, hot spring this year may have impacted the pest pressure. Low symphylan counts in control plots and no statistical differences in treatment means

| | | Rate/acre | Mean symphylan count per plot[a] | | | | Plant Density[b] |
|---|---|---|---|---|---|---|---|
| Trade Name | Active Ingredient | (fl. oz or lb/acre) | 14-Apr | 24-Apr | 2-May | 9-May | |
| Control | | | 0.0 | 0.0 | 0.0 | 0.0 | 69 |
| Seduce (high) | Spinosad | 44lb | 0.3 | 0.0 | 0.0 | 0.0 | 61 |
| Seduce (low) | Spinosad | 20lb | 0.0 | 0.3 | 0.0 | 0.0 | 53 |
| No Fly | Isaria fumosorosea strain FE 9901 | 2lb | 0.0 | 0.0 | 0.0 | 0.0 | 62 |
| Azaguard | Azadirachtin | 15oz | 0.0 | 0.0 | 0.0 | 0.0 | 68 |
| *P* value | | | ns | ns | ns | ns | ns |
| ns; statistically non-significant with P>0.05 | | | | | | | |
| [a] Symphylan counts were collected from three baits per plot. | | | | | | | |
| [b] Number of plants counted in three feet from each row of each plot | | | | | | | |

# Sugar beet for Seed

Table 3. Treatment, the active ingredient, rate (fl. oz/acre), IRAC Group, mean symphylan counts made during efficacy trial in spring 2023, ‘Sugar beet for Seed’

| Treatment | Active ingredient (IRAC Group) | Rate (fl. oz/acre) | Mean symphylan count per plot[a] | | | | Biomass rating[b] |
|---|---|---|---|---|---|---|---|
| | | | 28-Mar | 14-Apr | 24-Apr | 2-May | |
| **Control** | - | Untreated | 0.3 | 0.7 | 0.3 | 0.0 | 3.8ab |
| **Torac** | Tolfenpyrad (21A) | 21 | 0.0 | 0.3 | 0.0 | 0.7 | 2.7b |
| **WarriorII** | Lambda-Cyhalothrin (3) | 1.92 | 0.3 | 0.3 | 1.3 | 0.3 | 4.0ab |
| **Capture** | Bifenthrin (3) | 6.5 | 0.3 | 0.3 | 0.0 | 0.0 | 4.7a |
| **Lilacinos** | Bio nematicide (UN) | 10 gal | 0.0 | 0.0 | 0.0 | 1.7 | 3.2ab |
| **Seduce insect baits** | Spinosad (Spinosyn A and Spinosyn D) | 20-44lbs | 2.0 | 0.0 | 0.0 | 0.0 | 3.3ab |
| **Mustang 2ee** | Zeta-cypermethrin (3) | 4.3 | 0.3 | 0.0 | 0.0 | 0.0 | 3.8ab |
| **P value** | | | 0.1559 | 0.7468 | 0.5085 | 0.5784 | 0.058 |

Means within a column followed by the same letter are not significantly different (P>0.05). Columns without letters indicate no difference between treatments. Treatments were applied before planting on the same day.

[a] Symphylan counts were collected from three potato baits per plot.

[b] Number of plants counted in three feet from each row of each plot

# Summary

- Some promising chemistries were identified for symphylan control. Reminder- Always check specific insecticide labels for current registration uses
- There is a need to validate efficacy data in different seed crops and we are seeking registrant support for label expansions and new candidates with biological activity
- Cultural control tactics can help reduce the number of symphylans prior to crop establishment

# SYMPHYLANS:
# IN A CLASS OF THEIR OWN

Symphylans cause severe damage to a wide range of vegetable crops. Learn to monitor symphylans, prevent their spread, and reduce populations so you can grow great vegetables in their presence.

Think through ideas for future projects and join this farmer-to-farmer discussion with:

Navneet Kaur, Jon Umble & Nick Andrews

**Friday, February 16th**
**2:00-4:30 pm**

**LaSells Stewart Center – Ag Leaders Room, OSU Campus, Corvallis, OR**

# Acknowledgements


Funding

Growers, Crop Consultants, and Fieldmen

Students and Technician Field Crop Entomology Program OSU

Specialty Seed Growers of Western Oregon

Washington State COMMISSION ON PESTICIDE REGISTRATION

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AGRICULTURAL RESEARCH FOUNDATION


# Questions/Comments

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