Soil Arthropod Project Summary

Ellie Andrews, UCCE Specialty Crops Advisor for Sonoma, Marin & Napa Counties
Amanda Hodson, Assistant Professor, Soil Ecology & Pest Management Lab, UC Davis

Acknowledgements: A sincere thank you to the following farmers for hosting sample collection in support of this project, Elizabeth Kaiser, Rachel Kohn Obut, and Alice Tibbetts.

Introduction

Vegetable farmers encounter a wide range of soil arthropods on their farms. Some arthropods in the soil provide beneficial agroecosystem services, while others are pests that damage crops and reduce yield. Symphylans were the top economically damaging soil arthropod pest that commercial vegetable and flower farmers reported in 2023 and 2024 in the North Bay Area. Ellie Andrews, UCCE Specialty Crops Advisor in this region, designed and delivered the following programming to address growers' key questions and needs focused on symphylans:

- 2 Symphylans Focus Groups with local growers and technical assistance providers to identify key questions, needs, strategies and anecdotes
- Soil Arthropod Identification Webinar with Amanda Hodson (UC Davis) and Kelton Welch (Ecdysis Institute), see recording on the UCCE North Bay Specialty Crops YouTube channel
- Symphylans Field Day at Long Meadow Ranch with Jess Arnsteen (farmer), Jim Leap (retired UCSC Farm Manager), and Layla Aguilar (CAFF)
- Potato Bait Test Demo Video featuring Jim Leap on the UCCE North Bay Specialty Crops YouTube channel
- Symphylans IPM presentation summarizing all known IPM strategies for symphylans and areas for future research, see recording on the UCCE North Bay Specialty Crops YouTube channel

The UCCE Specialty Crops Advisor relied on the UC IPM website, UCCE Advisors with experience with this pest, as well as many other science-based resources and real-world IPM anecdotes from growers. Please explore the above resources to learn more about this pest as well as the many beneficial arthropods living in the soil.

Symphylans can be a difficult pest to manage. They have a wide host range and are very mobile in the soil. They often cause crop damage in organic vegetable and cut flower systems with high soil organic matter, plant residues, and good soil structure. They tend to appear less often in soil that is compacted or sandy. As Rex Dufour (ATTRA) put it, "ironically, they could be considered the single pest that is an indicator of good soil management where soil aggregation and soil organic matter are high."

Growers expressed the need to know whether there is a relationship between symphylans populations and the presence of their natural predators. This was a high-priority topic for many growers, but little is known about these potential relationships. To investigate this, Ellie Andrews (UCCE) collaborated with Dr. Amanda Hodson (UC Davis) and three local vegetable farmers to conduct on-farm soil arthropod sampling.

Symphylans on a potato bait.

Methods

Two farms in Sonoma County and one farm in Napa County hosted soil arthropod sample collection for this project in 2024. Amanda and Ellie installed potato bait traps for symphylans and pitfall traps for soil-dwelling arthropod predators of symphylans.

Sampling Method 1: Potato Baits

Potato bait installation procedure to monitor symphylans. After irrigating, scrape soil surface away and place potato slices on soil surface. Cover with a light-colored cup or pot to reflect heat, and secure it in place with a rock or some kind of weight. Return within 24-48 hours to look for symphylans. Count number of symphylans present. Symphylans can be washed into a vial using 95% ethanol to preserve them if that is of interest. Please see the UC IPM website for more details about this sampling procedure.

Stunted brassicas in an area where symphylans were found on potato bait traps.

Sampling Method 2: Pitfall Traps

Pitfall traps for soil arthropods including predators of symphylans. Dig a small hole in the soil within the irrigated area. Place two plastic cups in the hole, one cup inside of the other. Fill halfway with nontoxic antifreeze. Place mesh on top of cups to exclude wildlife. Return in ~2 weeks to collect arthropods. Pour contents into a small sieve over a funnel to capture arthropods, while antifreeze pours through the funnel into another container for disposal. Place arthropods in vial with 95% ethanol to preserve them until identification.

Chicken wire over pitfall traps to exclude wildlife.

Farm 1 Description and Results

At this farm, 12 potato bait traps and 11 pitfall traps were installed in lettuce, cabbage and kale beds. The lettuce and cabbage were in raised planter box beds while the kale was in beds in the ground. All beds had received grape pomace compost previously. Potato bait samples had 0-18 symphylans with an average of 6 symphylans per bait. Pitfall traps showed high levels of collembola but not many predators except for a few centipedes. No clear relationship was found between predatory mites and symphylans. In general, more soil life was found in raised beds than in-ground beds.

Table 1. Highlights from pitfall trap samples at Farm 1.

	Total Predators	Predatory Mites	Entomo-bryidae	Total Collembola	Carabidae	Predatory Beetles	Spiders	Centipedes
3 Samples in Lettuce	107	102	197	217	0	0	2	3
3 Samples in Cabbage	43	16	52	75	16	16	9	2
5 samples in Kale	42	13	60	98	8	12	14	3

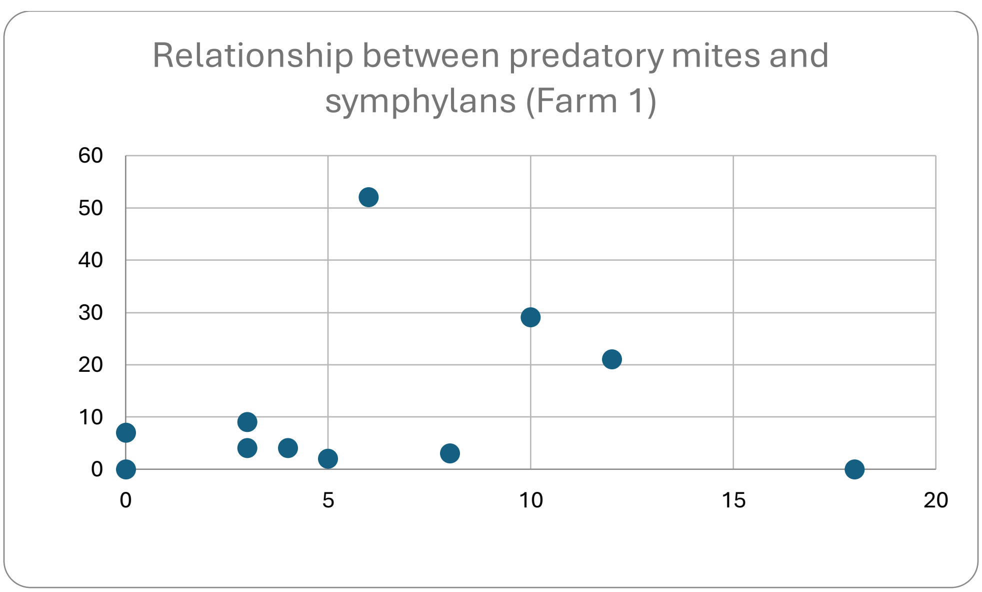

Figure 1. No clear relationship was found between predatory mites and symphylans at Farm 1.

Farm 2 Description and Results: Singing Frogs Farm

This diversified organic vegetable farm is run by farmers Elizabeth and Paul Kaiser. They practice, intensive, no-till, year-round cropping where beds constantly have photosynthesis (occasionally cover crops but primarily a large diversity of cash crops) and organic matter amendments. They grow on a sandy loam and loam soil. Several hedgerows provide many beneficial agroecosystem services throughout the farm.

At this farm, 13 potato bait traps and 13 pitfall traps were installed in mulched tomatoes, lettuce, mulched garlic, cabbage, cucumbers, corn, as well as fallow tarped soil, hedgerows, and nearby pasture. No symphylans were found on any potato bait samples from across the farm. Based on numerous previous soil tests, the soil at this farm is known to have high soil health metrics including high soil organic matter, which is carefully maintained by no-till and other soil health building practices. Nonetheless, no symphylans were found. This demonstrates that it is possible to use strict no-till practices, high organic matter inputs, and other soil health strategies and *not* have symphylans. Potential factors that may help explain the absence of symphylans could include high predator populations and soil biological diversity, soil texture, and a rigorous on-site compost making process that kills pests that may otherwise be brought to the farm.

Pitfall traps showed high populations of many arthropods including predatory beetles, spiders, isopods, crickets, etc. Massive amounts of ground beetles were found at this farm. There were relatively lower levels of collembola and predatory mites, which may be related to the high amounts of surface residue and lack of soil disturbance at this site. These practices likely promoted larger sized surface-dwelling arthropods. In particular, the hedgerows and straw mulch appeared to encourage high populations of beneficial arthropods.

Table 2. Highlights from pitfall trap samples at Farm 2.

	Total Predators	Predatory Mites	Isotomidae	Onychiuridae	Smithuridae	Total Collembola
2 Hedgerow Samples	97	5	0	0	0	0
10 Samples in Crops	383	18	18	87	51	169

	Carabidae	Staphylinidae	Elateridae	Tenebrionidae	Silphidae	Total Predatory Beetles
2 Hedgerow Samples	66	13	69	10	57	79
10 Samples in Crops	78	121	17	68	237	199

	Lycosidae	Gnaphosidae	Salticidae	Opliliones	Total Spiders
2 Hedgerow Samples	5	5	2	1	13
10 Samples in Crops	66	75	8	6	155

	Isopods	Centipedes	Millipedes	Earwigs	Crickets/Grasshoppers
2 Hedgerow Samples	2	0	0	0	13
10 Samples in Crops	91	8	6	7	155

Farm 3 Description and Results

This vegetable farm uses regenerative practices including compost and mulch application and low tillage. The farmer implements intensive planting with diversified crops and winter cover cropping. The farmer's first growing season at this site was 2024. The previous farmers at this site said that the site has a history of symphylans causing substantial crop damage. The farmer tilled the soil in late 2023 to alleviate severe compaction in this heavy clay soil and reduce potential symphylan pressure.

At this farm, 4 potato bait traps and 4 pitfall traps were installed in kale, chard, lettuce, and fallow soil. No symphylans were found on potato baits. One pitfall trap had a high number of ground beetles. This farm had high populations of collembola as well as some isopods and spiders. Potential factors that could help explain the absence of symphylans include heavy clay compacted soil and recent tillage.

	Total Predators	Predatory Mites	Hypogasturidae	Entomobryidae	Isotomidae	Total Collembola
2 Samples in Crops	18	2	0	73	122	203
1 Sample in Fallow	19	14	28	32	0	69

	Predatory Beetles	Lycosidae	Gnaphosidae	Total Spiders	Isopods
2 Samples in Crops	6	6	122	10	2
1 Sample in Fallow	1	1	3	4	2

Conclusions and Future Directions

These informal, descriptive surveys of soil dwelling arthropods provide a first look at community composition on three farms in the North Bay area in early summer. While no clear, direct relationships between symphylans and soil dwelling arthropods were found, results point towards areas for future study. Over time, could soil health building practices increase soil arthropod diversity and encourage suppression by predators? How much does soil type affect symphylan presence? How much do tillage and other practices reduce symphylans populations and how long does this effect last?

We need a better understanding of symphylans' biology, behavior, environmental preferences (such as soil temperature and moisture), and the effects of management practices, soil texture, timing, climate, etc. As more growers adopt soil health building practices in California, we will likely see symphylans pressure increase. Given the lack of prior research on this pest, there is great potential for future applied research to generate science-based information to help guide practical and affordable strategies that are compatible with organic and no/low-till systems.