

Project Title: Assessing and supporting effective areawide pear pest management

Report Type: Continuing Project Report

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Cooperators: Louis Nottingham, Molly Sayles (WSU)

Project Duration: 3 Years

Total Project Request for Year 1 Funding: \$79,989

Total Project Request for Year 2 Funding: \$79,770

Total Project Request for Year 3 Funding: \$77,304

Other related/associated funding sources: *Awarded*

Funding Duration: 2022–2023

Amount: \$40,000

Agency Name: WSU BIOAg Program

Notes: Funded project “Growers’ perceptions of IPM in pear across regions in the Pacific Northwest complements Obj. 1 of this proposal. PIs: Nottingham, Orpet, Sayles

Other related/associated funding sources: *Awarded*

Funding Duration: 2023

Amount: \$29,096

Agency Name: Western SARE

Notes: Funded project “Overcoming Roadblocks to IPM Adoption in Washington Pears” supported Sayles’s involvement in Obj. 2 and associated extension work. PIs: Sayles, Nottingham, Orpet

Other related/associated funding sources: *Awarded*

Funding Duration: 2024

Amount: \$22,314

Agency Name: Washington Commission on Integrated Pest Management

Notes: Funds supported Obj. 2 of this proposal. PI: Orpet

Other related/associated funding sources: *Awarded*

Funding Duration: 2024

Amount: \$15,000

Agency Name: Western IPM Center – Planning Document Grant

Notes: Funds supported Obj. 1 of this proposal. PI: Orpet

Other related/associated funding sources: *Awarded*

Funding Duration: 2024–2026

Amount: \$323,135

Agency Name: USDA Crop Protection & Pest Management

Notes: Funds were to support Obj. 2 of this proposal. PIs: DuPont, Orpet, Adams, Schmidt-Jeffris [Orpet was cut and RT Curtiss added during 2025]

Overall Leveraged Funding for Whole Project Life = \$429,545

Budget 1**Primary PI:** Robert Orpet**Organization Name:** Washington State University**Contract Administrator:** Office of Research Support and Administration**Telephone:** 509-335-9661**Contract administrator email address:** ORSO@wsu.edu**Station Manager/Supervisor:** Kimi Lucas (interim)**Station manager/supervisor email address:** kimi.lucas@wsu.edu

Item	2023	2024	2025
1 Salaries	\$38,250.00	\$39,780.00	\$41,371.00
Benefits	\$11,284.00	\$11,735.00	\$12,204.00
Wages			
Benefits			
RCA Room Rental			
Shipping			
2 Supplies	\$12,100.00		\$4,000.00
3 Travel			
4 Plot Fees	\$9,055.00	\$9,507.00	\$9,959.00
Miscellaneous			
Total	\$70,689.00	\$61,022.00	\$67,534.00

Footnotes:

¹Orpet salary: \$7,083 x 12 mo x 45% (x 1.04 for each additional year), benefits at 29.5%. Funds originally budgeted for Orpet in 2025, will instead be applied to salary of co-PI Curtiss at \$7,083 x 12 mo x 10%, benefits of 32.2% + a Research Intern at \$4,371.44 x 12 mo x 52.75%, benefits of 45.8%

²Supplies: Mailing for 2000 stakeholders = \$10,000 (yr1); materials for extension workshop meetings (\$2,100 yr1, \$4,000 yr3) includes room rental, food, color printing)

⁴Plot fees for WSU Sunrise Research Orchard (\$2,663 per acre X 3.4 acres in year 1, 5% increase for each additional year

Budget 2**Primary PI:** Rebecca Schmidt-Jeffris**Organization Name:** USDA-ARS**Contract Administrator:** Chuck Myers**Telephone:** 510-559-5769**Contract administrator email address:** Chuck.Myers@usda.gov**Station Manager/Supervisor:** Rodney Cooper**Station Manager/Supervisor email Address:** rodney.cooper@usda.gov

Item	2023	2024	2025
Salaries	\$3,523.00	\$7,222.00	\$3,701.00
Benefits	\$1,127.00	\$2,311.00	\$1,184.00
Wages			
Benefits			
RCA Room Rental			
Shipping			
Supplies			
Travel			
Plot Fees			
Miscellaneous			
Total	\$4,650.00	\$9,533.00	\$4,885.00

Footnotes:

¹GS-6 Biological Science Technician; \$40,262 annual salary, 7 months of work annually at 15% FTE in 2023 and 2025 and 30% FTE in 2024, with 32% fringe rate and COLA for Year 2 and 3 at 2.5%.

Budget 3**Primary PI:** Chris Adams**Organization Name:** OSU**Contract Administrator:** Charlene Wilkinson**Telephone:** 541-737-3228**Contract administrator email address:** charlene.wilkinson@oregonstate.edu

Item	2023	2024	2025
Salaries	\$3,523.00	\$6,981.00	\$3,701.00
Benefits	\$1,127.00	\$2,234.00	\$1,184.00
Wages			
Benefits			
RCA Room Rental			
Shipping			
Supplies			
Travel			
Plot Fees			
Miscellaneous			
Total	\$4,650.00	\$9,215.00	\$4,885.00

Footnotes:

¹Technician; \$40,262 annual salary, 7 months of work annually at 15% FTE in 2023 and 2025 and 29% FTE in 2024, with 32% fringe rate and COLA for Year 2 and 3 at 2.5%

Original Objectives and Significant Findings

1. *Conduct an industry-wide pear grower and consultant survey of pest management practices.*

- Data from growers for the year 2024 were analyzed for the entire pacific region (BC, WA, OR, CA), but response rates from consultants were too low for useful analysis.
- Wenatchee district growers had relatively low use of codling moth mating disruption, used the most insecticides, and had the greatest pear psylla problem.
- Growers in CA, Yakima, and BC used the fewest insecticides and had low pear psylla problems. Hood River and Okanogan were intermediate, but closer to Wenatchee in these metrics.
- Reported occurrence of rust mites was highest in BC and decreased latitudinally to CA; spider mites were sporadic across the whole region. Average occurrence of spider mites within a district was unrelated to total miticide applications.
- The reported importance of consultants from chemical distribution companies increased over the last two decades, while the importance of private consultants and extension declined.

2. *Evaluate and share outcomes of IPM program trials in Wenatchee, Yakima, and Hood River*

- Growers trialing IPM in Wenatchee replaced almost all use of “harsh” biocontrol-incompatible sprays with “IPM” options while achieving similar pear psylla control, although pear psylla damage was highly variable between locations and years.
- Insecticide and miticide materials costs per acre from grower spray records in Wenatchee from 2022–2024 averaged \$1446 in standard vs. \$1124 in IPM plots (\$322 less with IPM).
- Plots managed by commercial growers in Hood River and Yakima did not strictly follow the IPM guidelines used in Wenatchee, but used fewer insecticides, so are here termed “blended”.
- Hood River pear psylla dynamics and spray programs resembled Wenatchee programs more closely than assumed when this project was conceived.
- Yakima pear orchards had relatively low pear psylla, but could still experience damage at times.
- *Pear Entomology Weekly*, co-edited by Orpet and Sayles from 2023 – April 1, 2025, shared weekly in-season monitoring data across districts, pear psylla degree-days, and IPM guidelines with over 200 subscribers. After April 1, 2025, a similar report was coordinated by DuPont while Orpet contributed summary degree-day and insect population dynamics graphics.
- Funds from this project were used and leveraged by DuPont and by Sayles for additional grants supporting extension in Washington: Study Circles (two in 2023; 140 participants), a Pear Pest Management Discussion Group (four in 2023, three in 2024; four in 2025), panels at the NW Hort Expo and the NCW Pear Day, and a field day each year. Most participants, if surveyed at an event, reported learning something and planning to change at least one practice.
- Wenatchee growers increased adoption of IPM. In 2024, two of the six standard plots on the project switched to IPM, so monitoring was expanded to include replacement standard plots managed by neighbors. In 2025, three of the six standard plots switched to IPM, so the project expanded again with replacements.
- Standard plots always had very high pear psylla abundance in fall relative to IPM plots, but each spring the adult populations were similar regardless of management, suggesting standard spray programs generate large overwintering populations that spread across their district.

3. *Quantify correlations between IPM outcomes with landscape factors*

- Within the Wenatchee district, we found no correlations between local landscape factors (e.g., percentage pear surrounding study plots) with spring pear psylla populations, natural enemies, or fruit damage.
- Considering the observations and the biology of natural enemies, it is possible that the main source of natural enemies in a pear plot is the pear plot itself.
- Comparing districts, higher pear psylla damage was correlated with higher pesticide use, higher acreage of pear, and the Anjou cultivar.

Results and Discussion

Objective 1: an industry-wide pear grower and consultant survey of pest management practices

A subset of results from a 26-question survey are summarized below. A more detailed eight-page paper was prepared by Orpet, Sayles, Curtiss, Adams, and Goldberger entitled “Status of pear insect and mite management in western North America, 2024”, submitted to the Proceedings of the International Organization for Biocontrol (*in review*). A pre-print is available by request to Orpet.

Methods. In January 2025, 2,205 people received the survey by mail, e-mail, or both. Administration was done by the Washington State University Social and Economic Sciences Research Center. The Washington State University Institutional Review Board determined exemption from federal regulations on human subjects (IRB# 20391-001). Most questions asked respondents to consider the last three years, to avoid bias from unusual years. Responses from owners, lessees, or hired managers were analyzed. People with under 1 acre of pear were excluded, resulting in 32 exclusions and 130 usable responses, summarized by geographic district in Table 1. They represented 11,930 acres, which is about 27% of the regional acreage. Responses from consultants were not analyzed because there were only 13 usable responses, precluding plausible comparison of variation in practices between districts.

Table 1. Number of usable responses (N) by district with the sum, median (\tilde{x}), mean (\bar{x}), and standard deviation (SD) of reported acres. The same are reported for organic acreage (certified and in transition) and the number of people with 100% of their acreage organic (N 100%).

District	Total acres					Organic acres only					
	N	Sum	\tilde{x}	\bar{x}	SD	N	Sum	\tilde{x}	\bar{x}	SD	N 100%
CA: River	7	2179	7	311	571	3	109	5	37	54	3
CA: Mountain	7	484	47	69	47	1	18	18	18	0	0
CA: Other	4	158	4	40	74	3	37	4	13	15	2
OR: Hood River	46	5417	99	119	96	8	119	10	15	16	3
OR: Other	3	94	32	32	9	0	0	0	0	0	0
WA: Yakima	14	739	30	52	52	4	42	9	10	5	1
WA: Wenatchee	20	1324	47	67	77	8	185	17	23	22	2
WA: Okanogan	11	558	44	52	54	6	252	10	42	77	2
WA: Other	12	899	9	74	227	7	242	6	35	74	5
British Columbia	6	72	4	12	19	1	4	4	4	4	1
ALL:	130	11930	47	91	168	41	1008	25	59	106	19

Pest occurrence. The pests most often reported to cause damage were pear psylla, codling moth, stink bugs, rust mite, and spider mite. Pear psylla was least reported in British Columbia, Yakima, and California. Codling moth occurrence was lowest in British Columbia. Stink bugs were not reported in Yakima. There was a latitudinal gradient with increasing rust mite with northernliness. Leafrollers and thrips damage was most common in British Columbia.

Pesticides. One-hundred respondents inputted a pesticide record for a representative block in 2024. A total of 47 insecticide and miticide active ingredients were identified. For analysis they were grouped into working categories of “harsh”, “IPM”, and “miticide” (Table 2). The “harsh” ingredients are considered likely disruptive to biocontrol. The “IPM” ingredients are those considered permissible in the Washington

State University pear IPM guidelines used in objective 2 of this report. The 10 most-used ingredients across the Pacific region were (in descending order): mineral oil, mancozeb, spirotetramat, kaolin, sulfur, azadirachtin, abamectin, chlorantraniliprole, pyriproxyfen, and codling moth virus (Table 2).

Frequencies varied across districts (Figure 1). The average number of ingredients applied in 2024 ranged from 5.8 in British Columbia to 22.3 in Wenatchee. Particle films (e.g., kaolin) were only reported in Washington and Oregon. There was not much between-district variation in the number of “harsh” ingredients used, with 2–3 applications being generally reported. In Wenatchee, half of respondents reported they sprayed less than usual in 2024 (low fruit set and frost damage resulted in many blocks not being harvested), but in other districts the ratio of people spraying less vs. more was balanced (Figure 2A).

Table 2. Insecticide and miticide ingredients (and mean no. of applications) from 100 spray records from the year 2024. Categories “harsh” and “IPM” are judgements of unsuitability or suitability in programs meant to conserve insect biological control. “Miticide” ingredients are mainly used for mites

Category	Sub-category	Ingredient
Harsh	Neonicotinoid	Acetamiprid (0.23), imidacloprid (0.08), thiamethoxam (0.03)
	Pyrethroid	Beta-cyfluthrin (0.01), lambda-cyhalothrin (0.08), pyrethrins (0.01), zeta-cypermethrin (0.01)
	Other	Abamectin (0.56), carbaryl (0.01), cyantraniliprole (0.02), cyclaniliprole (0.01), diazinon (0.01), esfenvalerate (0.01), malathion (0.12), novaluron (0.16), spinetoram (0.25), spinosad (0.06), sulfoxaflor (0.03), tolfenpyrad (0.27)
IPM	Selective	<i>Bacillus thuringiensis</i> (0.17), codling moth virus (0.49)
	Particle	CaCO ₃ (0.31), diatomaceous earth (0.10), kaolin (0.83)
	Other	Azadirachtin (0.71), botanical oil (0.24), buprofezin (0.19), chlorantraniliprole (0.52), cinnamon oil (0.21), diflubenzuron (0.03), fish oil (0.01), lime sulfur (0.37), mancozeb (0.88), methoxyfenozide (0.13), mineral oil (3.95), potassium laurate (0.02), pyriproxyfen (0.49), spirotetramat (0.87), sulfur (0.74)
Miticide	--	Bifenazate (0.03), cyflumetofen (0.14), etoxazole (0.08), fenazaquin (0.12), fenbutatin-oxide (0.08), pyridaben (0.27), spiroadiclofen (0.22)

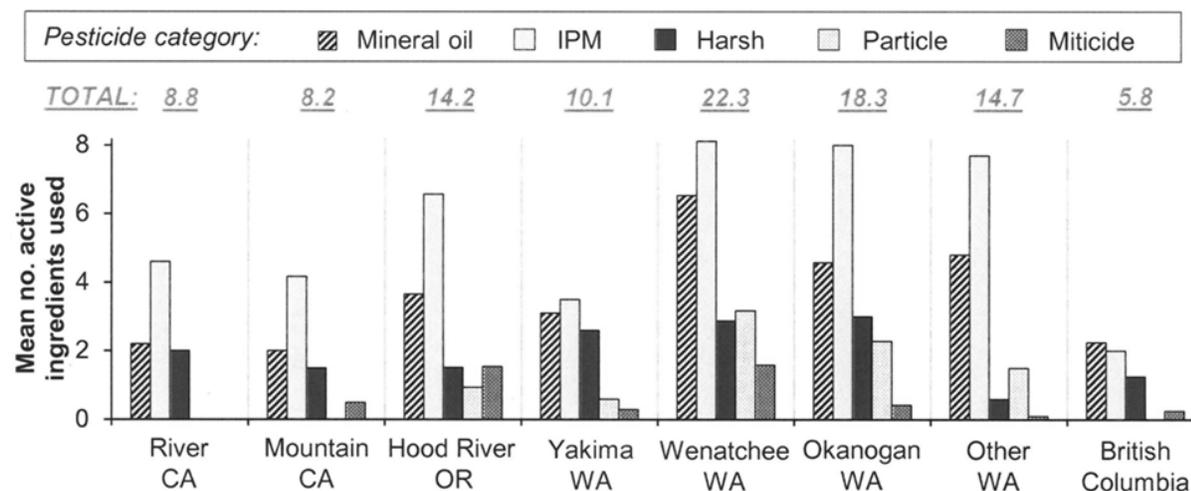


Figure 1. The mean number of pesticide ingredients used across districts in 2024.

Pesticide-pest correlations. There was a positive correlation between the mean percentage of pears damaged by pear psylla with the mean number of insecticides and miticides used (Figure 2B). There was no correlation when only “harsh” (Table 2) pesticides were analyzed ($P = 0.55$, $R^2 = 0.06$). There was no significant correlation between spider mite damage with pesticide use ($P = 0.46$, $R^2 = 0.09$; miticides only: $P = 0.54$, $R^2 = 0.06$).

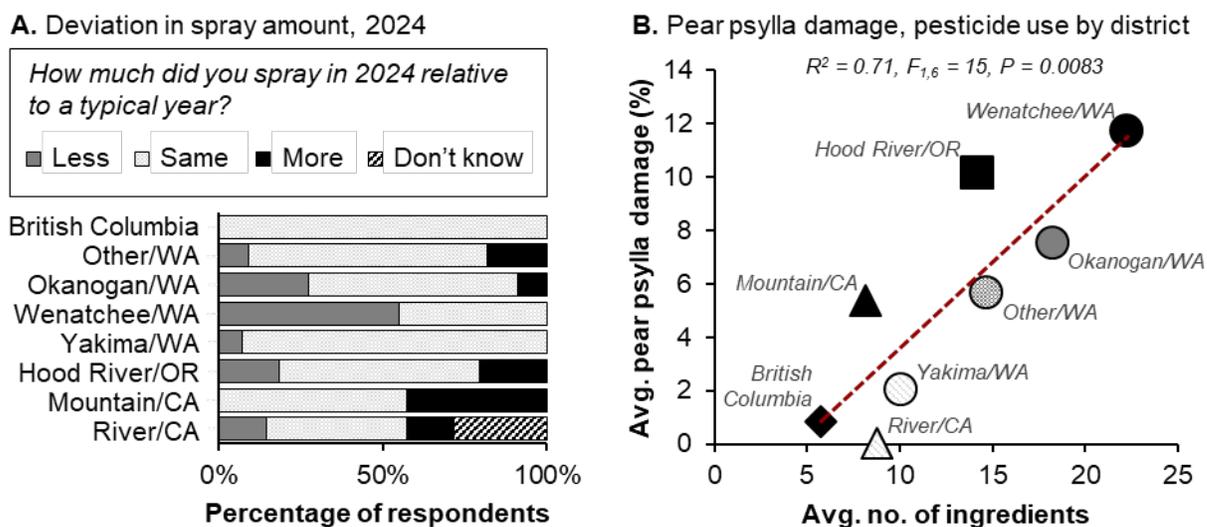


Figure 2. District mean percentage pears damaged (downgraded or culled) by pear psylla 2022–2024 by average no. of 2024 insecticides and miticides 2024 (A) and answers to the question “how much did you spray insecticides and miticides in 2024 relative to a typical year?” (B).

Other pest management practices. The number of growers reporting to use codling moth mating disruption on all of their pear acres was decisively the lowest in Wenatchee (30%). The percentages for other districts were: British Columbia (50%); Hood River (56%), Okanogan (63%) and all others (71–100%). Almost all growers reported using a codling moth degree-day model. Over 75% of Oregon and Washington growers reported using a pear psylla degree-day model. Among growers using models, Washington State University’s Decision Aid System website was used in Washington (70%), British Columbia (100%), and Oregon (24%). The website USPest.org was used in Oregon (41%), and Washington (13%). The balance and sources in other districts were from extension activity, other websites, or private sources. Consultants from chemical distribution companies were most often rated as very important to help make pest management decisions.

Relevance. Reports from the 1990s suggest that pear growers of California and British Columbia reduced insecticide use to a third of previous levels by adopting integrated management programs based on codling moth mating disruption and organophosphate alternatives. By integrating biocontrol, these programs also reportedly reduced pear psylla and mite problems. The survey results show these changes have been durable. Meanwhile, use of insecticides and miticides doubled in Washington since the 1990s¹ and use of

¹Compare current results with: Brunner, JF, J Dunley, W Jones, E Beers, GV Tangren, C Xiao and GG Grove. 2003. Pesticide use and IPM practices in Washington’s pear and cherry orchards. Agri. & Environ. News. <https://web.archive.org/web/20250421141833/http://aenews.wsu.edu/Aug03AENews/Aug03AENews.htm#PearCherry>

mating disruption is low in Wenatchee. The survey indicates that Yakima pear pest management resembles that of California more than the rest of Washington. Hood River is intermediate. In Hood River, reported pesticide use and pear psylla were higher than we had assumed when originally designing this research. The results put into context that an integrated management program characterized by relatively low insecticide use and low pear psylla has been accomplished long-term in several districts.

Limitations and reflections. These results fill in a missing gap where we had recently assumed patterns based on anecdotes and decades-old reports. The probability-based survey design used here was useful and allows for comparison with older surveys¹ and between districts. However, low response rates increase the risk of bias, and districts with fewer growers were unrepresented. For this research, a separate survey was designed for consultants, but there were few responses. Greater communication and buy-in could have improved response rates, but in retrospect a much shorter survey or other evaluation method for consultants would have been more effective. To increase response rates more generally, a future survey should be shorter to make it easier to respond. In addition, fewer surveys should be done overall to reduce survey fatigue. Needs assessments and project evaluations should be planned more carefully to avoid redundancy, improve validity, and consider benefits to the community. The input of a sociologist and the professional services of the Washington State University Social and Economic Sciences Research Center on this project were essential.

Objective 2. Outcomes of IPM program trials in Wenatchee, Yakima, and Hood River

A summary of key findings is given below. Results from Wenatchee in 2022–2024 are given in greater detail in an eight-page paper, entitled “Implementing a new integrated pest management program for pear pests in Washington State, USA” submitted to the Proceedings of the International Organization for Biocontrol (*in review*). A pre-print is available by request to Orpet.

Support for IPM implementation. In 2023, a weekly internal report to growers and consultants in Wenatchee during 2022 was expanded into a public newsletter called Pear Entomology Weekly. The newsletter shared pear psylla degree-days, IPM guidelines, and scouting data by plot. It reached 224 subscribers by the end of 2024. Orpet and Sayles co-edited 79 issues until April 1, 2025, after which time Orpet served as a contributor, providing summary charts from Wenatchee, Yakima, Hood River, and Southern Oregon. For a standing reference, the WSU “Pear Psylla Phenology Model” website was updated in 2024 (<https://treefruit.wsu.edu/crop-protection/psylla-phenology-model/>). This website contains pear IPM guidelines on a degree-day basis. The guidelines are summarized here in Figure 3. Pear psylla degree-days can be obtained on <http://USPEST.org> for free or <https://decisionaid.systems> a subscription fee.

Evaluation and data sources. In 2022, a pear IPM project in the Wenatchee Valley was initiated by Nottingham and Orpet. The current project extended it into 2023–2025 and added plots in Yakima and Hood River. In Wenatchee, seven pairs of commercial orchards (one plot using standard management and one nearby plot following the new IPM program) were monitored for pests, beneficials, and fruit damage in 2022. Six of the same pairs were used in 2023–2025 and one was dropped because the grower could not be contacted. In 2024 and 2025, standard plots sometimes switched to IPM programs, so replacement standard plots were sourced, but the number of pairs was reduced to five in 2025 since a replacement could not be found for one location. For Yakima and Hood River, the current project included scouting of four plots each during 2024 and 2025. In 2025, two additional plots were added to each district using a new USDA grant to Tianna DuPont for the “Scouting Network”. In 2025, Orpet added three plots from the Southern Oregon Research and Extension Center. Monitoring in all years included standard methods of weekly beat tray taps

(generally 25 per plot) and leaf brush samples (50–100 leaves per plot, taking 5 leaves per shoot from an equal mix of high and low first-year growth).

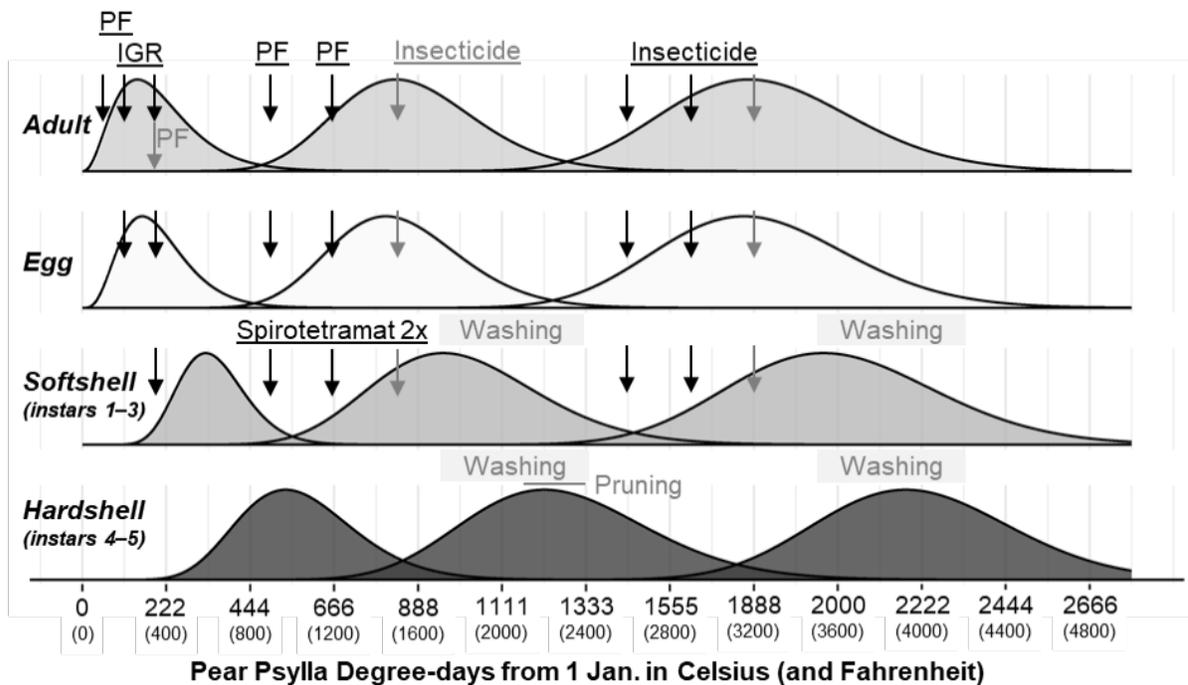


Figure 3. Pear IPM guidelines on a pear psylla degree-day basis. Each curve shows a gamma probability density function (from Jones et al.) predicting relative abundance of a given life stage and generation. Arrows or boxes show timings for IPM techniques (gray are considered optional); PF = particle film to deter adults and egg lay; IGR = insect growth regulator; spirotetramat can be used two times within the shown range; insecticide = various other options within the guidelines.

Results – Wenatchee Valley. There was no statistical difference in pear psylla pear downgrades between standard and IPM in Wenatchee Valley plots any year, but the P value was marginal (0.051) for higher IPM Anjou damage in 2024 (Table 3). At the Rock Island pair of plots (excluded from Wenatchee Valley comparisons), pear psylla downgrades were higher in the standard management plot three out of the four years (Table 3), but there was no statistical analysis due to lack of replication of plots at this location.

The IPM spray programs costed less than standard programs overall, but costs by year were significantly lower only in 2023 (Table 4). The IPM programs excluded all “harsh” chemicals listed in Table 2 except for some growers who chose, in the prebloom period, to use malathion, tolfenpyrad, or abamectin. The IPM programs had a mean number of 7.9 spray events involving insecticides or miticide per year and 23 uses of insecticide or miticide ingredients. The most commonly used materials with IPM programs were mineral oil, kaolin, azadirachtin (or neem oil), pyriproxyfen, spirotetramat, cinnamon oil, and sulfur. The standard programs had a mean number of 8.4 spray events and 28 ingredients. The most commonly used materials under standard programs were mineral oil, kaolin, spirotetramat, abamectin, acetamiprid, imidacloprid, malathion, novaluron, spinetoram, tolfenpyrad, thiamethoxam, and cyflumetofen. Codling moth mating disruption costs are not included in Table 3 and were not analyzed due to inconsistent documentation; it would cost \$125–240/acre in materials if used.

Table 3. Mean (SD) percentage ‘Anjou’ downgraded from pear psylla at plots across Washington and Oregon districts monitored in 2022–2025.

Location	Year	Percentage downgraded			Paired t-test
		Blended	Standard	IPM	
Wenatchee Valley	2022	-	8.43 (3.4)	11.4 (8.8)	T = -0.76, df = 6, P = 0.48
	2023	-	4.17 (6.9)	0.50 (1.2)	T = 1.23, df = 5, P = 0.27
	2024	-	15.8 (21)	23.4 (24)	T = -2.56, df = 5, P = 0.05
	2025	-	0.90 (1.2)	1.50 (1.6)	T = 0.47, df = 4, P = 0.66
Rock Island	2022	-	2.00	0	-
	2023	-	10.0	1.00	-
	2024	-	3.00	6.00	-
	2025	-	17.0	12.5	-
Yakima	2024	18.1 (11.5)	-	-	-
	2025	-	-	-	-
Hood River	2024	0.25 (0.4)	-	-	-
	2025	3.92 (2.8)	-	-	-
Southern Oregon	2025	-	0	0	-

Table 4. Mean (with range, and standard deviation) of per acre insecticide and miticide materials costs for standard and IPM plots in Wenatchee Valley project plots. To calculate chemical control materials costs, list prices of all insecticide and miticide products found in spray records were obtained from five chemical distributors and averaged for calculations.

Year	Mean materials cost per acre (range, SD)			Paired t-test
	Standard	IPM		
2022	\$1462 (856–2059, 477)	\$1517 (1162–2178, 409)		T = -0.44, df = 5, P = 0.68
2023	\$1563 (1166–1924, 268)	\$1082 (618–1425, 302)		T = 2.66, df = 5, P = 0.045
2024	\$1312 (871–1768, 402)	\$1124 (716–1611, 295)		T = 1.09, df = 5, P = 0.32
<i>MEAN:</i>	<i>\$1446 (1058–1876, 318)</i>	<i>\$1241 (1029–1431, 149)</i>		<i>T = 1.87, df = 5, P = 0.12</i>

Pear psylla tended to be found in similar abundance between standard and IPM plots in spring, higher in IPM in summer, and higher in standard plots in late summer through fall. Standard plots often had over 10 times more pear psylla adults than IPM plots in fall (Figure 4). *Trechnites* parasitoids, *Campylomma* bugs, and *Deraeocoris* bugs responded to pear psylla. *Trechnites* were hardly found under standard programs (Figure 5). *Campylomma* and *Deraeocoris* were sometimes found under standard programs later in the season (Figure 5). Green lacewing and coccinellidae (ladybug) occurrences were not highly associated with pear psylla and were found in similar amounts under both management programs.

There was no clear difference in rust mites or spider mites populations between IPM and standard plots. They occurred sporadically, and *Typhlodromus* predator mites tracked spider mites regardless of management program.

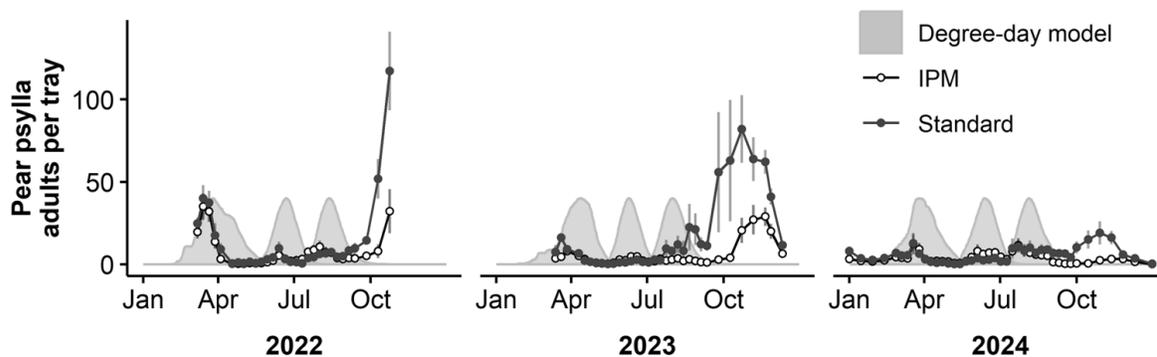


Figure 4. Weekly mean (\pm SEM) pear psylla adults per tap in standard and IPM pear plots (N = 7 pairs, 2022; N = 6 pairs, 2023–2024). The shaded area depicting the degree-model has an arbitrary height and is meant to show the predicted timing of insects, not the amount.

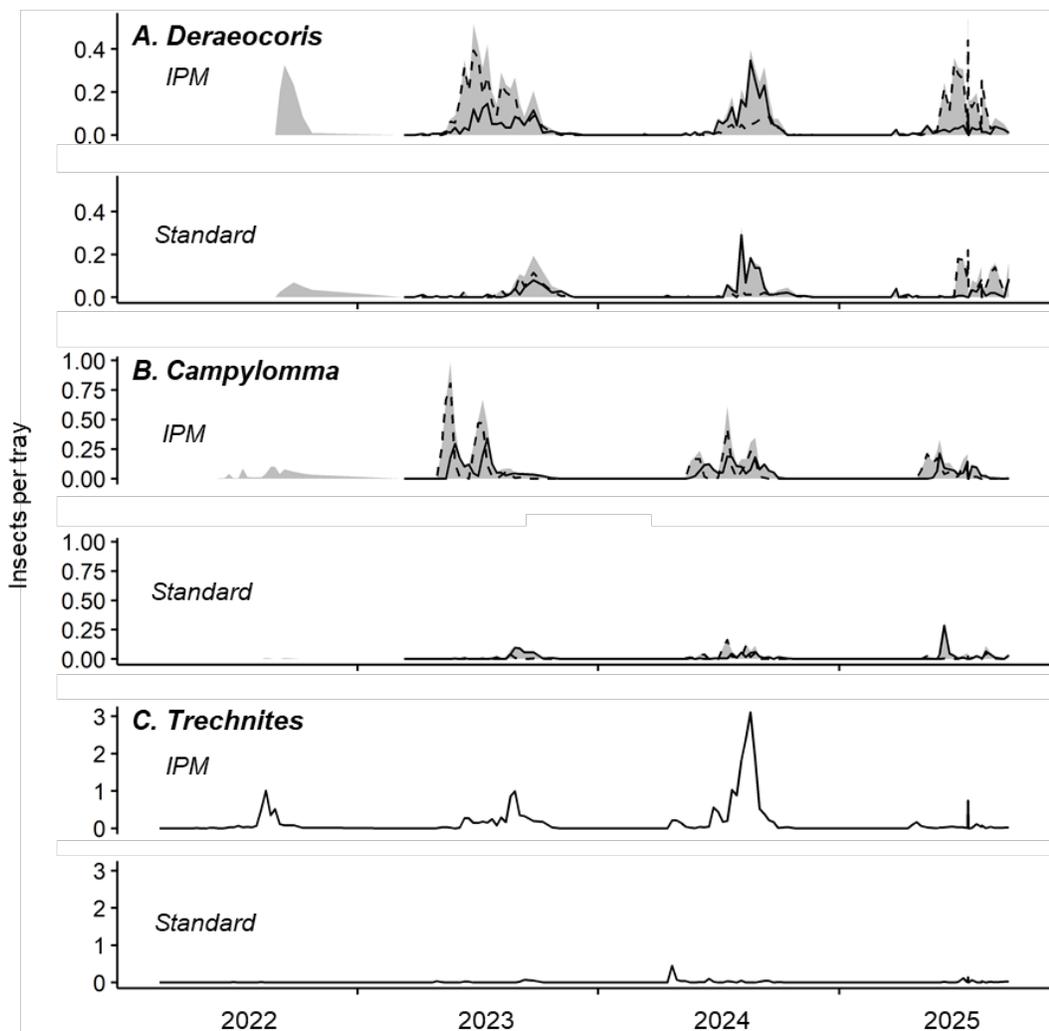


Figure 5. Weekly mean natural enemies per tap in standard and IPM pear plots (N = 7 pairs, 2022; N = 6 pairs, 2023–2024, N = 5 pairs, 2025). Grey areas show the total, solid black show adults, and dashed black show nymphs (nymphs and adults were not distinguished in 2022).

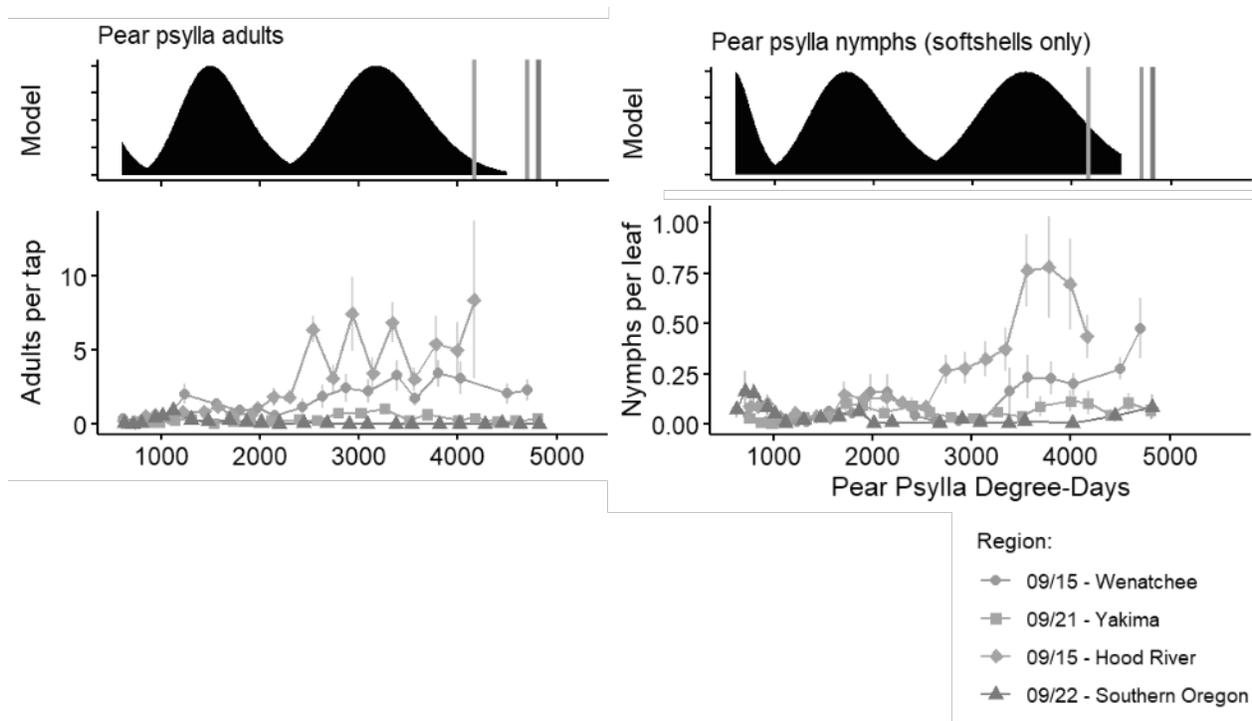


Figure 6. Weekly sampling of pear psylla adults and softshell nymphs (instars 1–3) on a degree-day scale below model predictions of relative abundance. The key also shows the final day of sampling in 2025 for each pear region. In the color version shared in Pear Entomology Weekly, colored vertical bars in the top portion would visualize where each region was on the model, progressing each week.

Results – District-level comparisons. Pear psylla adults and softshell nymphs (instars 1–3) are graphed on a degree-day basis during 2025 in four pear-growing districts in Figure 6, which is an example of a summary figure used in the Pear Entomology Weekly newsletter in 2025. Wenatchee and Hood River had higher populations than Yakima and Southern Oregon plots. All regions reasonably followed the pear psylla model prediction of relative abundance.

Natural enemy abundance and diversity across the 2025 season are visualized in Figure 7. Although Wenatchee and Hood River had high numbers of *Trechnites*, *Deraeocoris*, and *Campylomma*, this was in response to higher pear psylla populations. Thus the ratio of natural enemies to pear psylla was less favorable than in Yakima. Southern Oregon plots had few pear psylla and a community of generalists like ladybugs, lacewings and earwigs. Wenatchee was notable in having few earwigs compared with other districts.

Relevance. Attitudes and practices about pear pest management changed during this project. In 2022, we felt that the growers and consultants trialling the IPM program were innovators and early adopters. However, through extension activities and communication within the community, the IPM idea gained interest. In 2025, we had difficulty sourcing new standard plots to replace ones that were switching to IPM spray programs. Growers on the project increasing their IPM is a strong indication that the program is working. Nonetheless, insecticide and miticide use in the Wenatchee IPM plots we studied was higher than the mean usage of any other district reported in the survey from Objective 1. Wenatchee IPM plots did not greatly reduce pesticide use relative to standard plots, but rather substituted harsh sprays with azadiacthin and cinnamon oil while using near-maximum intensity of IPM-permissible ingredients like spirotetramat, pyriproxyfen, and kaolin.

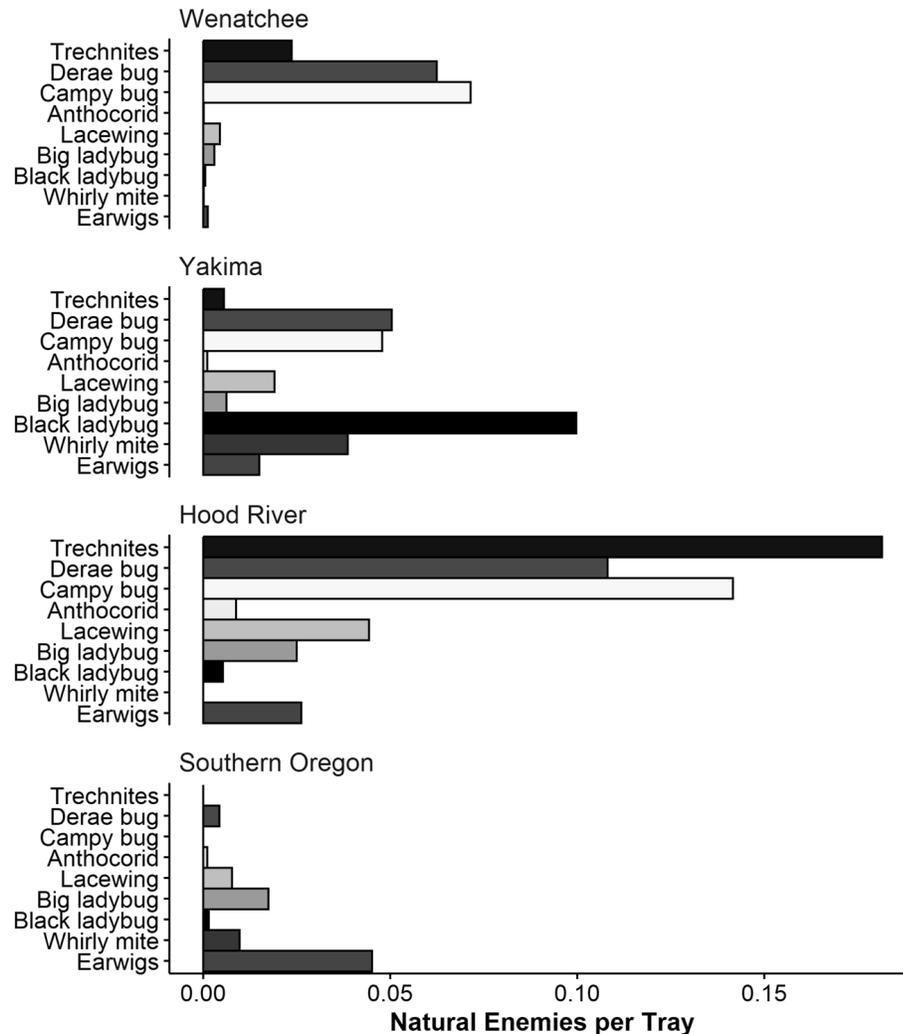


Figure 7. Natural enemies per tray across the entire 2025 growing season for four pear districts.

Limitations and reflections. A lack of control over pesticide programs in commercial plots, especially in Yakima and Hood River, limited evaluation of standard vs. IPM in different districts. The paired plot design in Wenatchee was successful, but higher replication would have been useful since there was so much variation. Sometimes standard plots had less pear psylla damage, and sometimes IPM had less. Future evaluations of pear IPM could attempt to study more plots, and attempt to have greater understanding or control of spray programs in carefully selected pairs.

Objective 3. Quantify correlations between IPM outcomes with landscape factors

This analysis used the data from Objective 2 to search for correlations between landscape factors with IPM program outcomes. It was thought that being next to more pears would decrease IPM program effectiveness in a plot due to close access to dispersive overwintering pear psylla adults and less accessibility to refuges of natural enemies.

Methods. A map of the Wenatchee Valley pear landscape was created with QGIS software. A base map of satellite imagery from Esri and polygons for different categories of land use were manually annotated. Categories included pear, other tree fruit (apple, cherry, peach), grape, open water (used for the Wenatchee River and parts of Peshastin Creek), creek or riparian (used for smaller creeks and buffer of apparent riparian vegetation around water), canal (including the canal and buffer of associated vegetation), developed (roads with roadsides; residential, commercial, and industrial lots), open fields or grassland, forest, and shrubland. The USDA Cropscape Website and Google Earth were used for assistance identifying most likely land use category. Organic pears (certified or in transition) were coded separately from conventional pears according to public data supplied by Washington State Department of Agriculture. The year 2023 was used as the reference point since it was not practical to generate a separate map for each year. Percentages of different land use categories were calculated within a 500-m radius around the central points of Wenatchee study sites from Objective 2 (Figure 8). Various correlations between land use and insect data were explored.

Results – Wenatchee correlations. There was not a significant effect of percentage of pears surrounding plots on peak spring pear psylla abundance in any year for IPM or standard plots. There was high variation between plots and years. For example, the most isolated plot in Wenatchee Valley studied here (Figure 9, HWY 97) had peak spring populations varying at 32, 8.7, 44, and 6.4 per tray in 2022, 2023, 2024, and 2025, respectively, despite supporting low pear psylla population each summer (there were 0, 0, 6.5, and 0.5 percentage pear psylla downgrades in those years at the plot). In contrast, spring pear psylla populations at WSU Rock Island plots, where the nearest other pears are about 4 miles away, were always low (1, 1, 5, 1; by year). Due to these observations, combined with the results shown in Figure 4, it is speculated that pear psylla are able to disperse readily through the scale of the Wenatchee Valley, even to relatively isolated orchards.

There were no correlations found with natural enemies, which were also highly variable between plots and years. *Campylomma* overwinter as eggs in pear orchards and other plants. *Campylomma* nymphs were found before winged adults in pear orchards each year (Figure 5), suggesting that their main population source is from within pear orchards. *Deraeocoris* overwinter as adults in pears and other plants. The main first appearance of *Deraeocoris* nymphs and adults were found around the same time in pear plots each year. If insects overwintering outside of pear orchards are moving in earlier in the spring, they are in numbers that are very low and difficult to detect. *Trechnites* are thought to be specialists of pear psylla nymphs, so again their main population source would be expected to be from within the pear orchard. Lacewings and coccinellids were found in too small numbers and sporadically for analysis.

The ultimate indicator of a pest management program's ability to control a pest is fruit damage. There was no significant correlation with landscape factors and fruit damage ratings in any year. Like with previous metrics, damage was highly variable between plots and years.

The results suggest that the Wenatchee landscape as a whole may have some effect on pest pressure, but the local landscape around specific plot has less of an effect than other factors.

Results – District comparisons. Taking together the data from all objectives, it is possible to consider associations between pear psylla pressure across districts in light of various hypotheses brought up by growers and consultants. A latitudinal gradient, with increasing pear psylla pressure at higher latitudes is not supported. British Columbia and Yakima have low pear psylla pressure, breaking the pattern between California, Southern Oregon, Hood River, and Wenatchee. Districts with higher pear psylla pressure have the highest acreages of pear (i.e., Hood River and Wenatchee are the highest-acreage districts). However, it should be considered that Sacramento Delta in California has considerable acreage, about 6,000 acres. Wenatchee and Hood River also have a higher proportion of Anjou pears relative to other districts. Wenatchee is notable for having scarce earwigs compared with all other districts with earwig monitoring data. Lastly, more intensive spray programs are correlated with higher pear psylla pressure (Figure 3B).

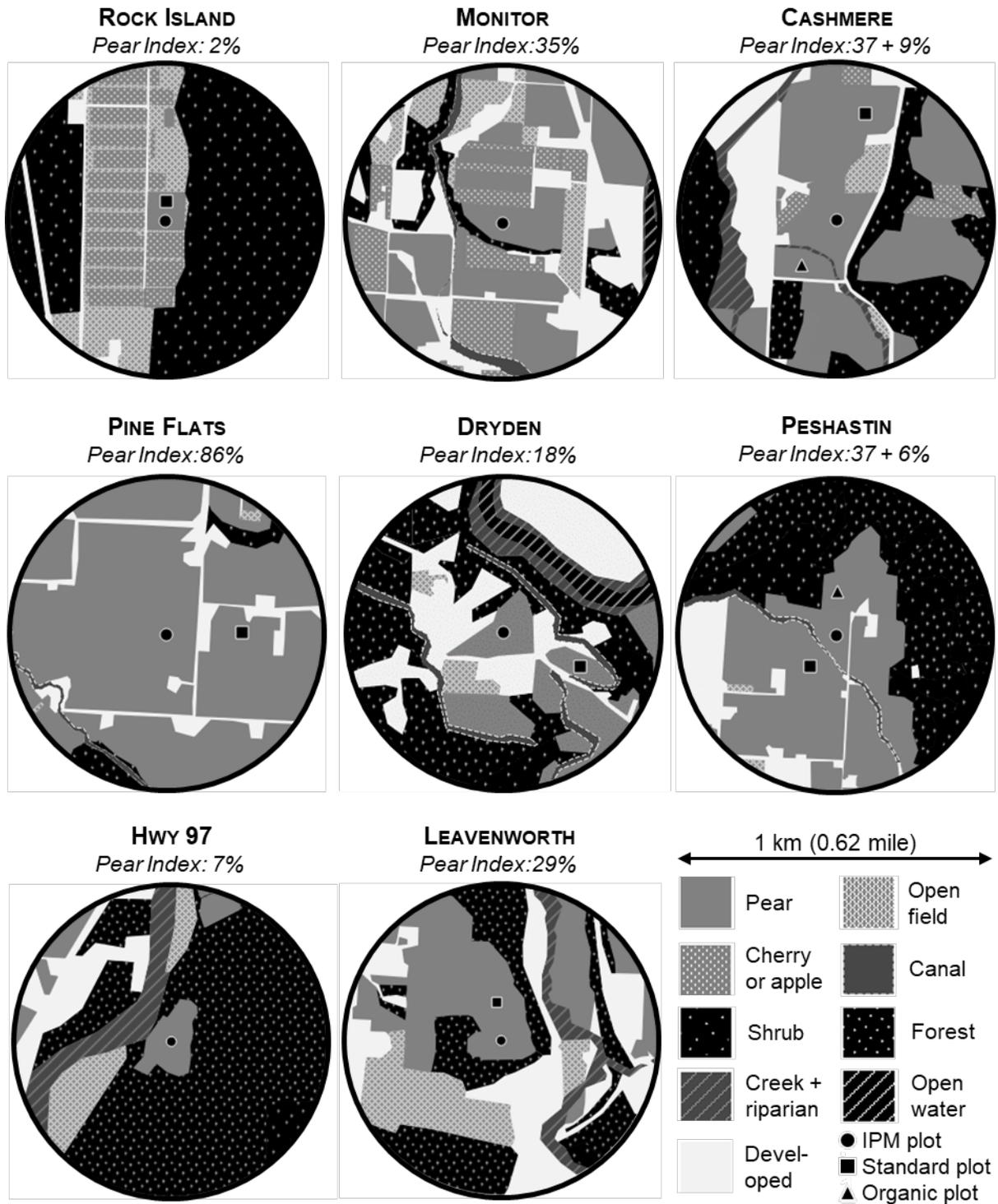


Figure 8. Visualization of pear landscapes around study plots (IPM plots only due to space limitations). The “Pear Index” is the percentage of conventional pears + organic pears within the radius of a given location.

Executive Summary

Assessing and supporting effective areawide pear pest management

Integrated pest management, landscape, pear psylla, survey

This project was designed to produce and share information that would help pear growers reduce chemical control costs while reducing damage of the key pest pear psylla by using an integrated pest management program (IPM) that conserves biocontrol. A survey was conducted and found that growers in Wenatchee used the most pesticides yet had the greatest pear psylla problem. An IPM program was designed for use in Wenatchee. It was built around a pear psylla phenology model for spray timings and a list of biocontrol-compatible spray options. The program was evaluated in commercial orchards from 2022–2025. The growers reduced spray costs in IPM plots in most years, but retained higher pesticide use than other districts through extensive applications of kaolin, azadirachtin, cinnamon oil, and other chemicals. The program resulted in similar pear psylla as standard programs. In Hood River and Yakima, growers meant to be trialing IPM programs ended up using blended programs that reduced but did not eliminate sprays excluded in the IPM guidelines, and outcomes were variable. Local and large-scale landscape factors were considered. Hood River pesticide use and pear psylla abundance was more similar to Wenatchee than we had assumed when the project was designed. Characteristics of Wenatchee and Hood River that may be associated with high pear psylla pressure relative to other districts includes high pesticide use (potential impairing biocontrol and causing pest resurgence), high pear acreage, and the Anjou cultivar. Notably, standard plots in Wenatchee generated very high overwintering pear psylla population in fall relative to IPM plots, but adult counts became similar between plots in spring. Overwintering pear psylla adults are known to be highly dispersive. It stands to reason that areawide adoption of IPM decreases pear psylla pressure across a district. An extensive program of field days, discussion groups, and newsletters shared data from the project, and adoption of IPM increased during the project. The survey and insect monitoring results here provide a conceptual basis for pear IPM and baseline data to compare with in the future.