PEAR PSYLLA INTEGRATED PEST MANAGEMENT

Introduction

Pear psylla (*Cacopsylla pyricola* [Foerster] [Hemiptera: Psyllidae]) is an important pest of pear in Washington. Honeydew produced by pear psylla causes fruit russet, and serious infestations can stunt and defoliate trees.

History

Pear psylla likely arrived in the United States along with shipments of pear nursery stock from western Europe. It was first found in Connecticut in 1832 and spread to Washington State by 1939 (Westigard et al. 1979). Within a few years it became a serious pest throughout all pear growing areas in the Pacific Northwest.

Hosts

In the Pacific Northwest, pear psylla is a pest only of pear. Several other plants are transitory hosts and overwintering sites for winterform pear psylla adults. Pear psylla adults may feed on other deciduous fruit trees including apples, conifers and shrubs as they disperse from pear orchards in the fall and return in the spring (Horton et al. 1994; Cooper et al. 2019). However, pear psylla does not reproduce on these transitory hosts (Kaloostian 1970; Cooper et al. 2019).

Life Stages

Egg: The egg, shaped like a grain of rice, is attached to the host by a small protrusion extending from the rounded end and inserted into host tissue. The egg is creamy white when laid but turns yellow to orange as it develops (Figure 1).

Nymph: The nymph passes through five stages (instars). The first instar is translucent yellow. It is somewhat cylindrical in shape and about the size of the egg. Each successive instar is larger, flatter and more oval than the previous instar. The fourth instar nymph is yellowish green to light tan. The fifth instar is dark green to dark brown and often referred to as the hardshell stage. Wing pads are noticeable on third instars and get progressively larger on fourth and fifth instars (Figures 1–3).

Figure 1. Pear psylla eggs and early instar nymph. Photo: E. Beers.

Figure 2. Pear psylla nymph hardshell (left), young nymph (right). Photo: T. DuPont.

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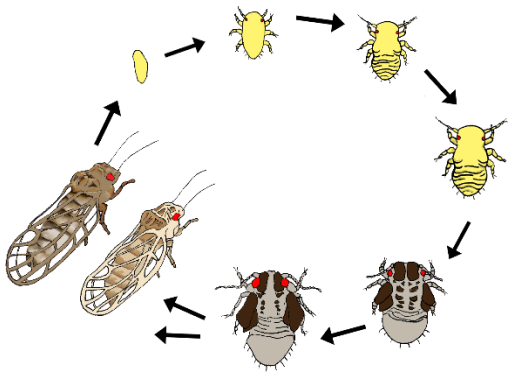

Figure 3. Developmental cycle of the pear psylla. Adapted from Tougeron et al. (2021).

Adult: There are two adult forms: winterform and summerform. Both forms of adults hold their wings roof-like over the abdomen. Adults have reddish brown bodies with black markings, and winterforms may appear almost black. The winterform is larger (wing length 2.3 to 2.5 mm) than the summerform (wing length 1.6 to 1.8 mm) (Figures 4 and 5) (Slingerland 1892; Wong and Madsen 1967; Burckhardt and Hodkinson 1986).

Figure 4. Pear psylla summerform adult. Photo: T. DuPont.

Figure 5. Pear psylla winterform adult. Photo: E. Burts.

Life History

Pear psylla overwinter as winterform adults in a state of reproductive diapause. They begin laying eggs when pear buds begin to swell. First, eggs are deposited on the wood, generally at the base of fruit and leaf buds (Horton 1999). Offspring of the overwintered generation become summerform adults first appearing in mid-May. Pear psylla has two to four summerform generations in most pear-growing regions, with generally two complete summerform generations occurring in Washington (Horton 1999). Summerform adults tend to lay eggs on rapidly growing leaf tissues, often placing eggs along the leaf mid-vein (Horton 1990).

Damage

Fruit russet: Nymphs and adults are phloem feeders. Honeydew, produced by nymphs, drips or runs onto fruit, causing dark, russet blotches or streaks and downgraded fruit (Figure 6). The damage may be exacerbated by a sooty mold fungus that colonizes the honeydew and also marks fruit (Burts 1970).

Figure 6. Fruit russet caused by psylla honeydew. Photo: T. DuPont.

Psylla shock: In large numbers, pear psylla can stunt and defoliate trees and cause fruit drop. A carryover effect may reduce fruit set the following year. These symptoms, called psylla shock, are caused by toxic saliva from feeding nymphs (Westigard et al. 1979).

Decline: Pear psylla also transmit a mycoplasma disease organism (*Candidatus Phytoplasma pyri*: Pear decline phytoplasma) through its saliva. The disease damages sieve tubes in the phloem. This damage prevents nutrients from moving down the tree and results in root starvation. Trees grafted on Ussurian pear (*P. ussuriensis*) and Asian pear (*P. pyrifolia*, synonymous with *P. serotina*) rootstocks are the most susceptible. Trees grafted on *P. communis*, *P. betulifolia*, *P. calleryana*, and *Cydonia oblongata* (quince) rootstocks become

infected but are tolerant and display reduced decline symptoms (Blomquist and Kirkpatrick 2002; Teng et al. 2002). Most pears in Washington and Oregon are grafted to tolerant *P. communis* (Elkins et al. 2012).

Monitoring

Weekly monitoring is recommended.

Adults: Monitor adults with beat tray sampling (Figure 7). Hold an 18-inch square tray with a white cloth cover one foot below a 0.75 to 1.5-inch diameter limb with an average number of spurs and branches. Tap the limb firmly three times with a stiff rubber hose. Count adults jarred from the limb onto the tray. Thirty trays at random through the sampling area is standard for a pear block of ten to twenty acres.

Nymphs and eggs: To determine the density of first-generation eggs and nymphs, examine spurs. Collect ten fruiting spurs with 0.5 to 2 inches of wood. Count eggs on the wood and count eggs and nymphs on emerging green tissue (once present) with a dissecting microscope or a ten-power hand lens.

Subsequent generations of eggs and nymphs should be sampled on new shoot growth. Collect a total of ten leaves from each of ten randomly selected trees. Select five leaves from the lower canopy with two in the center of the canopy near the crotch of the scaffold limbs and three in the middle of each of two scaffold limbs (Figure 8). Include one to two leaves that may not receive good coverage in the center of the tree. Use a telescopic pruner to collect five leaves across two clusters or shoots in areas which are difficult to spray, such as the upper canopy and the back side of limbs.

Biological Control

Important biological control organisms in Washington pear orchards are the parasitic wasp *Trechnites insidiosus*; true bugs *Deraeocoris brevis*, *Campylomma verbasci*, and *Anthocoris* spp.; lacewings *Chrysoperla carnea*, *Chrysopa nigricornis*, *Hemerobius* spp.; and the earwig *Forficula auricularia*.

Trechnites insidiosus can parasitize pear psylla at rates that exceed 70% in unsprayed orchards and 50% in organic orchards (Beers et al. 1993). Maximum parasitism rates in a review of nineteen field studies range from 1.7% to 100% (Tougeron et al. 2021). Over half of the studies reported parasitism rates exceeding 40% (Tougeron et al. 2021). *Trechnites insidiosus* generally has four generations per year in Washington orchards. Peak counts may often occur at approximately bloom time as parasitoids emerge from their overwintering sites within psylla hosts (Figures 9 and 10).

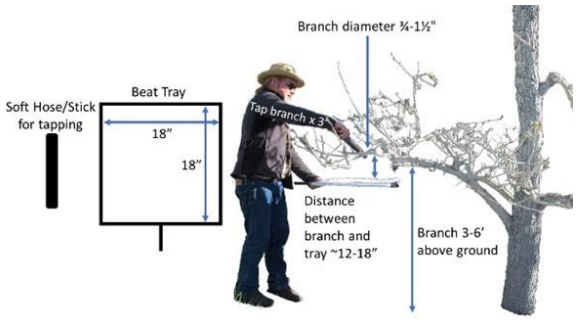

Figure 7. Beat tray sampling.

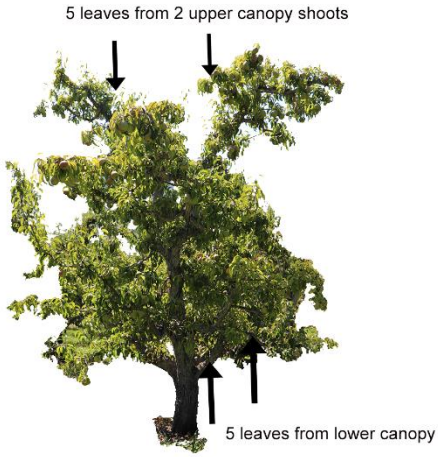

Figure 8. Leaf sampling.

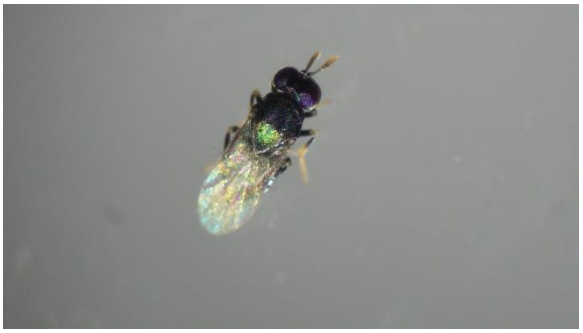

Figure 9. *Trechnites* adult. Photo: R. Schmidt-Jeffris.

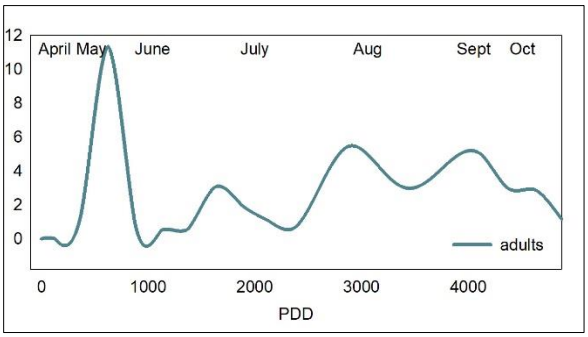

Figure 10. Relative average occurrence of *Trechnites* adults captured on yellow sticky cards in North Central Washington orchards. Pear psylla degree days (PDD). *Source*: Data from T. DuPont and C. Strohm.

Deraeocoris brevis is an abundant predator found in Pacific Northwest apple and pear orchards. *Deraeocoris brevis* may consume approximately 200 psylla eggs per day (Booth 1992). Overwintering adults can be found active in orchards starting in early March. Egg lay begins in April or May, and first-generation nymphs generally occur starting in mid-May (Yakima) to early June (Wenatchee) (Horton et al. 2012; DuPont and Strohm 2020). *Deraeocoris brevis* has two to three generations per year in Washington and is present from April to October (DuPont and Strohm 2020) (Figures 11 and 12).

Figure 11. *Deraeocoris* adult on pear. Photo: T.J Mullinix, T. DuPont, and C. Strohm.

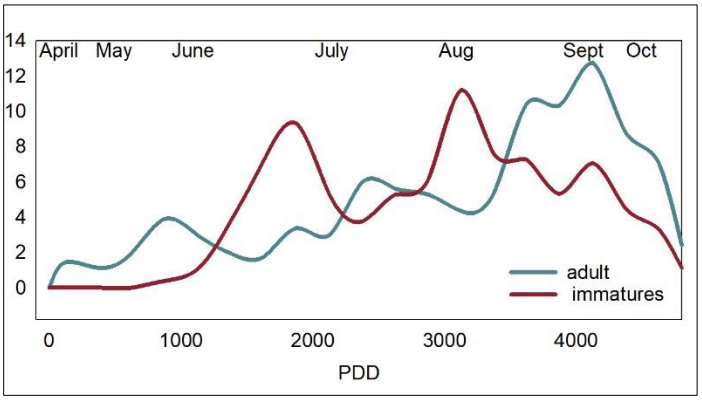

Figure 12. Relative average occurrence of *Deraeocoris* in beat tray samples in North Central Washington orchards. Pear psylla degree days (PDD). *Source*: Data from T. DuPont and C. Strohm.

Anthocoris spp. are close relatives of the minute pirate bug (Orius) and comprise a mixture of two or three species in Pacific Northwest orchards. They are well adapted to feed on pear psylla and can play a major role in the biological control of this pest. *Anthocoris* spp. are found occasionally in Wenatchee River Valley orchards and commonly in the Yakima Valley in Washington (Horton and Lewis 2000; Horton et al. 2012; Horton and Lewis 2014). They overwinter as adults in multiple habitats, have multiple generations per year, and are frequently active very early. They have a strong preference for psyllids and are common outside of orchards, often occurring on willow, alder, poplar, and bitterbrush, among other trees and shrubs (Horton and Lewis 2000).

Campylomma verbasci is a known pest in apple, but it is a beneficial predator of pear psylla and is not known to cause economic injury in pears. *Campylomma* can consume more than 170 pear psylla eggs per day in the laboratory (Booth 1992). *Campylomma* also consume young pear psylla nymphs and hardshells, eating an average of four eggs, five young psylla nymphs, and two hardshells per day in one study (Nelson 1985). *Campylomma* overwinters in the egg stage and has three generations per year in Washington (DuPont and Strohm 2020) (Figures 13 and 14).

Figure 13. *Campylomma* adult. Photo: T.J Mullinax, T. DuPont, and C. Strohm.

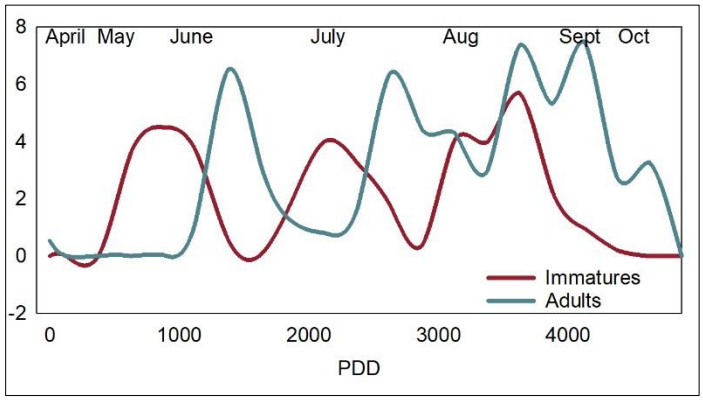

Figure 14. Relative average occurrence of *Campylomma* in beat tray samples in North Central Washington orchards. Pear psylla degree days (PDD). *Source*: Data from T. DuPont and C. Strohm.

European earwig (*Forficula auricularia*) is an important predator in pear and apple orchards, feeding on aphids, pear psylla, mites, and insect eggs. In one study, young earwigs consumed as many as 1,000 pear psylla eggs per day (Lenfant et al. 1994). Earwigs overwinter and rear their young in nests underground. They are found in the orchard canopy at night beginning in June in central Washington (Figures 15 and 16).

Figure 15. European earwig nymph. Photo: T.J. Mullinax, T. DuPont, and C. Strohm.

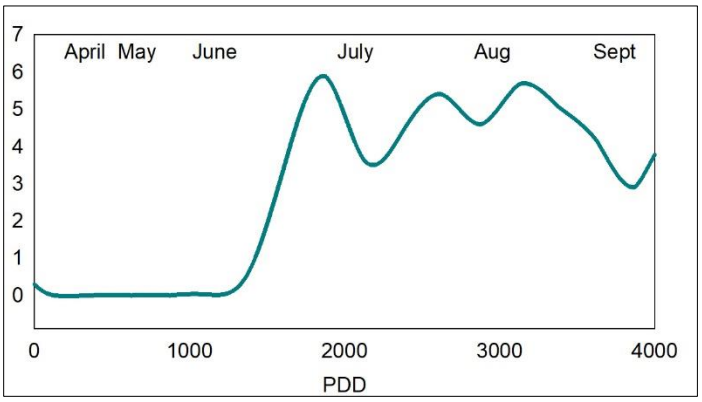

Figure 16. Relative average occurrence of European earwigs in traps in North Central Washington orchards. Pear psylla degree days (PDD). *Source*: Data from T. DuPont and C. Strohm.

Brown lacewings (*Hemerobius* spp.) occur sporadically in central Washington pear orchards and are most abundant from July until late September (Horton et al. 2012) (Figure 17).

Figure 17. Brown lacewing adult. Photo: T. DuPont.

Green lacewings (*Chrysoperla carnea*/*plorabunda*, *Chrysopa nigricornis*) are predators of aphids and, to a lesser extent, psyllids (Carroll and Hoyt 1984). *Chrysoperla carnea* adults are generally seen earlier in Washington orchards (first seen in April) than *C. nigricornis* (starting mid-May to July) (Horton et al. 2012; DuPont and Strohm 2020) (Figures 18 and 19).

Immatures are more common starting in May in Yakima or June in Wenatchee. They are active until September (Horton et al. 2012; DuPont and Strohm 2020). Green lacewings are common outside of orchards on many woody and herbaceous plants.

Figure 18. Green lacewing adult. Photo: T. DuPont.

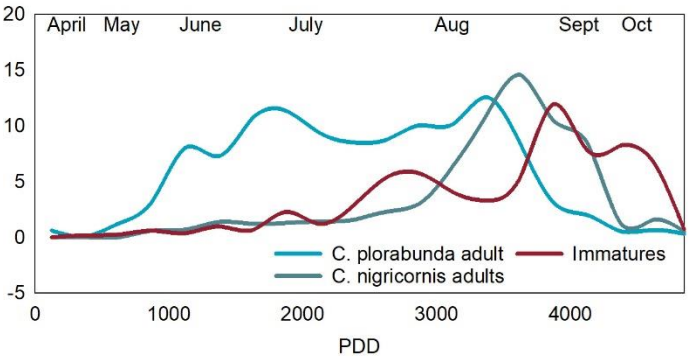

Figure 19. Relative average occurrence of lacewing species *Chrysoperla plorabunda* and *C. nigricornis* immatures from beat tray samples and adults from traps with plant volatile lures in North Central Washington orchards. Pear psylla degree days (PDD). *Source*: Data from T. DuPont and C. Strohm.

Thresholds

An important aspect of integrated pest management is the use of economic thresholds (ET) to make spray decisions. Control is recommended at an ET where pest densities are projected to surpass an economic injury level (EIL), the minimum pest density where the economic loss due to the pest is equal to the cost of controlling the pest (Higley and Pedigo 1996).

Research has identified the quantity of fruit damage we might expect at varying levels of pear psylla pest densities. DuPont et al. (unpublished data) found >2% culls (US grade 3) occur with >0.4 second or third generation pear psylla nymphs per leaf, >0.6 second generation pear psylla adults per tray, or >1.1 third generation pear psylla adults per tray (Figures 20 and 21). This is similar to previous studies. Burts (1988) reports >0.3 pear psylla nymphs per leaf results in detectable fruit russet. Westigard et al. (1981) report 5% fruit downgrades occur with 2 pear psylla nymphs per leaf for Bosc or 0.4 nymphs per leaf for Anjou.

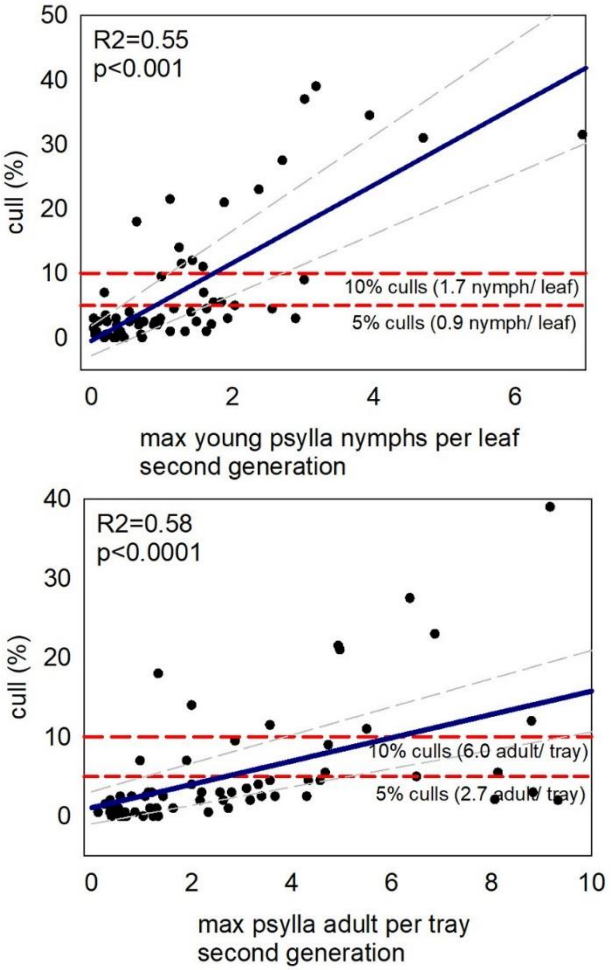

Figure 20. Linear regression of percentage of fruit downgraded to cull versus maximum first to third instar nymphs per leaf for the second generation based on pooled data of 67 plots between 2018 to 2021. Solid blue lines represent the regression. Dotted grey lines represent 95% confidence intervals.

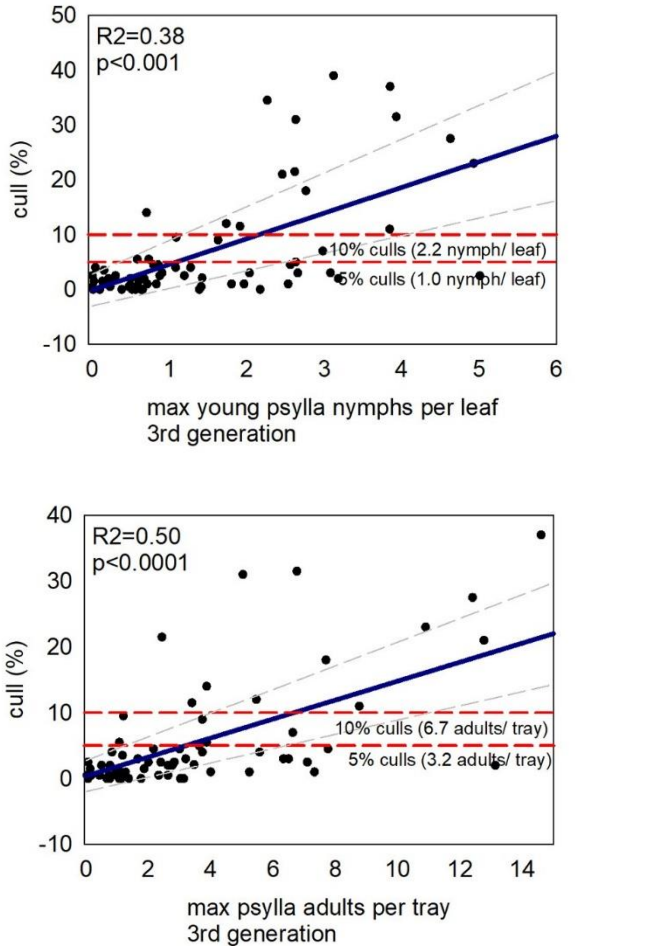

Figure 21. Linear regression of percentage of fruit downgraded to cull versus maximum psylla adults per beat tray for third generation based on pooled data of 67 plots between 2018 to 2021. Solid blue lines represent the regression. Dotted grey lines represent 95% confidence intervals.

To avoid fruit damage, managers should spray before pear psylla reach injurious levels. In pear psylla management prebloom sprays are essential. During the second and third generation managers can modify spray intensity, depending on whether pear psylla are predicted to exceed economic thresholds.

To determine what economic threshold to use, managers must consider the value of losses, the economic cost of management, the delay between monitoring and management, and prospects for biocontrol. The EIL will vary depending on yield and price. To use Tables 1 and 2:

1. Select yield and pricing which most closely align with your system.
2. Identify the economic injury level that coincides with your scenario.
3. Use the corresponding **Treatment Threshold** to determine whether pear psylla populations are likely to reach economically damaging levels if not controlled.
4. If natural enemies are above biological control thresholds in the third generation (shown in Table 3) use the higher **Treatment Thresholds**. Natural enemy abundance is predicted to slow or prevent population growth of pear psylla (Table 3).

Table 1. Economic injury levels (EILs) and economic injury thresholds (ETs) for *second generation* pear psylla at 1300 pear psylla degree days (PDD) for conventional (CONV), organic (ORG), and integrated pest management (IPM).

Components of EIL*				Injury		EIL		**Treatment Threshold** ET at 1500 PDD†			**Treatment Threshold** ET at 1300 PDD†		
								CONV	IPM	ORG	CONV	IPM	ORG
Cost of control ($/acre)	Yield (bin/acre)‡	Price fancy§ ($/box)	Price US#1§ ($/box)	% culls at EIL	% fancy‖ at EIL	Psylla adults/ tray (max)#	Psylla nymph/ leaf (max)††	Psylla adults/tray#			Psylla nymph/leaf††		
808	40	22.2	30.5	2.3	5	0.9	0.5	0.86	0.82	0.85	0.16	0.09	0.12
808	50	22.2	30.5	1.6	4.6	0.3	0.3	0.29	0.27	0.28	0.10	0.05	0.07
808	40	17.75	23.3	4.7	6.2	2.5	0.9	2.4	2.28	2.35	0.29	0.15	0.21
808	50	17.75	23.3	3.4	5.6	1.6	0.6	1.54	1.46	1.5	0.19	0.10	0.14

*The economic injury level is set to where the cost of downgrades equals the cost of management, assuming an average management cost of $808 per acre. Management costs include five critical sprays using 2022 prices and a spray application labor cost of $36 per hour. Spray applications include: kaolin at 75 PDD (dormant), kaolin+pyriproxyfen+oil at 200 PDD (bud burst), kaolin+pyriproxyfen at 350 PDD (popcorn), kaolin+spirotetromat at 900 PDD, and kaolin+spirotetramat+oil at 1200 PDD. Additional sprays at 1500 and 2600–3200 PDD should depend on economic thresholds. Assuming a 50% reduction in pest population per spray.

†Using population growth models to predict population at 1300 PDD the spray timing (1400–1750 PDD) to target second generation pear psylla which coincides with maximum populations at the EIL.

‡1,100 lb bin.

§Free on board (FOB) prices from Pear Marketing Association for size class 90 where the high price example is the average from the 2020/21 year and low prices are the average from the 2018/19 year. 44 lb box. Revenue assumes price minus $13.50 per box packing charges.

‖Fancy estimates based on estimated downgrades at designated psylla nymph levels.

#Average of 30 beat tray samples per 10 acres.

††Average of 100 leaves per 10-acre orchard. Immatures instars 1–3.

Table 2. Economic injury levels (EILs) and economic injury thresholds (ETs) for third generation pear psylla at 2600 pear psylla degree days (PDD) for conventional (CONV), organic (ORG), and integrated pest management (IPM).

Components of EIL*				Injury		EIL		Treatment Threshold ET at 2600 PDD†			Treatment Threshold ET at 2600 PDD†			
								CONV	IPM	ORG	CONV	IPM	ORG	Natural enemies above thresholds‡‡
Cost of control ($/acre)	Yield (bin/acre)‡	Price fancy§ ($/box)	Price US#1§ ($/box)	% culls at EIL	% fancy‖ at EIL	Psylla adults/ tray (max)#	Psylla nymph/ leaf (max)††	Psylla adults/tray#			Psylla nymph/leaf††			
808	40	22.20	30.50	2.3	5.0	1.3	0.5	0.07	0.24	0.35	0.29	0.39	0.39	0.50
808	50	22.20	30.50	1.6	4.6	0.8	0.4	0.05	0.15	0.21	0.23	0.31	0.31	0.40
808	40	17.75	23.30	4.7	6.3	3.0	1.0	0.17	0.55	0.8	0.58	0.78	0.78	0.10
808	50	17.75	23.30	3.4	5.6	2.1	0.7	0.13	0.4	0.56	0.40	0.54	0.55	0.70

*The economic injury level is set to where the cost of downgrades equals the cost of management assuming an average management cost of $808 per acre. Management costs include five critical sprays using 2022 prices and spray application labor cost of $36 per hour. Spray applications include: kaolin at 75 PDD (dormant), kaolin+pyriproxyfen+oil at 200 PDD (bud burst), kaolin+pyriproxyfen at 350 PDD (popcorn), kaolin+spirotetromat at 900 PDD, and kaolin+spirotetramat+oil at 1200 PDD. Additional sprays at 1500 and 2600–3200 PDD should depend on economic thresholds. Assuming a 50% reduction in pest population per spray.

†Using population growth models to predict the population at 2600 PDD the spray timing (2800–3200 PDD) to target third generation pear psylla before young nymphs molt into hardshells which coincides with maximum populations at the EIL. Assumes EIL at 4000 PDD (harvest timing).

‡1,100 lb bin.

§Free on board (FOB) prices from Pear Marketing Association for size class 90 where the high price example is from the 2020/21 year and low prices are from the 2018/19 year. Revenue assumes price minus $13.50 per box packing charges.

‖Fancy estimates based on estimated downgrades at designated psylla nymph levels (regressions Table 2).

#Average of 30 beat tray samples per 10 acres.

††Average of 100 leaves per 10-acre orchard.

‡‡*D. brevis* immatures exceed 6 per 30 trays, *C. verbasci* immatures exceed 3 per 30 trays, or earwig populations exceed 1.5 per 30 trays or 2 per trap.

Table 3. Natural densities above biological control thresholds.

	Insects per Beat Tray	Insects per 30 Beat Trays	Insects per Trap
D. brevis immatures	0.2	6	
C. verbasci immatures	0.1	3	
European earwigs	0.05	1.5	2

Cultural Tactics

Summer pruning is the removal of vegetative shoots from trees and is an important cultural control. Summer pruning improves spray penetration and light in the canopy. If timed correctly, pruning can also reduce the pear psylla population and amount of honeydew in trees. Prune between 2100–2400 PDD to remove nymphs before they molt into third generation adults (Figure 22).

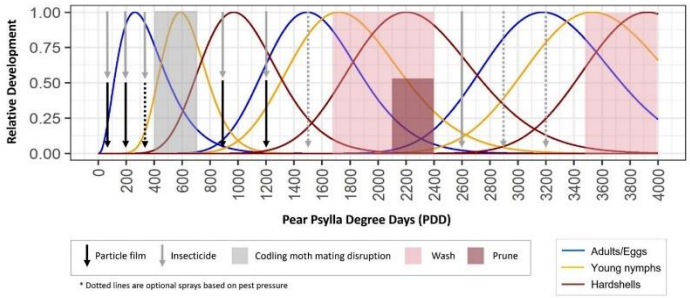

Figure 22. Pear psylla phenology in Washington State with spray application timings. Prebloom pear psylla management is mainly based on tree development. After bloom, pear psylla degree days (PDD) become more important. Figure by R. Orpet.

Honeydew Washing: Washing honeydew off fruit trees with overhead sprinklers or airblast sprayers can significantly reduce fruit marking damage (Brunner and Burts 1981). Honeydew washing methods differ from overhead irrigation and are only used to remove honeydew. Under-tree sprinklers are recommended for general irrigation to reduce disease risk and increase irrigation efficiency. It is critical to limit honeydew washes, because washing too often and for too long can cause disease issues. Time washing to target honeydew from old nymphs of the second and third generations at 1600–2400 PDD and 3500–4000 PDD, respectively. Washing is not necessary if visible honeydew is not apparent. In replicated on-farm trials, one to two washes with systems of 60–80 GPM per acre for eight to twelve hours effectively reduces fruit marking (Strohm and DuPont, unpublished data). For airblast sprayer washes, use at least 800 GPA for smaller trees, and increase gallonage with tree size.

Chemical Tactics

Prebloom Applications

Dormant/Delayed Dormant (75–100 PDD): A particle film application (Surround CF/WP or Celite 610 at 50 lb/acre) should be made as early as it is safe to drive a sprayer through the orchard. This spray prevents pear psylla from colonizing the orchard. Particle films reduce pear psylla adult colonization and egg lay by 80–100%, which reduces pear psylla pressure for the first generation (Hull et al. 2008; Nottingham et al. 2020; Nottingham and Beers 2022) (Figure 22). In some years, a repeat application may be necessary during delayed dormant after a rain or if many weeks have passed since the first application. Effectiveness and longevity of particle films is improved when combined with a spreader sticker. A sulfur or lime sulfur application with oil can also suppress pear rust mites and spider mites in addition to pear psylla adults.

Budburst (200 PDD): Pear psylla adults will begin laying eggs on soft green tissues as soon as they emerge from flower buds. In some years and orchards, budburst is the earliest growers are able to spray due to wet ground. Applications just before budburst help prevent pear psylla adults from laying eggs on freshly emerging bud tissues. A second particle film (Surround CF or Celite 610 at 50 lb/acre) applied just before budburst renews particle film residues, repels pear psylla adults, and prevents egg lay. If budburst is the first spray a grower can make, a second particle film spray at popcorn may be necessary. Pyriproxyfen (Esteem 35WP) is an insect growth regulator that can sterilize pear psylla adults and has little nontarget effect on natural enemies (Higbee et al. 1995; Dunley et al. 2001; Nottingham and Beers 2022). If greater suppression is needed, pyriproxyfen can be mixed with other nondisruptive materials, such as diflubenzuron (Dimilin 2L), buprofezin (Centaur WDG), cinnamon oil (Cinnerate), or azadirachtin (Aza-Direct or Neemix 4.5) (Nottingham et al. 2019; Nottingham and Sater 2021b).

Popcorn (350 PDD): The insect growth regulator pyriproxyfen (Esteem 35WP) sprayed at popcorn will sterilize pear psylla adults and have little negative effect on natural enemies (Dunley et al. 2001). If the 14-day window required between applications of pyriproxyfen has not been met, other selective materials such as cinnamon oil (Cinnerate), azadirachtin (Aza-Direct or Neemix 4.5), diflubenzuron (Dimilin 2L), or buprofezin (Centaur WDG) can be used instead (Nottingham and Sater 2021a). If pear psylla adult pressure is high, a particle film (Surround CF or Celite 610) sprayed just before bloom renews the residue to repel pear psylla adults from trees.

Postbloom Conventional Applications

Prior to summerform adult and young nymph emergence (900 PDD): Apply a particle film (e.g., Surround CF, Celite 610 at 50 lb/acre) at 900 PDD to deter the emerging summerform adults from landing on trees and laying eggs. Application of spirotetramat (Ultor or Movento) at this timing will reduce survival of nymphs as they hatch (Wise et al. 2008; Beers and Greenfield 2014; Wise et al. 2018). This material works best when two applications are made, so a second application can be made in 14 days, at approximately 1200 PDD. Spirotetramat can only be applied twice per season, and applications must be at least 14 days apart.

Prior to peak adults and eggs (1200 PDD): At 1200 PDD (at least two weeks after the previous spray), applying a second particle film repels summerform adults from trees, and a second

spirotetramat application (Ultor or Movento) suppresses newly hatched nymphs. If this is the first spirotetramat application, a second can be made in 14 days, at approximately 1500 PDD.

Prior to peak young nymphs second generation (1500 PDD): If only one particle film (Surround WP or Celite 610 at 50 lb/acre) was applied after bloom, a second (final) application at 1500 PDD will repel the remaining summerform adults, preventing further egg lay. No more than two particle film applications should be made after bloom, as this can increase the risk of mite outbreaks. If only one application of spirotetramat (Ultor or Movento) has been made and it has been 14 or more days, a second application at this timing targets young nymphs. If pressure is high in the summer, additional sprays with more toxic materials are warranted (see Tables 1 to 3), the most effective time to make insecticide applications is as young nymphs are increasing toward peak and prior to hardshells (1400–1750 PDD). Use products that kill young nymphs, such as diflubenzuron (Dimilin 2L), cinnamon oil (Cinnerate), or azadirachtin (Aza-Direct or Neemix 4.5). Do not use azadirachtin products on Comice pears.

Third generation pear psylla (2600–3200 PDD): Time insecticides to 2600–3200 PDD, before young nymphs molt into hardshells. Hardshells are harder to kill, and once they are present (starting 3000–3400 PDD) the optimal spray timing has passed. Consider pear psylla and natural enemy thresholds to determine the necessity for sprays for third generation pear psylla. If pear psylla are projected to surpass damage thresholds, an insect growth regulator, such as pyriproxyfen (Esteem 35WP) or diflubenzuron (Dimilin 2L), will suppress this generation of pear psylla. Alternatively, the organic insecticides cinnamon oil (Cinnerate) or azadirachtin (Aza-Direct or Neemix 4.5) can also suppress pear psylla. Do not use azadirachtin products on Comice pears.

Postbloom Organic Applications

For organic sprays, scout and begin spraying organic insecticides weekly once young nymphs become present, and continue until just past young nymph peak, 1100–1800 PDD (second generation) and 2800–3500 PDD (third generation). Consider pear psylla and natural enemy thresholds to determine the necessity for sprays at this timing. Products to use include summer oil, Cinnerate, or neem (Aza-Direct, Neemix, or Rango) (Nottingham and Sater 2021b). Do not use azadirachtin products on Comice pears. If pear psylla numbers are high, these products can be mixed to improve efficacy, but extra care should be taken to avoid marking or phytotoxicity.

Selective Codling Moth and Mite Management

For successful pear psylla integrated pest management, codling moth and mite sprays need to be compatible with pear psylla biological control. Include effective materials with few indirect effects on natural enemies.

If spider mites are found, give predators time to suppress them. In areas where pear rust mites or spider mites are becoming a problem, selective miticides such as fenbutatin (Vendex 50WP), spirodiclofen (Envidor 2SC), or cyflumetofen (Nealta) are effective and have relatively low indirect impacts on natural enemies.

Codling moth management should include mating disruption and effective use of selective pesticides. The first codling moth spray targets eggs and should be conducted at the standard (225–275 codling moth degree day [DD]) or delayed first cover (375 DD) timing. This spray can include materials such as oil and methoxyfenozide (Intrepid 2F). The second spray should be conducted at 425 DD (standard timing) or 525 DD (delayed first cover timing) and can include oil in addition to larvicides such as granulovirus (Cyd-X HP) or diflubenzuron (Dimilin 2L). For second and third generations of codling moth, add 1000 DD to the previous timings, but treatment may not be necessary. For more information, see *How to Effectively Manage Codling Moth* (Jones 2020).

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