

2020 | WILLAMETTE VALLEY

PEST MANAGEMENT GUIDE FOR HAZELNUTS

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This guide lists recommendations for insect, mite and disease control in hazelnut orchards. The chemicals, formulations and application rates listed here are based on label directions, research and orchard experience.

Pest management depends on producers and their knowledge of the orchard and its characteristics. Producers must weigh several factors: cultivar, tree size, tree density, canopy characteristics, pest complex and pest history. Consider all these factors when choosing which chemicals to apply and at what rates. Other variables include the amount of water used per acre, and the method of application.

Trade name products are mentioned as examples only. Occasionally, manufacturers register different formulations of a product that contain a different concentration of active ingredient. This does not mean that OSU Extension either endorses these products or intends to discriminate against products not mentioned. Consult product labels to determine whether their use confers advantages over the products listed in this guide.

Always refer to the pesticide label for use instructions. It is the legal document.

Producers ask two common questions about the chemical control of insects and diseases:

- “How much chemical do I use per acre?”
- “What is the least amount of water I need per acre to apply in my concentrate sprayer?”

The schedule below suggests an amount of formulated product to use per acre, and not the amount of active ingredient. This amount is based on a “typical” orchard of middle age and average tree density, with moderate pest pressure. Less product may be needed in 1- to 4-year-old orchards. Conversely, more chemical (within label limits) may be required for large, mature trees experiencing heavy pressure from multiple pests.

It takes less spray to get good coverage on an



Photo: Betsy Hartley, © Oregon State University

Young hazelnut trees at a farm.

orchard with immature trees with limited canopy, but this does not affect the rate of application by volume. For most ground-applied applications, apply products in a minimum of 100 gallons of water per acre. For larger canopies, 150 to 200 GPA of water can improve coverage and efficacy. Always calibrate sprayers to tree size to improve coverage, reduce waste, and avoid drift.

Please be aware of recent regulations governing the application of pesticides outlined in the EPA Worker Protection Standard, particularly the Application Exclusion Zone, which is enforced by Oregon Occupational Safety and Health. All new pesticide labels provide orchard re-entry intervals and personal protection equipment information. See Oregon standards at [osha.oregon.gov/Pages/topics/worker-protection-standard.aspx](https://www.osha.gov/Pages/topics/worker-protection-standard.aspx).

Apply pesticides judiciously and promote good relationships with neighbors.

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Stages

Photos: Nathaniel Edmonds, © Oregon State University



DORMANT SEASON
STAGE 1A: Flowering.
 Female stigmas outside buds.
 From red dot to spider stage.
STAGE 1B: Flowering.
 Male catkins just before
 elongation and pollen shed.

STAGE 2: Dormant buds

STAGE 3: Bud swelling
STAGE 4: Budbreak
 Green leaf tips showing.

**STAGE 5: Advanced
 budbreak**
 Highly susceptible to
 Eastern filbert blight

**STAGE 6: Early shoot
 elongation**
 First leaves fully open.



EARLY SPRING

LATE SPRING

EARLY SUMMER

MID- TO LATE SUMMER

LATE SUMMER AND FALL

Spraying precautions

CHECK THE LABEL BEFORE SPRAYING!

Also:

- Make sure any tank-mixes of pesticides are compatible. When in doubt, make a sample mixture in a jar to evaluate compatibility. In some cases, the mixture may not react visibly, but efficacy may be compromised.
- Most pesticides perform best when water is slightly acidic (a pH of 5–6), and a pH above 7.0 can cause rapid loss of efficacy. Consider testing pH and adjusting water pH prior to mixing, or avoid certain tank mixes. For example, elevated pH of boron spray solution can weaken insecticides when mixed.
- Use adjuvants and spreader stickers with caution.
- See Table 3, Effectiveness of fungicide for eastern filbert blight management, page 16.
- Rotate pesticides by mode of action (group); do not become reliant on a single group for control.
- Premix products may have reduced rates of active ingredients, and may contribute to development of resistance.

The information in this pest management guide is valid for 2020. Trade-name products and services are mentioned as illustrations only. This does not mean that the Oregon State University Extension Service either endorses these products and services or intends to discriminate against products and services not mentioned. Due to constantly changing laws and regulations, the Oregon State University Extension Service can assume no liability for the suggested use of chemicals contained in this guide. Pesticides should be applied according to the label directions on the pesticide container.

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Published May 2020

Hazelnut pest control recommendations

Use only one material except where a combination is indicated. Follow label precautions when tank-mixing oils, fungicides, and insecticides. Materials are not listed in order of preference.

STAGES 1–2: Dormant season

Eastern filbert blight

Note: Scout orchards and remove and destroy all cankered wood prior to budbreak. Burning or chipping of pruned, infected branches is an acceptable practice. Fungicides should not be applied prior to budbreak.

STAGES 3–5: Mid-March, budbreak *See footnote 5, page 13*

Eastern filbert blight (see footnotes 6, 7, and 8, page 13, and Table 3, page 16)

Pest or disease/ material	Active ingredient	Application rate/acre	Comments/reentry interval
Abound	azoxystrobin	12 fl oz	Group 11 fungicide. Use on a 10-day schedule. Do not use with silicone-based surfactants. 4-hour reentry. 45-day PHI.
Aframe Plus	azoxystrobin + propiconazole	14–21 fl oz	Group 3+11 fungicide. See footnote 6, page 13. Do not use more than 2 consecutive applications. 12-hour reentry. 60-day PHI.
Approach	picoxystrobin	6–12 fl oz	Group 11 fungicide. Do not use more than 3 applications or on trees less than 2 years old. 12-hr reentry. 7-day PHI
Bravo Weather Stik	chlorothalonil	4 pt	Group M5 fungicide. 12-hour reentry. 120-day PHI.
Bumper 41.8EC	propiconazole	5–8 fl oz	Group 3 fungicide. See footnote 6, page 13. 12-hour reentry.
Cabrio EG	pyraclostrobin	9.5 oz	Group 11 fungicide. Use with a spreader sticker. Do not use more than 2 consecutive applications. 12-hour reentry.
Copper-Count-N	copper ammonium carbonate	8–12 qt	Group M1 fungicide. 48-hour reentry.
Echo 90DF	chlorothalonil	3.25 lb	Group M5 fungicide. Can be mixed with other fungicides. 12-hour reentry. 120-day PHI.
Flint Extra	trifloxystrobin	1.9–3.8 oz	Group 11 fungicide. 12-hour reentry. 60-day PHI.
Inspire Super	difenoconazole + cyprodinil	16–20 fl oz	Group 3 + 9 fungicide. 12-hour reentry. 14-day PHI.
Kocide 3000-O	copper hydroxide	7–10.5 lb	Group M1 fungicide. Add 1 pt HMO per 100 gal of water. 48-hour reentry.
Merivon	fluxapyroxad + pyraclostrobin	5–6.5 fl oz	Group 7 + 11 fungicide. Do not use with EC or oil-based products. 12-hour reentry. 14-day PHI.
NuCop 50DF	copper hydroxide	8–12 lb	Group M1 fungicide. Add 1 pt HMO per 100 gal of water. 48-hour reentry.
Procure 480SC	triflumizole	4–6 fl oz	Group 3 fungicide. 12-hour reentry. 18-day PHI.
Propi-Max EC	propiconazole	4–8 fl oz	Group 3 fungicide. See footnote 6, page 13. 12-hour reentry.
Quadris Top	azoxystrobin + difenoconazole	12–14 fl oz	Group 3 + 11 fungicide. Do not use within 45 days of harvest. 12-hour reentry.
Quash	metconazole	3.5 oz	Group 3 fungicide. Use with a surfactant. 12-hour reentry. 25-day PHI.
Quilt Xcel	azoxystrobin + propiconazole	14–21 fl oz	Group 3 + 11 fungicide. 12-hour reentry. 60-day PHI.
Stratego	propiconazole + trifloxystrobin	12–15.4 fl oz	Group 3 + 11 fungicide. Do not confuse this with a similar product called Stratego YLD, which may be phytotoxic to hazelnuts. 12-hour reentry. 60-day PHI.
Tilt	propiconazole	5–8 fl oz	Group 3 fungicide. See footnote 6, page 13. 12-hour reentry.
TopGuard	flutriafol	14 fl oz	Group 3 fungicide. Use of an adjuvant may result in Plant Growth Regulation (PGR) effects. Lower rates were not as effective. 12-hour reentry. 14-day PHI.
Topguard EQ	flutriafol + azoxystrobin	5–8 fl oz	Group 3 + 11 fungicide. Do not use with silicone surfactants. 45-day PHI. 12-hr reentry.
Trionic 4 SC	triflumizole	4–6 fl oz	Group 3 fungicide. 12-hour reentry. 18-day PHI.
Unicorn DF	tebuconazole + sulfur	3–5 lb	Group 3 + M2 fungicide. 24-hour reentry. 35-day PHI.
Willowood Azoxy 2SC	azoxystrobin	6–12 fl oz	Group 11 fungicide. Use on a 10-day schedule. Do not use with silicone surfactants. 4-hour reentry. 45-day PHI.
Ziram 76 DF	ziram	4–8 lb	Group M3 fungicide. 48-hour reentry. Do not use after May. See supplemental label. Aerial application prohibited.

MARCH-APRIL

Pest or disease/ material	Active ingredient	Application rate/acre	Comments/reentry interval
Bud mites (see footnote 3, page 13)			
Agri-Mek SC	abamectin	2.25-4.25 oz	Group 6 insecticide. Restricted use. Translaminar activity. Do not apply more than twice per season. See also generics. Potentially more effective on spider mites. Do not make aerial applications. 12-hour reentry. 21-day PHI.
Bexar	tolfenpyrad	27 oz	Group 21A insecticide. No more than 1 application per season. Do not make aerial applications. Maintain a 25 ft buffer strip. See 2(ee) label for hazelnut. 12-hour reentry. 14-day PHI.
Envidor 2 SC	spirodiclofen	16-34 fl oz	Group 23 miticide. No more than 1 application per season. Do not make aerial applications. Minimum of 100 GPA. 12-hour reentry. 7-day PHI.
Fujimite XLO	fenpyroximate	2-4 pt	Group 21A insecticide. No more than 2 applications per season. Do not make aerial applications. Minimum of 100 GPA. 12-hour reentry. 14-day PHI.
Kanemite 15 SC	acquinocyl	21 oz	Group 20B miticide. Do not make aerial applications. No more than 2 applications per year. Use 150 GPA or higher. 12-hour reentry. 7-day PHI.
Lime sulfur (BSP)	calcium polysulfide	12 gal	Do not apply when temperatures exceed 85°F. Do not use in combination with or within 3-4 weeks of an oil spray application. Minimum 100 GPA. 48-hour reentry.
Sulfur (DF)	sulfur	10-20 lbs	Group M2 fungicide. Includes Kumulus, Microthiol Disperss, Sulfur W.G. 24 (c) labels for control of budmite. Do not apply when air temperatures may exceed 90°F for three days after application. Reapplications recommended every 7-10 days. 24-hour reentry.
Nexter	pyridaben	10.62 oz	Group 21 miticide. Do not make aerial applications. Do not apply more than twice per season, with a minimum of 30 days between applications. 12-hour reentry. 7-day PHI.
Sulforix (BSP)	calcium polysulfide	3 gal	Minimum of 100 GPA. 48-hour reentry.
Winter moth, omnivorous leaftier			
Note: Larvae can damage young trees by feeding on developing buds, leaving a distinct skeletonization pattern on leaves. Sprays are triggered only when >20% of terminals are infested. Because of the early timing for this spray, application of these chemicals now may not adequately control filbert and obliquebanded leafrollers, which become active slightly later.			
<i>Bacillus thuringiensis kurstaki</i> (Btk)	bacterium	See label rates.	Multiple formulations available. OMRI approved for organic use. Spray when larvae first detected. Apply with a sticker. 0-day PHI.
Delegate WG	spinetoram	3-7 oz	Group 5 insecticide. Rates are approximate. Time application for first appearance of larvae. 4-hour reentry. 1-day PHI.
Dimilin 2L	diflubenzuron	8-16 oz	Group 15 insecticide. Use a minimum of 50 gal water/A. Restricted use. Can use up to 4 applications per season (64 fl oz maximum per season). 12-hour reentry. 28-day PHI.
Intrepid 2F	methoxyfenozide	8-16 oz	Group 18 insecticide (IGR). 4-hour reentry. 14-day PHI.
Proclaim	emamectin benzoate	3.2-4.8 oz	Group 6 insecticide. Restricted use. Targets small larvae. 12-hour reentry. 14-day PHI.

STAGE 6: Early shoot elongation

Pest or disease/ material	Active ingredient	Application rate/acre	Comments/re-entry interval/preharvest interval (PHI)
Eastern filbert blight (see footnotes 6, 7, and 8, page 13, and Table 3, page 16)			
Abound	azoxystrobin	12 fl oz	Group 11 fungicide. See footnote 9, page 13. Use on a 10-day schedule. Do not use with silicone-based surfactants. 4-hour reentry. 45-day PHI.
Aframe Plus	azoxystrobin + propiconazole	14–21 oz	Group 3+11 fungicide. See footnote 6, page 13. Do not use more than 2 consecutive applications. 12-hour reentry. 60-day PHI.
Aproach	picoxystrobin	6-12 fl oz	Group 11 fungicide. Do not use more than 3 applications or on trees less than 2 years old. 12-hr reentry. 7-day PHI
Bravo Weather Stik	chlorothalonil	4 pt	Group M5 fungicide. 12-hour reentry. 120-day PHI.
Bumper 41.8EC	propiconazole	5–8 fl oz	Group 3 fungicide. See footnote 6, page 13. 12-hour reentry.
Cabrio EG	pyraclostrobin	9.5 oz	Group 11 fungicide. Do not use more than 2 consecutive applications. 12-hour reentry.
Copper-Count-N	copper ammonium carbonate	8–12 qt	Group M1 fungicide. 48-hour reentry.
Echo 90 DF	chlorothalonil	3.25 lb	Group M5 fungicide. Can be mixed with other fungicides. 12-hour reentry. 120-day PHI.
Flint Extra	trifloxystrobin	1.9–3.8 oz	Group 11 fungicide. 12-hour reentry. 60-day PHI.
Inspire Super	difenoconazole + cyprodinil	16–20 fl oz	Group 3 + 9 fungicide. 12-hour reentry. 14-day PHI.
Kocide 3000-O	copper hydroxide	7–10.5 lb	Group M1 fungicide. Add 1 pt HMO per 100 gal water. 48-hour reentry.
Merivon	fluxapyroxad + pyraclostrobin	5–6.5 fl oz	Group 7 + 11 fungicide. Do not use with EC or oil-based products. 12-hour reentry. 14-day PHI.
NuCop 50DF	copper hydroxide	8–12 lb	Group M1 fungicide. Add 1 pt HMO per 100 gal water. 48-hour reentry.
Procure 480SC	triflumizole	4–6 fl oz	Group 3 fungicide. 12-hour reentry. 18-day PHI.
Propi-Max EC	propiconazole	4–8 fl oz	Group 3 fungicide. See footnote 6, page 13. 12-hour reentry.
Quadris Top	azoxystrobin + difenoconazole	12–14 fl oz	Group 3 + 11 fungicide. Do not use within 45 days of harvest. 12-hour reentry.
Quash	metconazole	3.5 oz	Group 3 fungicide. Use with a surfactant. 12-hour reentry. 25-day PHI.
Quilt Xcel	azoxystrobin + propiconazole	14–21 fl oz	Group 3 + 11 fungicide. 12-hour reentry. 60-day PHI.
Stratego	propiconazole + trifloxystrobin	12–15.4 fl oz	Group 3 + 11 fungicide. Do not confuse this with a similar product called Stratego YLD, which may be phytotoxic to hazelnuts. 12-hour reentry. 60-day PHI.
Tilt	propiconazole	5–8 fl oz	Group 3 fungicide. See footnote 6, page 13. 12-hour reentry.
TopGuard	flutriafol	14 fl oz	Group 3 fungicide. Use of an adjuvant may result in Plant Growth Regulation (PGR) effects. Lower rates were not as effective. 12-hour reentry. 14-day PHI.
Topguard EQ	flutriafol + azoxystrobin	5–8 fl oz	Group 3 + 11 fungicide. Do not use with silicone surfactants. 12-hr reentry. 45-day PHI.
Trionic 4 SC	triflumizole	4–6 fl oz	Group 3 fungicide. 12-hour reentry. 18-day PHI.
Unicorn DF	tebuconazole + sulfur	3–5 lb	Group 3 + M2 fungicide. 24-hour reentry. 35-day PHI.
Willowood Azoxy 2SC	azoxystrobin	6–12 fl oz	Group 11 fungicide. Do not use with silicone surfactants. See footnote 9, page 13. Use on a 10-day schedule. 4-hour reentry. 45-day PHI.
Ziram 76 DF	ziram	4–8 lb	Group M3 fungicide. 48-hour reentry. Do not use after May. See supplemental label. Aerial application prohibited.

APRIL—MAY

Pest or disease/ material	Active ingredient	Application rate/acre	Comments/re-entry interval/preharvest interval (PHI)
Filbert leafroller			
Note: Filbert leafroller eggs hatch in late March and early April during warm weather. No treatments are necessary below 20% to 25% infestation rate on terminal leaf clusters. Natural enemies typically provide good control of leafrollers.			
Altacor	chlorantraniliprole	3–4.5 oz	Group 28 insecticide. No more than 4 applications per season. 4-hour reentry. 10-day PHI.
Ambush 25W	permethrin	12.8–25.6 oz	Group 3A insecticide. Restricted use. Do not graze treated orchards. Ex-
Asana XL	esfenvalerate	9.6–19.2 oz	Group 3A insecticide. Restricted use. Do not apply a second spray within 3 weeks of the first. Do not apply more than 0.2 lb ai/A per season. Do not graze livestock in treated orchards. 24-hour reentry. 21-day PHI.
Aza-Direct	azadirachtin	16–32 oz	Botanical extract of the neem tree. OMRI approved for organic use. 4-hour reentry. 0-day PHI.
Bacillus thuringiensis kurstaki (Btk)	bacterium	See label rates.	Multiple formulations available. OMRI approved for organic use. Spray when larvae first detected. Apply with a sticker. 0-day PHI.
Brigade WSB	bifenthrin	0.05–0.2 lb ai/A (8–32 fl oz)	Group 3A insecticide. Restricted use. 12-hour reentry. 7-day PHI.
Cobalt	chlorpyrifos + lambda cyhalothrin	22–57 oz	Group 1B + 3A insecticide. Restricted use. Premix product, see label as both AIs have cumulative limits/season. 24-hour reentry. 14-day PHI.
Delegate WG	spinetoram	4.5–7 oz	Group 5 insecticide. 4-hour reentry. 7-day PHI.
Diazinon AG 500	diazinon	1 pt	Group 1B insecticide. Restricted use. Apply in dilute spray (250–400 gal/A). No more than 1 application per season. 18-day reentry. 45-day PHI.
Dimilin 2L	diflubenzuron	8–16 oz	Group 15 insecticide. Restricted use. Use a minimum of 50 gal water/A. Can use up to 4 applications per season (64 fl oz maximum per season). 12-hour reentry. 28-day PHI.
Entrust	spinosad	1.25–3 oz	Group 5 insecticide. OMRI approved for organic use. No more than 9 oz per season. 24-hour reentry. 1-day PHI.
Exirel	cyantraniliprole	10–20.5 oz	Group 28 insecticide. No more than 0.4 lb AI per season. 12-hour reentry. 5-day PHI.
Grandevo	chromobacterium	1-3 lbs	Group UN insecticide. OMRI approved for organic use. 4-hour REI. 0-day PHI
Intrepid 2F	methoxyfenozide	8–16 oz	Group 18 insecticide (IGR). Apply at or just prior to egg hatch. 4-hour reentry. 14-day PHI.
Intrepid Edge	methoxyfenozide + spinetoram	6–12 oz	Group 5 + 18 insecticide. Apply at the beginning of egg hatch when larvae begin feeding. 4-hour reentry. 7-day PHI.
Pounce 25 WP	permethrin	12.8–16 oz	Group 3A insecticide. Restricted use. Do not graze treated orchards. Do not apply more than 1.6 lb ai/A per season. 24-hour reentry. 14-day PHI.
Proclaim	emamectin benzoate	3.2–4.8 oz	Group 6 insecticide. Restricted use. Targets small larvae. 12-hour reentry. 14-day PHI.
Sevin XLR Plus	carbaryl	2–5 qt	Group 1A insecticide. Make first application during egg hatch. Sevin may cause rapid increase of aphid populations 3-4 weeks after application. 4F and 80S formulations also available. 12-hour reentry. 14-day PHI.
Success Naturalyte Insect Control	spinosad	4–10 oz	Group 5 insecticide. 24-hour reentry. 14-day PHI.
Warrior II	lambda-cyhalothrin	1.28–2.56 fl oz	Group 3A insecticide. Restricted use. Apply no more than 7.68 oz after bloom. 24-hour reentry. 14-day PHI.
Filbert aphid, hazelnut aphid			
Note: Some products are very toxic to pollinators. Avoid applying when bees are actively foraging on honeydew or weeds on orchard floors. Minimize drift to adjacent beehives or flowering crops. When possible, rely on biological control from the aphid parasitoid <i>Trioxys pallidus</i> .			
Admire Pro	imidacloprid	1.2–2.4 oz	Group 4A insecticide. Systemic activity. Avoid drift to flowering crops. Can be applied as soil application through chemigation system, rates and restrictions differ for this application, see label. Generic labels available. 12-hour reentry. 7-day PHI.

CONTINUED ON PAGE 7

APRIL—MAY *Continued from page 6*

Pest or disease/ material	Active ingredient	Application rate/acre	Comments/re-entry interval/preharvest interval (PHI)
Assail 70WP	acetamiprid	1.1–4.1 oz	Group 4A insecticide. Systemic activity. Avoid drift to flowering crops. The higher rate may be needed for control in mature orchards with full canopies. No more than 4 applications per season. 12-hour reentry. 14-day PHI.
Belay	clothianadin	3–6 oz	Group 4A insecticide. Systemic activity. Avoid drift to flowering crops. Low rate for low infestation and/or smaller trees. No more than 0.2 lb AI per year. 12-hour reentry. 21-day PHI.
Transform WG	sulfoxaflor	0.75–1.5 oz	Group 4C insecticide. Do not allow drift to flowering weeds or cover crops. No more than 4 applications or 8.5 oz per season. 12-hour reentry. 7-day PHI.
Cobalt	chlorpyrifos + lambda cyhalothrin	22–57 oz	Group 1B + 3A insecticide. Restricted use. Premix product, see label as both AIs have cumulative limits/season. 24-hour reentry. 14-day PHI.
Leverage 2.7	beta-cyfluthrin + imida- cloprid	3.8–5.1 oz	Group 3 + 4A insecticide. Systemic activity. Avoid drift to flowering crops. Restricted use. Premix product, see label as both AIs have cumulative limits/season. Leverage 360 is also available. 12-hour reentry. 14-day PHI.
Movento	spirotetramat	6–9 oz	Group 23 insecticide. Toxic to aquatic organisms. Minimum interval between treatments is 14 days. Limited to 21.5 oz per year. 24-hour reentry. 7-day PHI.
Sivanto 200 SL	flupyradifurone	7–10.5 oz	Group 4D insecticide. Minimum interval between treatments is 14 days. Limited to 28 oz per year. 4-hour reentry. 7-day PHI.
Surround WP	kaolin clay	50–75 lb	Suppression only. OMRl approved for organic use. 4-hour reentry. 0-day PHI.
Omnivorous leaftier, winter moth (if present)			
Note: Primarily pests during orchard establishment, see note for March–April.			
Intrepid Edge	methoxyfenozide + spin- etoram	6–12 oz	Group 5 + group 18 insecticide. Apply when larvae first begin to feed. 4-hour reentry. 7-day PHI.

MAY–JUNE

Pest or disease/ material	Active ingredient	Application rate/acre	Comments/re-entry interval/preharvest interval (PHI)
To increase nut set			
Note: These are rates for foliar-applied sprays. Consult labels for soil-applied rates. For maximum effect, apply boron from mid- to late May. Do not tank-mix with insecticides.			
Nutritional — not pest management	Boron	Varies	See label; many formulations and brands exist.
Filbertworm			
Note: See footnote 4, page 13, on use of pheromone traps.			
Isomate FBW ring	E,E-8,10-dodecadienyl acetate	0.01–5 g/day/ha	Pheromone dispensers for filbertworm mating disruption. Apply before first flight of moths at a minimum of 20 dispensers per acre in the upper 1/3 of canopy. Monitor trap captures carefully to determine if additional management is needed.
Pacific flatheaded borer			
A serious pest that mostly affects young hazelnut trees in their first and second leaf. Adults lay eggs on trunks, and larvae feed on the cambium layer and may girdle the tree, killing or severely weakening it. Adults generally emerge and begin egg laying in late May/early June. The flight period of adult borers lasts through August. Prevent sunburn by painting trunks with white latex paint, manage weeds and prevent water stress. Growing vigorous trees is the key to preventing borer attack. Practice sanitation by removing infested stems and burning or shredding them. This is an emerging issue, and no registered products for hazelnut list Pacific flatheaded borer on the label (but see 2(ee) label for Belay). Research suggests that registered Group 4 systemic insecticides used against aphids and scale insects (imidacloprid, clothianidin) can also prevent attack by Pacific flatheaded borer if applied in a manner to ensure plant uptake or residue presence by the time of flight of adult borers.			
Admire Pro	imidacloprid	1.2–2.4 oz	Group 4A insecticide. Systemic activity. Avoid drift to flowering crops. Can be applied as soil drench or through chemigation for aphids. Rates and restrictions differ by application method; see label. If applied as drench allow adequate time for uptake prior to borer emergence. Generic labels available. 12-hour reentry. 7-day PHI.
Belay	clothianidin	3–6 oz	Group 4A insecticide. See FIFRA Section 3(ee) label for control of Pacific flat-headed borer in hazelnuts. Systemic activity. Avoid drift to flowering crops. No more than 0.2 lb AI per season.
Obliquebanded and filbert leafroller			
Note: Larvae primarily feed on leaves but also can cause damage by feeding between husk and nut. Severe infestations on young trees may affect growth. Inspect under husks for larvae between mid-June and late July. Use pheromone traps and degree-day (DD) models to time applications. No treatments are necessary below 20 to 25 percent infestation rate on terminal leaf clusters. Trap captures of >40 moths/week and larvae detected on nuts indicate damaging levels. Natural enemies typically provide good control of mature leafroller larvae, avoid treatment when larvae are mature.			
Altacor	chlorantraniliprole	3–4.5 oz	Group 28 insecticide. No more than 4 applications per season, 4-hour reentry. 10-day PHI.
Baythroid XL	beta-cyfluthrin	2.4–2.8 oz	Group 3 insecticide. 12-hour reentry. 14-day PHI.
Bacillus thuringiensis kurstaki (Btk)	bacterium	See label rates.	Multiple formulations available. Spray when larvae first detected. OMRI approved for organic use. Apply with a sticker. Highly effective against LR. 0-day PHI.
Cobalt	chlorpyrifos + lambda cyhalothrin	22–57 oz	Group 1B + 3A insecticide. Restricted use. Premix product, see label as both AIs have cumulative limits/season. 24-hour reentry. 14-day PHI.
Delegate WG	spinetoram	4.5–7 oz	Group 5 insecticide. Do not apply more than 3 consecutive treatments of group 5 materials. Target larvae. 4-hour reentry. 1-day PHI.
Dimilin 2L	diflubenzuron	8–16 oz	Group 15 insecticide. Use a minimum of 50 gal water/A. Restricted use. Can use up to 4 applications per season (64 fl oz maximum per season). 12-hour reentry. 28-day PHI.
Entrust	spinosad	1.25–3 oz	Group 5 insecticide. OMRI approved for organic use. No more than 9 oz per season. 24-hour reentry. 1-day PHI.
Exirel	cyantraniliprole	10–20.5 oz	Group 28 insecticide. No more than 0.4 lb AI per season. 12-hour reentry. 5-day PHI.
Grandevo	chromobacterium	1–3 lbs	Group UN insecticide. OMRI approved for organic use. 4-hour REI. 0-day PHI
Intrepid 2F	methoxyfenozide	8–16 oz	Group 18 insecticide. Apply prior to first egg hatch to take advantage of ovicidal properties (200–400 DD). Reapply 10–18 days later (500–700 DD). Generics available. 4-hour reentry. 7-day PHI.
Intrepid Edge	methoxyfenozide + spinetoram	6–12 oz	Group 5 + 18 insecticide. Apply at the beginning of egg hatch when larvae begin feeding. 4-hour reentry. 7-day PHI.

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MAY–JUNE *Continued from page 8*

Pest or disease/ material	Active ingredient	Application rate/acre	Comments/re-entry interval/preharvest interval (PHI)
Success Naturalyte Insect Control	spinosad	4–10 oz	Group 5 insecticide. 24-hour reentry. 14-day PHI.
Spider mites, rust mites			
Note: Look for webbing and brown discoloration (“bronzing”) on the underside of leaves during the summer. Spider and rust mite problems may be a symptom of overreliance on broad-spectrum chemistries, including pyrethroids and organophosphates. Mite outbreaks are also associated with water stressed trees and dusty conditions. Rotate action groups and do not apply below the minimum rate to avoid development of resistance.			
Agri-Mek SC	abamectin	2.25–4.25 oz	Group 6 insecticide. Restricted use. Translaminar activity. Do not apply more than twice per season. See also generics. Do not make aerial applications. 12-hour reentry. 21-day PHI.
Acramite 50WS	bifenazate	0.75–1.5 lb	Group un (unclassified) miticide. Use only once per season. 12-hour reentry. 14-day PHI.
Envidor 2 SC	spirodiclofen	16–34 fl oz	Group 23 miticide. No more than 1 application per season. Do not make aerial applications. Minimum of 100 GPA. 12-hour reentry. 7-day PHI.
Fujimite XLO	fenpyroximate	2–4 pt	Group 21A insecticide. No more than 2 applications per season. Do not make aerial applications. Minimum of 100 GPA. 12-hour reentry. 14-day PHI.
Kanemite 15 SC	acquinocyl	21 oz	Group 20B miticide. Do not make aerial applications. No more than 2 applications per year. Use 150 GPA or higher. 12-hour reentry. 7-day PHI.
Nealta	cyflumetofen	13.7 oz	Group 25 miticide. Do not reapply at less than 14-day interval. Minimum of 100 GPA. No more than 27.4 oz/season. 12-hour reentry. 7-day PHI.
Nexter	pyridaben	10.62 oz	Group 21 miticide. Do not make aerial applications. No more than 2 applications per season, with a minimum of 30 days between applications. 12-hour reentry. 7-day PHI.
Savey 50DF	hexythiazox	3–6 oz	Group 10A miticide. No more than 1 application per season. Apply before population build-up, does not control adult mites. 12-hour reentry. 28-day PHI.
Zeal	etoxazole	2–3 oz	Group 10B miticide. Apply while spider mite populations are low. No more than 1 application per season. 12-hour reentry. 28-day PHI.

Follow the ‘RULES’ for fungicide stewardship

- Rotate or mix fungicides of different chemical groups.
- Use labeled rates.
- Limit total number of applications.
- Educate yourself about fungicide activity, mode of action, and class—as well as resistance management practices.
- Start a fungicide program with multisite mode of action materials.

JULY–AUGUST

Pest or disease/ material	Active ingredient	Application rate/acre	Comments/re-entry interval/preharvest interval (PHI)
Scale			
Note: Several scale species can infest hazelnut orchards, but lecanium scale is most common. Severe infestations can produce abundant honeydew that is colonized by sooty mold, inhibiting photosynthesis and causing leaf drop. Time sprays for the emergence of crawlers, or the active immatures that emerge from the larger bodied females in early summer (late June–July). Avoid applications when bees are actively foraging on honeydew.			
Admire Pro	imidacloprid	1.2–2.4 oz	Group 4A insecticide. Systemic activity. Can be applied as soil application by drench or chemigation system, rates and restrictions differ for this application, see label. Generic labels available. 12-hour reentry. 7-day PHI.
Aza-Direct	azadirachtin	16–32 oz	Botanical extract of the neem tree. OMRI approved for organic use. 4-hour reentry. 0-day PHI.
Belay	clothianidin	6 oz	Group 4A insecticide. Systemic activity. Avoid drift to flowering crops. No more than 0.2 lb AI per year. 12-hour reentry. 21-day PHI.
Brigade WSB	bifenthrin	8–32 oz	Group 3A insecticide. Restricted use. Do not graze livestock on treated cover crops. Highly toxic to bees and toxic to fish and aquatic invertebrates. 12-hour reentry. 7-day PHI.
Centaur WDG	buprofezin	1.5–2.0 lb	Group 16 insecticide. No more than one application per season. 12-hour reentry. 60-day PHI.
Transform WG	sulfoxaflor	2.75 oz	Group 4C insecticide. Do not apply more than 8.5 oz per growing season. 12-hour reentry. 7-day PHI.
Esteem 35 WP	pyriproxyfen	4–5 oz	Group 7C insecticide. Note: This treatment should be timed to precede scale egg laying as this insect growth regulator suppresses egg development, see label. No more than 2 applications per season. Generics available. 12-hour reentry. 21-day PHI.
Movento	spirotetramat	6–9 oz	Group 23 insecticide. Toxic to aquatic organisms. Minimum interval between treatments is 14 days. Limited to 21.5 oz per year. 24-hour reentry. 7-day PHI.
Brown marmorated stink bug			
BMSB is an increasing problem on hazelnuts in the Willamette Valley. BMSB may pose a risk to nut quality, causing corking or decay if feeding occurs on developed kernels. Monitor for BMSB using pheromone traps, timed visual counts or beating trays. Populations tend to build up as harvest approaches, but BMSB also feed on vegetative growth early in the season and may build up in the orchard. Eggs and nymphs are found from May to September. Note that border sprays and Alternate Row Middle treatments can provide BMSB control while reducing impacts on natural enemies and potentially preventing flaring of secondary pests (mites, aphids, scale). See: <i>Brown Marmorated Stink Bug</i> , EM 9054, <i>Monitoring for Brown Marmorated Stink Bug</i> , EM 9138, the <i>PNW Insect Management Handbook</i> , and <i>How to Recognize Brown Marmorated Stink Bug Damage in Commercial Hazelnuts</i> , EM 9102, available at catalog.extension.oregonstate.edu .			
Admire Pro	imidacloprid	1.2–2.4 oz	Group 4A insecticide. Systemic activity. Avoid drift to flowering crops. Generic labels available. 12-hour reentry. 7-day PHI.
Ambush 25W	permethrin	12.8–25.6 oz	Group 3A insecticide. Restricted use. Do not graze treated orchards. Extremely toxic to fish and aquatic habitat. Do not apply more than 1.6 lb ai/A per season. 24-hour reentry. 14-day PHI.
Baythroid XL	beta-cyfluthrin	2–2.4 oz	Group 3 insecticide. 12-hour reentry. 14-day PHI.
Belay	clothianidin	6 oz	Group 4A insecticide. Systemic activity. Avoid drift to flowering crops. No more than 0.2lb AI per year. 12-hour reentry. 21-day PHI.
Brigade WSB	bifenthrin	8–32 oz	Group 3A insecticide. Restricted use. Do not graze livestock on treated cover crops. Highly toxic to bees and toxic to fish and aquatic invertebrates. 12-hour reentry. 7-day PHI.
Cobalt	chlorpyrifos + lambda cyhalothrin	22–57 oz	Group 1B + 3A insecticide. Restricted use. Premix product, see label as both AIs have cumulative limits/season. 24-hour reentry. 14-day PHI.
Danitol	fenpropathrin	10.6–21.3 oz	Group 3 insecticide. Restricted use. No more than 2 applications recommended, no more than 0.8 lb AI allowed per season. 24-hour reentry. 3-day PHI.
Declare	gamma-cyhalothrin	1.02–2.05 oz	Group 3A insecticide. Restricted use. No more than 0.08 lb AI per year. 24-hour reentry. 14-day PHI.
DoubleTake	diflubenzuron + lambda-cyhalothrin	4–5 oz	Group 15 + group 3A insecticide. Restricted use. Do not exceed 4 applications per growing season. Premix product, see label as no more than 0.12 lb lambda-cyhalothrin is allowed per season. Use the higher rate for longer residual control, high pest population, low crop load, larger trees, or heavy/dense foliage. Reapply at 21-day intervals under sustained pest pressure. 24-hour reentry. 28-day PHI.

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JULY–AUGUST *Continued from page 10*

Pest or disease/ material	Active ingredient	Application rate/acre	Comments/re-entry interval/preharvest interval (PHI)
Endigo ZC	lambda-cyhalothrin + thia-methoxam	5–6 oz	Group 3A + group 4A insecticide. Restricted use. Systemic activity. Avoid drift to flowering crops. Premix product, see label as both AIs have cumulative limits/season. 24-hour reentry. 14-day PHI.
Mustang Maxx	zeta-cypermethrin	3.2–4 oz	Group 3A insecticide. Restricted use. Applications must be 7 days apart. No more than 0.125 lb AI per season. 12-hour reentry. 7-day PHI.
Proaxis	gamma-cyhalothrin	2.56–5.12 oz	Group 3A insecticide. Restricted use. No more than 0.08 lb AI per year. 24-hour reentry. 14-day PHI.
Surround WP	Kaolin clay	50–75 lb	Suppression only. OMRI approved for organic use. 4-hour reentry. 0-day PHI.
Tombstone	cyfluthrin	2–2.4 oz	Group 3A insecticide. Restricted use. Maximum of 2.8 oz per season. 12-hour reentry. 14-day PHI.
Warrior II	lambda-cyhalothrin	1.28–2.56 oz	Group 3A insecticide. Restricted use. Generics available. Do not apply more than 0.12 lb (7.68 fl oz or 0.48 pt of product)/acre post bloom. 24-hour reentry. 12-day PHI.
Filbertworm			
Note: See footnote 4, page 13, on use of pheromone traps and degree day model.			
Altacor	chlorantraniliprole	3–4.5 oz	Group 28 insecticide. Apply at or just prior to egg hatch to target emergent larvae (955 DD). Do not make more than 4 applications per season. 4-hour reentry. 10-day PHI.
Ambush 25W	permethrin	12.8–25.6 oz	Group 3A insecticide. Restricted use. Do not graze treated orchards. Extremely toxic to fish and aquatic habitat. Do not apply more than 1.6 lb ai/A per season. 24-hour reentry. 14-day PHI.
Asana XL	esfenvalerate	9.6–19.2 oz	Group 3A insecticide. Restricted use. Do not apply a second spray within 3 weeks of the first. Do not apply more than 0.2 lb ai/A per season. Do not graze livestock in treated orchards. 24-hour reentry. 21-day PHI.
Assail 70WP	acetamiprid	1.1–4.1 oz	Group 4A insecticide. Systemic activity. Avoid drift to flowering crops. The higher rate may be needed for control in mature orchards with full canopies. Some ovicidal activity. No more than 4 applications per season. 12-hour reentry. 14-day PHI.
Baythroid XL	beta-cyfluthrin	2–2.4 oz	Group 3 insecticide. 12-hour reentry. 14-day PHI.
Brigade WSB	bifenthrin	8–32 oz	Group 3A insecticide. Restricted use. Do not graze livestock on treated cover crops. Highly toxic to bees and toxic to fish and aquatic invertebrates. 12-hour reentry. 7-day PHI.
Cobalt	chlorpyrifos + lambda cyhalothrin	22–57 oz	Group 1B + 3A insecticide. Restricted use. Premix product, see label as both AIs have cumulative limits/season. 24-hour reentry. 14-day PHI.
Delegate WG	spinetoram	4.5–7 oz	Group 5 insecticide. Apply at or just prior to egg hatch to target emergent larvae (955 DD). Do not apply more than 3 consecutive treatments of group 5 materials. 4-hour reentry. 1-day PHI.
Declare	gamma-cyhalothrin	1.02–2.05 oz	Group 3A insecticide. Restricted use. No more than 0.08 lb AI per year. 24-hour reentry. 14-day PHI.
Dimilin 2L	diflubenzuron	12–16 oz	Group 15 insecticide. Restricted use. Can be applied over the egg laying period up to egg hatch (815-955 DD). 12-hour reentry. 28-day PHI.
Entrust	spinosad	1.25–3 oz	Group 5 insecticide. OMRI approved for organic use. Apply at or just prior to egg hatch to target emergent larvae (955 DD). No more than 9 oz per season. 24-hour reentry. 1-day PHI.
Exirel	cyantraniliprole	10–20.5 oz	Group 28 insecticide. Rates are approximate. No more than 0.4 lb AI per season. Labeled for leafrollers. 12-hour reentry. 5-day PHI.
Fastac CS	alpha-cypermethrin	3.2–3.8 oz	Group 3A insecticide. Restricted use. Do not exceed 11.4 fl oz/A per season. 12-hour reentry. 7-day PHI.
Grandevo	chromobacterium	1-3 lbs	Group UN insecticide. OMRI approved for organic use. Apply at or just prior to egg hatch to target emergent larvae (955 DD). 4-hour REI. 0-day PHI
Intrepid 2F	methoxyfenozide	8–16 oz	Group 18 insecticide. See also generics. Can be applied over the egg laying period up to egg hatch (815-955 DD). 4-hour reentry. 14-day PHI.

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JULY–AUGUST *Continued from page 11*

Pest or disease/ material	Active ingredient	Application rate/acre	Comments/re-entry interval/preharvest interval (PHI)
Intrepid Edge	methoxyfenozide + spinetoram	6–12 oz	Group 18 + group 5 insecticide. Can be applied over the egg laying period up to egg hatch (815-955 DD). Reapply after 14 days if pressure continues. 4-hour reentry. 7-day PHI.
Leverage 360	beta-cyfluthrin + imidacloprid	2.8 oz	Group 3A + 4A insecticide. Restricted use. Systemic activity. Avoid drift to flowering crops. Premix product, see label as both AIs have cumulative limits/season. 12-hour reentry. 14-day PHI.
Pounce 25 WP	permethrin	12.8–16 oz	Group 3A insecticide. Restricted use. Do not graze treated orchards. Do not apply more than 1.6 lb ai/A per season. 24-hour reentry. 14-day PHI.
Proaxis	gamma-cyhalothrin	2.56–5.12 oz	Group 3A insecticide. Restricted use. No more than 0.08 lb AI per year. 24-hour reentry. 14-day PHI.
Proclaim	emamectin benzoate	3.2–4.8 oz	Group 6 insecticide. Restricted use. Apply at or just prior to egg hatch (955 DD). 12-hour reentry. 14-day PHI.
Success Naturalyte Insect Control	spinosad	4–8 oz	Group 5 insecticide. Apply at or just prior to egg hatch to target emergent larvae (955 DD). Do not apply more than 3 consecutive treatments of group 5 materials. Entrust is the OMRI-approved formulation for organic use. 24-hour reentry. 14-day PHI.
Surround WP	Kaolin clay	50–75 lb	Strong suppression effect. OMRI approved for organic use. 4-hour reentry. Apply prior to egg laying (815 DD), maintain coverage throughout flight period. Good agitation in spray tank is essential. 0-day PHI.
Warrior II	lambda-cyhalothrin	1.28–2.56 fl oz	Group 3A insecticide. Generics available. Do not apply more than 0.12 lb (7.68 fl oz or 0.48 pt of product)/A post bloom. 24-hour reentry. 14-day PHI.
Eastern filbert blight			
none	—	—	New cankers develop in late summer and can be removed any time prior to bud break the next growing season.

LATE AUGUST–SEPTEMBER

Pest or disease/ Material	Active ingredient (AI)	Application rate/acre	Comments/Reentry interval/Preharvest interval (PHI)
Kernel molds			
none	—	—	Harvesting before fall rains and keeping full totes dry or shielded from rain have been associated with reduced mold counts.
Bacterial blight			
Note: An important spray for young filberts (less than 10 years old). Apply coppers after harvest and before fall rains. If heavy rains occur, repeat application when three-fourths of the leaves have dropped.			
Badge X2	copper hydroxide + copper oxychloride	7-20 lb	M01 fungicide/bactericide. 48-hour reentry.
Bordeaux 6-3-100	copper sulfate + hydrated lime	—	M01 fungicide/bactericide. 24-hour reentry. See footnote 2, page 13.
Champion++	copper hydroxide	7-10.5 lb	M01 fungicide/bactericide. 48-hour reentry.
C-O-C-S WDG	copper oxychloride + copper sulfate	11.6 lb	M01 fungicide/bactericide. Add 1 pt HMO per 100 gal water. 48-hour reentry.
Copper-Count-N	copper ammonium complex	8–12 qt	M01 fungicide/bactericide. 48-hour reentry.
Cuprofix Ultra 40 Dispers	copper sulfate	10–15 lb	M01 fungicide/bactericide. 48-hour reentry.
Kocide 3000-O	copper hydroxide	7–10.5 lb	M01 fungicide/bactericide. Add 1 pt HMO per 100 gal water. 48-hour reentry.
Nordox 75WG	cuprous oxide	8–13 lb	M01 fungicide/bactericide.
NuCop 50DF	copper hydroxide	8–12 lb	M01 fungicide/bactericide. Add 1 pt HMO per 100 gal water. 48-hour reentry.

FOOTNOTES

1. More than one type of formulation is available for some insecticides.
2. Thoroughly spray the trunks and lower scaffolds as well as upper branches. Bordeaux 6-6-100 means 6 pounds of copper sulfate plus 6 pounds of hydrated lime in 100 gallons of water. In any bordeaux formula, the ingredients always are listed in the same order — copper sulfate, hydrated lime, then gallons of water.
3. The time to apply insecticide for big bud mite depends on the timing of the mite migration, which depends on factors such as orchard location, variety and weather. Use a 20x hand lens or microscope to determine whether mites are migrating from blasted buds to new buds. Research has shown that the most effective treatment timing is when 50%–60% of mites have migrated out of blasted buds. Movement occurs with daily max temps above 59°F or average temps of 48°F, particularly during long-term warming trends. Tanglefoot, Stickem Special, petroleum jelly, duct tape or double-sided Scotch tape applied in bands above and below buds infested with big bud mite will trap and hold migrating mites. Beginning in March, inspect weekly for migrating mites. Complete spray coverage is necessary. Use no less than 100 gallons of water per acre. Do not graze livestock in treated orchards or make aerial applications of any of the products registered for bud mite in Oregon. Excessive use of pyrethroids or other broad-spectrum materials for other pests may lead to bud mite problems (in susceptible varieties) because of loss of biological control.
4. Pheromone traps are available to detect and monitor flight activity of filbertworm moths. They have been successfully used to time cover sprays and work best when used with the filbertworm degree-day (DD) model (available from uspest.org/cgi-bin/ddmodel.us?spp=fbw&uco=1 and <https://cropconnect.com/custom/OSU/>). Place pheromone traps in the upper third of the tree canopy in late May or early June prior to first moth emergence, typically in mid-June. Apply insecticides eight to 12 days after filbertworm moths emerge in your area to target larvae emerging from eggs prior to nut penetration (first egg hatch occurs when 955 degree-days have accumulated after April 1). A second application usually is necessary in two to three weeks. A repeat spray may be necessary if heavy rainfall occurs a day or two after application and the label allows it. Second and third sprays may be necessary and should be made if pheromone traps continue to catch moths two to three weeks after a spray. Spray when two or three moths are collected per trap or if any one trap has caught five moths. Degree-day timings can greatly enhance timing and efficacy. Timings vary depending on insecticide mode of action. Pyrethroids (Group 3) can kill adult moths so can be applied after adults emerge (610 DD). Certain growth regulators (Group 18) kill eggs that are laid on top of residues or when residues cover eggs and can be applied over the egg laying period to egg hatch (815-955 DD). Other materials have larvicidal activity (for example Group 5 and Group 28), so these are best applied just prior to egg hatch (955 DD). Note the model does not help predict lifestages for the second flight of filbertworm so it is important to watch traps after the first generation. See also Table 2, page 15.
5. All fungicides should be applied beginning or just before budbreak. Continue applications at two-week intervals to cover an eight-week susceptibility period (four applications total).
6. Products that contain propiconazole, such as Bumper, Propi-Max, Quilt Xcel, Stratego, or Tilt, may result in smaller, thicker, greener leaves and shortened internodes, but trees will grow out of this condition within two weeks of the last application. These products have eradicator activity if applied at higher rates within 72 hours of infection.
7. Several materials are registered for Eastern filbert blight management but are not recommended. These include Cueva, Luna Experience, Luna Sensation, OxiDate, Pristine, Previsto and Regalia.
8. Luna Experience is legal to use but not recommended since only the group 3 chemistry in this prepackaged mix is effective. The other chemical, Luna Privilege, was ineffective in field tests. The effective group 3 chemistry is available alone as Tebucon, which is recommended. Luna Sensation is legal to use but not recommended since only the group 11 chemistry in this prepackaged mix is effective. The effective group 11 chemistry is available alone as Flint Extra, which is recommended.
9. Pristine is not recommended since only the group 11 chemistry in this prepackaged mix is effective. The other chemical was ineffective in field tests. The effective group 11 chemistry is available alone as Cabrio EG, which is recommended.
10. Regalia and Cueva are registered but were not effective in tests in western Oregon.
11. Although OxiDate is registered, it will not control this disease due to its short residual activity.
12. Cultivars with the single dominant gene for resistance to EFB (Gasaway), such as Jefferson or McDonald, need protection the first spring after planting when located near heavily infected orchards.
13. Sprayers used for Abound, Aframe Plus, Quadris Top, Topguard EQ or Willowood Azoxy **should not be used on apples** such as Gala, Cox's Orange Pippin and McIntosh. Even a small amount of drift or residue can severely impact these trees.

Table 1. Quick reference guide to herbicides labeled for use in hazelnuts

Active ingredient [WSSA number ¹] (trade name)	Rate pounds ai/a (product)	Max seasonal per acre per year (product)	Reapply (month)	Minimal age (month)	Replant (month)	PHI (day)
Soil-active herbicides (pre-emergence)						
diuron [7] (Direx 4L)	1.6–2.4 lb ai (1.6–2.4 qt)	3.2 lb ai (3.2 qt)	5	12	24	
indaziflam [29] (Alion)	0.04–0.06 lb ai (3.5–5 fl oz)	0.09–0.13 lb ai (7.0–10.3 fl oz)	3	12	12	14
isoxaben [21] (Trellis SC)	0.5–1 lb ai (16–31 fl oz)	1.0 lb ai (31 fl oz)		0	0	60
napropamide [15] (Devrinol 50DF)	4 lb ai (8 lb)	4 lb ai (8 lb)	12	0	12	N/A
norflurazon [12] (Solican DF)	1.95–3.93 lb ai (2.5–5 lb)	3.93 lb ai (5 lb)	0	0/6	12	60
oryzalin [3] (Surflan)	2–6 lb ai (2–6 qt)	12 lb ai (12 qt)	2.5	0	0	N/A
pendimethalin [3] (Prowl H2O)	1.9–6 lb ai (2–6.3 qt)	6 lb ai (6.3 qt)	1	0	12	60
simazine [5] (Princep 4L)	2–4 lb ai (2–4 qt)	4 lb ai (4 qt)	3	0	12	21
sulfentrazone [14] (Sulfentrazone 4SC)	0.25–0.375 lb ai (8–12 fl oz)	0.375 lb ai (12 fl oz)	2	36	1	3
trifluralin [3] (Treflan 4L)	0.5–1 lb ai (1–2 pt)	1 lb ai (2 pt)	N/A	0	0	60
trifluralin + isoxaben [3+21] (Snapshot 2.5 TG)	2.5–5 lb ai (100–200 lb)	15 lb ai (600 lb)	2	0	0	365
Pre- and postemergence herbicides						
flazasulfuron [2] (Mission)	0.03–0.04 lb ai (2.14–2.85 oz)	0.09 lb ai (5.7 oz)	3	36	12	130
flumioxazin [14] (Chateau SW)	0.18–0.38 lb ai (6–12 oz)	0.76 lb ai (24 oz)	1	12	18	60
halosulfuron [2] (Sanda)	0.03–0.06 lb ai (0.6–1.3 oz)	0.13 lb ai (2.6 oz)	1.5	12	9	1
oxyfluorfen [14] (Goal 2XL)	1.25–2 lb ai (1–4 pt)	2 lb ai (4 pt)		0	30	60
oxyfluorfen + penoxsulam [14 + 2] (Pindar GT)	1.47+0.03 lb ai (1.5–3 pt)	2.2 + 0.04 lb ai (4.5 pt)		48	30	60
rimsulfuron [2] (Matrix)	0.03–0.06 lb ai (2–4 oz)	0.06 lb ai (4 oz)	1	12	12	21
mesotrione [27] (Broadworks)	0.09–0.18 lb ai (3–6 floz)	0.36 lb ai (12 fl oz)	5	12	18	30
Postemergence herbicides²						
2,4-D [4] (Saber)	0.95–1.4 lb ai (2–3 pt)	1.9 lb ai (4 pt)	2.5	12	1	60
carfentrazone [14] (Aim EC)	0.01–0.03 lb ai (1–2 fl oz)	0.079 lb ai (7.9 fl oz)	0.5	0	0	3
clethodim [1] (Select max)	0.07–0.12 lb ai (9–16 fl oz)	0.64 lb ai (64 fl oz)	0.5	0	0	14
diquat [22] (Reglone)	0.37–0.56 lb ai (1.5–2 pt)	0.56 lb ai (2 pt)	0.5	12	0	365
fluazifop [1] (Fusilade DX)	0.25–0.375 lb ai (16–24 fl oz)	1.125 (72 fl oz)	0.5	0	0	365
glufosinate [10] (Rely 280)	0.88–1.5 lb ai (48–82 fl oz)	4.5 lb ai (246 fl oz)	0.5	0	6	14
glyphosate [9] (Roundup Powermax)	0.38–3.69 lb ae (11–105 fl oz)	7.87 lb ae (224 fl oz)	0.5	0	0	3
paraquat [22] (Gramoxone SL)	0.625–1 lb ai (2.5–5 pt)	4 lb ai (20 pt)	0.5	0	0	1

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1. WSSA number — Weed Science Society of America herbicide site of action group number. Trade names listed are not a recommendation but are listed to facilitate interpretation of the table. Always consult and follow the label recommendations.
2. The use of trunk guards is recommended until the bark is well developed (two to three years).

Active ingredient [WSSA number ¹] (trade name) <i>Continued from page 14</i>	Rate pounds ai/a (product)	Max seasonal per acre per year (product)	Reapply (month)	Minimal age (month)	Replant (month)	PHI (day)
pelargonic acid (Scythe)	3–10 % v/v	N/A	NA	NA	NA	1
pyraflufen [14] (Venue)	0.002–0.005 lb ai (2–4 fl oz)	0.0085 lb ai (6.8 fl oz)	1	12	0	0
Saflufenacil [14] (Treevix)	0.04 lb ai (1 oz)	0.13 lb ai (3 oz)	0.7	1	1	7
sethoxydim [1] (Poast)	0.19–0.47 lb ai (1.5–2.5 pt)	1.88 lb ai (10 pt)	0.5	0	0	30
Green sucker control						
2,4-D [4] (Saber)	0.71–0.95 lb ai (1.5–2 pt)	1.9 lb ai (4 pt)	1	12	1	45
carfentrazone [14] (Aim EC)	0.03 lb ai (2 fl oz)	0.079 lb ai (7.9 fl oz)	0.5	0	0	3
glufosinate [10] (Rely 280)	1.0 lb ai (56 fl oz)	4.5 lb ai (246 fl oz)	0.5	0	6	14
paraquat [22] (Gramoxone SL)	0.625–1 lb ai (2.5–5 pt)	4 lb ai (20 pt)	0.5	0	0	1
pelargonic acid (Scythe)	5–7 % v/v	N/A	NA	NA	NA	1
pyraflufen [14] (Venue)	0.002–0.005 lb ai (2–4 fl oz)	0.0085 lb ai (6.8 fl oz)	1	12	0	0

1. WSSA number — Weed Science Society of America herbicide site of action group number. Trade names listed are not a recommendation but are listed to facilitate interpretation of the table. Always consult and follow the label recommendations.
2. The use of trunk guards is recommended until the bark is well developed (two to three years).

Table 2. Hazelnut IPM sampling methods and action thresholds

Insect	Sampling period	Sampling method	Action threshold
European winter moth	Larvae: March 15–May 31	3 terminals/tree and 3 leaf clusters/terminal. Each terminal is a sampling unit.	20% infestation
Big bud mite	April	In late March, place Tanglefoot or double-sided tape on twigs proximal to blasted buds. Check for extremely small, white, cigar-shaped mites with a 20x hand lens.	When consistent mite movement is observed, which usually occurs with budbreak; optimal timing is peak migration
Omnivorous leaftier	April 15–June	3 bud clusters/tree.	5% infestation
Filbert aphid	April 1–Sept. 30	3 terminals/tree — newest fully expanded leaf on each terminal. Check for mummies caused by the wasp <i>Trioxys pallidus</i> . If there is wasp activity, sprays may not be necessary.	April: 20/leaf May: 30/leaf June: 40/leaf July: 40/leaf with an increasing population
Obliquebanded leafroller (OBLR) and filbert leafroller	Larvae: April–August Adult: Mid-May–September	Larvae: 3 terminals/tree and 3 leaf clusters/terminal. Each terminal is a sampling unit. If larvae are large, avoid treatment Adult: Pheromone trap for each 5 acres; 6-ft height.	Larvae: 20%–25% infestation Adult: 40 moths/week and find second-generation OBLR larvae feeding on nuts
Filbertworm	June–September	Adult: Pheromone traps: 4 for first 10 acres and 1 for each additional 4 acres. Place traps in the upper third of the canopy by mid-June.	2–3 moths per trap or 5 moths in any one trap

Table 3. Effectiveness of fungicides for eastern filbert blight management

These ratings are relative rankings based on full application rates, good spray coverage, and proper spray timing. Actual levels of disease control will be influenced by these factors in addition to cultivar susceptibility, disease pressure and weather conditions. Possible ratings for disease control include none, slight, fair, good or excellent.

Fungicide trade name	Common name	Fungicide group #	EFB control	Use with surfactant
Abound	azoxystrobin	11	Fair–good	Yes, but avoid silicone-based products
Aframe Plus	azoxystrobin + propiconazole	3 + 11	Fair–good	Yes, but avoid silicone-based products
Aproach	picoxystrobin	11	Excellent	Yes
Bravo	chlorothalonil	M5	Excellent	No
Bumper	propiconazole	3	Good–excellent	Yes
Cabrio	pyraclostrobin	11	Excellent	Yes
Copper-Count-N	copper ammonium carbonate	M1	Good	?
Echo	chlorothalonil	M5	Excellent	No
Gem	trifloxystrobin	11	Good–excellent	Yes
Inspire Super	difenoconazole + cyprodinil	3 + 9	Fair–good	OK
Kocide	copper hydroxide	M1	Good	Yes
Merivon	fluxapyroxad + pyraclostrobin	7 + 11	Good	OK
Nu-Cop	copper hydroxide	M1	Good	Yes
Ph-D	polyoxin D	19	Fair	Yes
Procure	triflumizole	3	Fair–good	Yes
Propi-Max	propiconazole	3	Good–excellent	Yes
Quadris Top	azoxystrobin + difenoconazole	3 + 11	Good–excellent	Yes, but consult label
Quash	metconazole	3	Good	Yes
Quilt Xcel	azoxystrobin + propiconazole	3 + 11	Excellent	Yes
Stratego	propiconazole + trifloxystrobin	3 + 11	Excellent	Yes
Tilt	propiconazole	3	Good–excellent	Yes
TopGuard	flutriafol	3	Good	No
TopGuard EQ	flutriafol + azoxystrobin	3 + 11	Good	Yes, but avoid silicone-based products
Trionic	triflumizole	3	Fair–good	Yes
Unicorn	tebuconazole + sulfur	3 + M2	Good	Yes
Willowood Azoxy 2SC	azoxystrobin	11	Fair–good	Yes, but avoid silicone-based products
ZiramTab	ziram	M3	Excellent	Yes

Strategies for using fungicides for managing eastern filbert blight

Fungicides have been useful to suppress or delay development of eastern filbert blight in an orchard of susceptible cultivars such as Ennis or Barcelona. Cultivars such as Jefferson or McDonald, with the single dominant gene for resistance only, need protection the first spring after planting, when located near heavily infected orchards. Fungicides will not remove or eliminate cankers from the tree.

Fungicides are best used to protect susceptible tissue in the spring at budbreak and for the next eight weeks. Most fungicides will last two weeks before another application is needed. This means a total of four applications, starting with the first at budbreak. Although hazelnuts are still susceptible after this period, additional applications have not resulted in consistent, significant disease control.

Because of fungicide resistance issues and resulting label requirements, you may not be able to use the same fungicide for all four applications. Since the EFB fungus has a long (two-year) life cycle, the resistance risk is already low relative to other diseases, such as powdery mildew. Strategies to further minimize this risk include alternating or tank-mixing fungicides with different modes of action. The Fungicide Resistance Action Committee has categorized, grouped and assigned numbers to the modes of action (see Table 3, page 16).

Alternating fungicides with different modes of action has been effective to manage EFB. Research has not identified any one alternating strategy as better than any other strategy. We have several fungicide groups to choose from, including FRAC groups 3, 11, M5, M3 and M1. It is suggested that the first application be chlorothalonil or ziram (group M5 or M3) followed by your choice of a Group 3 or Group 11 fungicide. Each of the next two applications would be different from the previous one. An example of this program might be to start with Bravo (or any of its generics, Group M5) at bud break, followed by Flint Extra (Group 11) two weeks later, then Tilt (Group 3) two weeks after that, and ending with Cabrio (Group 11). Use of multisite products such as chlorothalonil (Group M5), ziram (Group M3) or copper-based products (Group M1) for all four applications would also be acceptable.

Do not just alternate fungicides with different trade names, as they might have the same mode of

action. Some fungicide premixes already combine two fungicides with different modes of action, generally a Group 3 and Group 11 fungicide. These products cannot be used for every application because they do not allow more than two sequential applications before switching to a different product with a different mode of action. If you use these premixes, you must use an M5, M3 or M1 fungicide in the rotation. An example of this program might be to start with Bravo (M5) at bud break, followed by Stratego (3 + 11) or QuiltXcel (3 + 11) two weeks later, then the same product two weeks after that, but ending with Bravo.

You can make your own tank-mixes. Since tank-mixing can be expensive, growers have asked about reducing the rate of each product in the tank. Research to date has shown that a half rate of Echo 90 DF (Group M5) tank-mixed with either Tilt (Group 3) or Cabrio (Group 11) is effective to manage EFB. Combining fungicide resistance theory and research on EFB in Oregon suggests we should use a half rate of chlorothalonil tank-mixed with a full rate of a Group 3 fungicide or a half rate of a Group 11 fungicide. An example of this program might be:

- **First application:** A full rate of Bravo (M5) at bud-break
- **Second application, two weeks later:** A mix of Cabrio (11) plus Echo 90DF (M5), each at half rate.
- **Third application, two weeks later:** A mix of Tilt (3) at full rate plus Echo 90DF (M5) at half rate.
- **Fourth application, two weeks later:** A mix of Cabrio (11) plus Echo 90DF (M5), each at half rate.

Research has indicated that addition of a surfactant provides better disease control than a fungicide alone. Numerous products can break the surface tension of water to get better coverage of plant tissue. They also can help keep the fungicide solution in contact with the plant, reducing wash-off during rain events. Unless otherwise stated on the label, add a surfactant with a fungicide. Copper-based products have traditionally been applied with a horticultural mineral oil. Newer fungicides may be mixed with silicone-based or nonionic surfactants. Be careful, as several fungicides may already come formulated with a surfactant and/or specifically say NOT to add these products. For example, do not add a surfactant to Bravo or Quadris Top.

Table 4. Toxicology information for insecticides used in hazelnuts

Insecticides/miticides	Mammals	Beneficials	Bees¹	Aquatics
Abamectin (Agri-mek)	High	Low to high	Very high	High
Acetamiprid (Assail)	Very low	Moderate to high	Moderate	Low
Azadirachtin (Aza-Direct)	Very low	Low to moderate	Moderate	Moderate
Bacterium Bacillus thuringiensis kurstaki (Btk)	Very low	Low	Low	Low
Bifenthrin (Brigade)	Moderate	High	Very high	High
Chlorantraniliprole (Altacor)	Very low	Moderate	Low	Low
Chlorpyrifos (Lorsban)	High	Very high	Very high	Very high
Clothianiden (Belay)	Moderate	-	Very high	Very low
Cyfluthrin (Tombstone)	Low	High	Very high	High
Diflubenzuron (Dimilin)	Low	Moderate	Low	Very high
Emamectin benzoate (Proclaim)	High	-	Moderate	Low
Esfenvalerate (Asana)	Moderate	High	Very high	High
Fenpropathrin (Danitol)	Moderate	High	Very high	Very high
Fenpyroximate (Fujimite)	Low	Moderate	Low	Very high
Hexythiazox (Savey)	Low	Low	Low	Low
Imidacloprid (Admire Pro, generics)	Moderate	Moderate to high	Very high	Low
Lambda-cyhalothrin (Warrrior II, generics)	Moderate	High	Very high	High
Methoxyfenozide (Intrepid)	Very low	Low	Low	Moderate
Permethrin (Ambush, Pounce)	Moderate	Low to high	Very high	High
Pyridaben (Nexter)	Moderate	Moderate	Moderate	Moderate
Pyriproxyfen (Esteem)	Very low	Moderate	Low	Moderate
Spinetoram (Delegate)	Very low	High	Moderate	Low
Spinosad (Entrust, Success)	Very low	Low to moderate	Moderate	Low
Spirodiclofen (Envidor)	Very low	Low	Very high	High

Data sources: UCANR pesticide active ingredients database, National Pesticide Information Center, Orchard Pesticide Effects on Natural Enemies Database.

1. Hazelnuts are wind-pollinated and do not depend on pollinator insects. However, pollinator pesticide hazards still exist when pollinators are foraging on pollen, honeydew or blooming groundcover in and around hazelnut orchards.

OSU resources for plant protection

Information on plant protection is available from several sources at Oregon State University:

- OSU Integrated Plant Protection Center. Online weather data and degree day information for insect pests and diseases uspest.org/wea/
- Pacific Northwest Plant Disease Management Handbook, pnwhandbooks.org/plantdisease
- Pacific Northwest Insect Management Handbook, pnwhandbooks.org/insect
- Pacific Northwest Weed Management Handbook, pnwhandbooks.org/weed

Using pesticides safely

Always read the label

The single most important approach to pesticide safety is to read the pesticide label before each use and then follow the directions. If still in doubt after reading the label, contact a person qualified to help evaluate the hazard of the chemical and its use. Qualified people include Extension specialists, county educators, pesticide product representatives and retailers.

Pesticides are toxic and should be handled with care — but they can be used safely if you follow recommended precautions. Follow all label requirements, and strongly consider any recommendations for additional personal protective clothing and equipment. In addition to reading and following the label, other major factors in the safe and effective use of pesticides are the pesticide applicator's qualifications, common sense and positive attitude. Always take all safety precautions when using pesticides.

In case of accidents involving pesticides, see your doctor at once. It will help your doctor to know exactly which pesticide is involved. The label on the container gives this information. Take to the physician the pesticide label or information from the label, such as the product name, registration number of the U.S. Environmental Protection Agency, common name and percentage of active ingredient and first aid instructions. If the label cannot be removed, take along the pesticide container (if not contaminated), but do not take it into the hospital or doctor's office.

Pesticide safety checklist

- Use pesticides only when necessary and as part of an Integrated Pest Management program.
- Always read the label and follow the instructions.
- Do not allow children to play around sprayers or mixing, storage, and disposal areas.
- Wear appropriate protective clothing and equipment.
- Never eat, drink, or smoke while handling pesticides.
- Avoid drift into non-target areas and pesticide runoff into streams, rivers, lakes, irrigation ponds and canals.
- Avoid spilling materials on skin or clothing.
- Have access to clean water, soap, and first aid supplies.
- Keep pesticides in a dry and locked storage area away from food and feed.
- Triple rinse or pressure rinse empty containers and dispose or recycle in accordance with state and local regulations.
- Stay out of recently sprayed areas until the spray has dried, and observe the restricted entry intervals specified on the pesticide label.
- Follow the pre-harvest interval on the pesticide label before harvesting crops or gardens and before allowing livestock to graze fields.

Emergency response for exposure and spills

- For any pesticide exposure emergency, dial 911.
- First aid for exposure is indicated on the pesticide label.
- For information on poison emergency treatment call the National Poison Center at 1-800-222-1222.
- For emergency information related to pesticide spills contact the Oregon Emergency Response System at 1-800-452-0311.

Non-emergency information

- **General pesticide information** — The National Pesticide Information Center provides objective, science-based information about pesticides and pesticide-related topics. Visit npic.orst.edu/index.html or call 1-800-858-7378.
- **Pesticide licensing and regulation** — The Oregon Department of Agriculture regulates most aspects of pesticide use in the State of Oregon. Visit www.oregon.gov/ODA/programs/Pesticides/Pages/AboutPesticides.aspx or call 503-986-4635.
- **Worker protection** — The federal Worker Protection Standard for Agricultural Pesticides protects agricultural workers from pesticide exposure at work. The Oregon Occupational Safety and Health Administration is the state agency responsible for administering the WPS in Oregon. For information on WPS requirements for employers, visit osha.oregon.gov/Pages/topics/worker-protection-standard.aspx or call 1-800-922-2689.
- **Pesticide waste** — The Oregon Department of Environmental Quality regulates the disposal of pesticide waste in the State of Oregon. Visit www.oregon.gov/deq/Hazards-and-Cleanup/hw/Pages/Miscellaneous-Industries.aspx or call 503-229-5263. The Tricounty Hazardous Waste and Recycling Program conducts periodic collection events for unused pesticides in Hood River, Sherman, and Wasco counties. Visit www.tricountyrecycle.com/managing-my-materials/hazardous-waste or call 541-506-2632. Most chemical distributors offer plastic pesticide container recycling.