2,4-D drift delays kernel drop in hazelnut

Marcelo Moretti, Linda Brewer and Joshua Miranda Teo

Hazelnut growers in the Willamette Valley have been telling us what research now confirms: The herbicide 2,4-D drifting into the tree canopy delays nut drop (abscission) in hazelnut orchards. In this publication, you will learn the sources of 2,4-D drift, the environmental conditions that support it and how to reduce risk of 2,4-D drift in your orchard. Grower observation inspired this field research.

Herbicide 2,4-D is a synthetic auxin — a class of growth regulators. It is commonly applied to the base of hazelnut trees to manage suckers. As an herbicide, 2,4-D kills plants by causing xylem cells to grow out of control, disrupting their function.

Sucker management is an essential part of hazelnut production. It facilitates mechanical harvest, removes a potential source of disease organisms and increases yield.

2,4-D is a commonly used herbicide in many production systems in the Willamette Valley, the heart of the U.S. hazelnut industry. Hazelnut orchards are at risk of exposure to 2,4-D drift.

Studies by other researchers in grape, pear and apple indicate delayed fruit ripening after exposure to auxin herbicides.

Oregon State University

EM 9450 | January 2025

View online: https://extension.oregonstate.edu/catalog/pub/em9450

Sources of drift

Hazelnut orchards may be exposed to damaging 2,4-D drift from applications within the orchard or from 2,4-D drifting in from surrounding crops. Drift can be primary — off-target spray particles at the time of application. Or, it can be secondary — herbicide movement after completion of an application. Volatilization is a common example of secondary drift.

Figure 1: Chlorotic leaf margins are a common symptom of 2,4-D drift exposure in hazelnut.

Credit: Marcelo L. Moretti, © Oregon State University

We studied the effect of simulated 2,4-D drift on hazelnut abscission and yield in a 10-year-old hazelnut orchard. Weed and sucker management in the study orchard were consistent with grower standard practice.

Four basal-directed treatments spaced 28 days apart were applied to suckers between May and August during each year of the three-year study. The number and timing of applications were based on the use pattern permitted on the 2,4-D label and adopted by growers. Application rates represented 1-, 2- and 4-fold the maximum seasonal use of 2,4-D.

In a subset of treatments, 2,4-D drift at 1/10th and 1/100th of the field rate was simulated once yearly in the second half of July when nut filling occurs rapidly. Simulated drift was included in Years 1 and 2 of the study, but not in Year 3, to evaluate plant recovery from drift in the following season.

What we learned:

Figure 2a: The highest rate of drift — 1/10th of the standard field rate — resulted in dead limbs.

Credit: Marcelo L. Moretti, © Oregon State University

Figure 2b: The highest rate of drift — 1/10th of the standard field rate — resulted in dead limbs.

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Abscission delay

- In mild cases, 2,4-D drift in hazelnuts caused symptoms such as leaf cupping, crinkling, and chlorosis of leaf margins (Figure 1).
- Severe cases of 2,4-D drift resulted in tissue necrosis and dead limbs. Dead limbs were only observed with 2,4-D drift at 1/10th of the field rate (0.6 mg L^{-1}) (Figures 2A and 2B).
- Simulated 2,4-D drift delayed hazelnut abscission, but only during the years when drift occurred (Figures 3A and 3B). No lingering effects on hazelnut abscission were observed in subsequent years.
- In Year 1, the time to reach 50% nut fall increased by approximately five days and 15 days for the two drift dosages, respectively. A similar response occurred in Year 2, with 2,4-D drift delaying nut fall by approximately five and eight additional days.
- When 2,4-D was applied directly to suckers (no drift), hazelnut abscission was unaffected, regardless of the rate used (1 to 4 times the annual rate).

Figure 3a: Exposure of 2,4-D drift increased days to nut drop in hazelnut.

Credit: Marcelo L. Moretti, © Oregon State University

Figure 3b: Exposure of 2,4-D drift increased days to nut drop in hazelnut. Both photos were taken in February. Note in figure 3B that the trees have retained some nuts until after catkin emergence.

Credit: Marcelo L. Moretti, © Oregon State University

Yield

- Simulated drift treatments had no effect on yield in Year 1 of the study.
- In Year 2, 2,4-D drift reduced yield by 18% and 37% for drift rates of 1/100th (0.06 mg L^{-1}) and 1/10th (0.6 mg L^{-1}) of the field rate, respectively, compared to the nontreated control.
- No impact on maximum yield was observed in Year 3, which did not receive simulated drift treatments.
- Drift reduction practices are essential for ensuring timely hazelnut abscission and maintaining high crop yields.

Mitigating 2,4-D drift in your orchard

Management practices

- Increase droplet size: Use drift reduction nozzles, such as Air Induction Under Leaf (AIUB) spray nozzles, to produce larger droplets that are less likely to drift off-target.
- Reduce spray pressure: Lowering spray pressure minimizes the formation of fine droplets, which can remain airborne near the crop and drift into the canopy.
- Monitor wind speed: Avoid spraying during calm conditions, which are often associated with temperature inversions that promote drift into the canopy. Similarly, do not spray when winds exceed 6 mph, as high wind speeds increase the risk of drift.

Environmental conditions

- 2,4-D volatilization is influenced by air temperature and humidity. It can volatilize at temperatures above 60°F, with the likelihood increasing significantly above 85°F, especially when humidity is low.
- Spray drift moves most efficiently at wind speeds greater than 6 mph.

Reducing the risk of 2,4-D drift in orchards

- Spray herbicides or agricultural products when wind speeds measure between 2 and 8 mph.
- Equip sprayers with drift-reduction nozzles, such as turbo air-induction nozzles, to minimize drift.
- Apply 2,4-D at lower pressures to create larger droplets and mitigate the risk of drift.
- Time applications earlier in the season, using 2,4-D before May 30, when air temperatures are lower and less conducive to volatilization.
- Apply 2,4-D during daylight hours to increase weed uptake and reduce the risk of thermal inversion, which is more common in the early morning or evening.
- Choose low-volatility 2,4-D formulations, such as acid or choline formulations, to reduce drift risk.
- Mild 2,4-D drift symptoms include chlorotic leaf margins, leaf cupping, and crinkling. Severe drift can cause tissue necrosis and dead limbs. A single drift at 1/100th of the field rate delayed hazelnut abscission, and exposure closer to harvest could cause greater delays.
- Consider alternative herbicides if drift is a concern. Refer to the PNW Weed Management Handbook (https://pnwhandbooks.org/weed) for a list of registered options for sucker control in hazelnuts.
- Always follow pesticide label instructions. It is a violation of federal law to apply any herbicide inconsistently with its labeling.

Resource

Moretti, M.L. and L.L. de Souza. 2023. Hazelnut abscission is delayed by simulated drift of 2,4-D. (https://doi.org/10.1017/wsc.2023.43) Weed Science. 71: 506–513.

Use pesticides safely!

- *Wear protective clothing and safety devices as recommended on the label. Bathe or shower after each use.*
- *Read the pesticide label—even if you've used the pesticide before. Follow closely the instructions on the label (and any other directions you have).*
- *Be cautious when you apply pesticides. Know your legal responsibility as a pesticide applicator. You may be liable for injury or damage resulting from pesticide use.*

About the authors

Marcelo Moretti (https://extension.oregonstate.edu/people/marcelo-moretti)

Associate Professor

Linda Brewer (https://horticulture.oregonstate.edu/users/linda-brewer)

Senior Faculty Research Assistant II, Department of Horticulture

Joshua Miranda Teo

Graduate student

Department of Horticulture, Oregon State University

Related publication

Integrated Pest Management Strategic Plan for Hazelnuts in Oregon and Washington (https://extension.oregonstate.edu/catalog/pub/em-9223-integrated-pest-management-strategic-plan-hazelnuts-oregon-washington)