



Glyphosate Herbicide Injury to Coffee

Scot Nelson

Department of Plant and Environmental Protection Sciences

Where coffee trees (*Coffea arabica* L. and other *Coffea* spp.) are grown as unshaded monocrops in Hawai'i, tall and quickly growing grasses and herbaceous weeds may become difficult to control. Many coffee growers in the state use a combination of herbicide applications within coffee plant rows coupled with mowing or mechanical weed control between rows to manage weeds in the crop.

When spray applications of the herbicide glyphosate (as found in Roundup® and several other herbicide products) contact the coffee plant, extensive injury can occur. The injury can significantly reduce coffee plant growth and yield potential for an extended period of time. It may also predispose plants to other diseases, including nutritional deficiencies, Cercospora leaf spot, and root rots. Glyphosate injury is a relatively widespread and sometimes severe problem on coffee farms in Hawai'i.

This publication describes the symptoms and effects of glyphosate injury to coffee plants and suggests management practices to avoid or minimize the damage caused by the herbicide on coffee foliage, stems, or young exposed coffee roots.

The plant

Coffea arabica is a shrub or small tree grown for its beverage-yielding seeds. Its leaves are shiny, oval, pointed, and 3–6 inches long. Its flowers are white, fragrant, and massed in thick clusters at leaf axils along the

wide-spreading branches. Coffee originates from the Old World tropics, especially Africa. *Coffea arabica* is a native of tropical Africa and is now cultivated throughout the tropics; it is naturalized and grows wild on many islands in the Pacific Ocean.

There are no coffee diseases in Hawai'i that create witches' broom symptoms as in glyphosate injury, but glyphosate injury can resemble nutritional deficiency disorders such as iron, zinc, and nitrogen deficiencies.

The problem

Glyphosate is a chemical compound that is the active ingredient in some herbicide products. It is a non-selective, systemic herbicide that is absorbed through plant leaves and green stem tissues. It can be injected into stems or applied to stumps of trees to kill them. Glyphosate applications are mainly used to kill perennial weedy plants in agricultural fields. They are broadcast or used in cut-stump treatments to kill undesirable plants in forests. Glyphosate initially was marketed by Monsanto under the trade name Roundup®, but it is no longer under patent protection. It is manufactured and applied in a number of formulations for different plant or crop uses.

Glyphosate inhibits the activity of certain plant enzymes and key amino acids that are necessary for protein synthesis and plant growth. It is effective in killing a wide variety of plants,



A typical coffee field in Hawai'i where glyphosate is used within rows and mowers are used between rows to control grassy weeds Photos: S. Nelson



Strap-like, discolored, and deformed leaves can result from glyphosate injury. The symptoms may resemble zinc or iron deficiency.



Low-hanging branches should be removed before applying glyphosate to coffee fields. Here the affected branches display some mild symptoms of glyphosate injury

including grasses, broadleafed, and woody plants. Other woody dicots (e.g., macadamia) can express disease symptoms similar to coffee plants. Contact with leaves, stems, or exposed young roots can damage the plants.

The Environmental Protection Agency permits the use of at least some glyphosate formulations on coffee. The products are labeled safe for domestic animals and humans when used as directed. Allow at least 28 days between the last application and harvest.

Primary disease symptoms

- abnormal stem proliferation (also known as witches' broom)
- leaf narrowing, production of strap-like leaves
- reduction in leaf size
- leaf chlorosis (yellowing), complete or between veins
- leaf distortion (curling, wrinkling)
- retarded vertical stem re-growth after pruning
- plant stunting.

Symptoms of glyphosate injury can negatively affect plants or persist for many months, up to one year or more on coffee in Hawai'i, depending on the dosage and exposure points on plants.

The principal negative effects of glyphosate injury to coffee plants include stunting and arrested growth of plants, nutritional deficiency symptoms (foliar yellowing), poor coffee bean yields, and predisposition to other diseases such as *Cercospora* leaf spot and berry blotch. Banana moth injury to coffee verticals after pruning, and root rots in wet soils after severe coffee pruning, also cause plant damage and slow re-growth of new vertical branches.

Management practices to avoid glyphosate injury to coffee

- Train herbicide applicators to mix and apply herbicides in accordance with herbicide label instructions (the label is the law).
- Avoid herbicide contact with foliage, green stems, exposed, non-woody roots, or fruits of coffee.



(Above and right) foliar yellowing, leaf narrowing, and witches' brooms on coffee plants affected by exposure to glyphosate



A Kona coffee plant displaying some of the symptoms of glyphosate injury in the apical region of the plant on the main vertical stem and some lateral branches: yellowed, narrowed, deformed leaves

- Control grassy weeds before they produce seeds, in order to minimize their spread.
- Use a spray shield to help contain overspray.
- Encourage non-climbing, low-growing nitrogen-fixing ground covers around coffee plants.
- Apply composts and mulches around coffee plants to inhibit weed growth (but keep mulches and composts away from contact with coffee stems).
- Use weed-feeding animals such as geese or cattle in coffee fields to inhibit weeds.
- Use mobile chicken containers ("chicken tractors") to control weeds in coffee fields.
- Use string-trimmers or mowers to control weeds, or weed the fields by hand where possible.
- Grow coffee plants under shade trees such as monkey-pod, koa, avocado, and mango to inhibit weed growth, or grow coffee in a diverse multi-level agroforestry cropping system with other plants of agricultural or



Narrow, discolored and deformed leaves and slow re-growth of coffee stems on a pruned plant as a result of glyphosate injury.

aesthetic value.

- Discourage grassy weeds where possible.
- Use alternative herbicide products, or organic mixtures, or less injurious chemicals.
- Do not exceed the recommended dosage of glyphosate in spray applications.
- Apply glyphosate before pruning coffee plants, not immediately after pruning them.
- If climbing or tall weeds cover coffee plants, do not spray the plants with glyphosate; remove them by hand.
- Prune low-hanging coffee branches away from the ground before applying glyphosate to coffee rows.
- Grow coffee organically (do not use herbicides).
- Avoid mixing glyphosate in spray equipment used to apply other pest-control chemicals or foliar nutrient sprays to coffee plants.
- Avoid over-irrigation of plants injured by glyphosate to minimize the development of root rot.

References

- Nelson, S.C. 2008. Cercospora leaf spot and berry blotch of coffee. College of Tropical Agriculture and Human Resources, University of Hawai'i at Mānoa (CTAHR). www.ctahr.hawaii.edu/oc/freepubs/pdf/PD-41.pdf.
- Nelson, S.C. 2005. Coffee pest and disease image gallery. CTAHR. www.ctahr.hawaii.edu/nelsons/coffee/coffee.html.
- Nelson, S.C., V.E. Smith, and M.G. Wright. 2005. Banana moth as a pest of coffee. CTAHR. www.ctahr.hawaii.edu/oc/freepubs/pdf/IP-21.pdf.



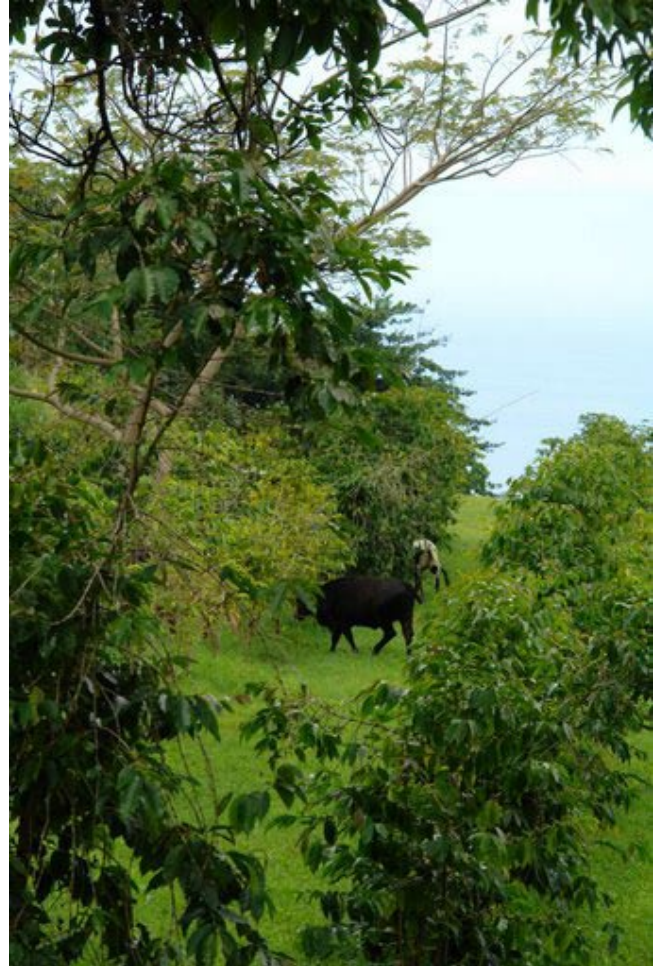
Witches' brooms, narrow leaves and foliar chlorosis on a lateral coffee branch affected by glyphosate injury.



Severe witches' brooms and foliar chlorosis on the re-growth of vertical stems on a recently pruned coffee plant affected by glyphosate injury; coffee growers should avoid overspray of freshly pruned plants.

Acknowledgments

Craig Elevitch (leader of a shade coffee project in Kona as director of Permanent Agriculture Resources, Hōlualoa, Hawai'i) for access to damaged coffee fields and for observations regarding observed damage; Fred Brooks (UH-CTAHR) for review.



Shade-grown coffee may have fewer weed problems and require reduced herbicide use, as can coffee farms with cattle or other herbivores that browse among the coffee plants



A mobile “chicken tractor” containing a flock of chickens can help to control weeds, provide fertilizer, and supply eggs for the coffee farm. The brown rectangular areas of ground between rows in the photo at right are where a chicken tractor was kept for a day or two.