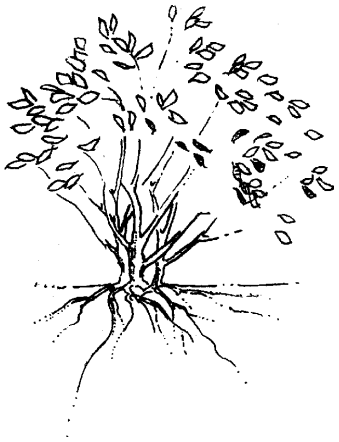

Department of Horticulture

Purdue University Cooperative Extension Service • West Lafayette, IN

BLACK WALNUT TOXICITY

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Black walnut (*Juglans nigra L.*) is a valuable hardwood lumber tree and Indiana native. In the home landscape, black walnut is grown as a shade tree and, occasionally, for its edible nuts. While many plants grow well in proximity to black walnut, there are certain plant species whose growth is hindered by this tree. The type of relationship between plants in which one produces a substance which affects the growth of another is know as "allelopathy."

Awareness of black walnut toxicity dates back at least to Roman times, when Pliny noted a poisoning effect of walnut trees on "all" plants. More recent research has determined the specific chemical involved and its mode of action. Many plants have been classified through observation as either sensitive or tolerant to black walnuts.

The Source of Toxicity

Plants adversely affected by being grown near black walnut trees exhibit symptoms such as foliar yellowing, wilting, and eventually death. The causal agent is a chemical called "juglone" (5 hydroxy-1,4-napthoquinone), which occurs naturally in all parts of the black walnut. Juglone has experimentally been shown to be a respiration inhibitor which deprives sensitive plants of needed energy for metabolic activity.

The largest concentrations of juglone and hydrojuglone (converted to juglone by sensitive plants) occur in the walnut's buds, nut hulls, and roots. However, leaves and stems do contain a smaller quantity. Juglone is only poorly soluble in water and thus does not move very far in the soil.

Since small amounts of juglone are released by live roots, particularly juglone-sensitive plants may show toxicity symptoms anywhere within the area of root growth of a black walnut tree. However, greater quantities of juglone are generally present in the area immediately under the canopy of a black walnut tree, due to greater root density and the accumulation of juglone from decaying leaves and nut hulls. This distribution of juglone means that some sensitive plants may tolerate the amount of juglone present in the soil near a black walnut tree, but may not survive directly under its canopy. Alternatively, highly sensitive plants may not tolerate even the small concentration of juglone beyond the canopy spread. Because decaying roots still release juglone, toxicity can persist for some years after a tree is removed.

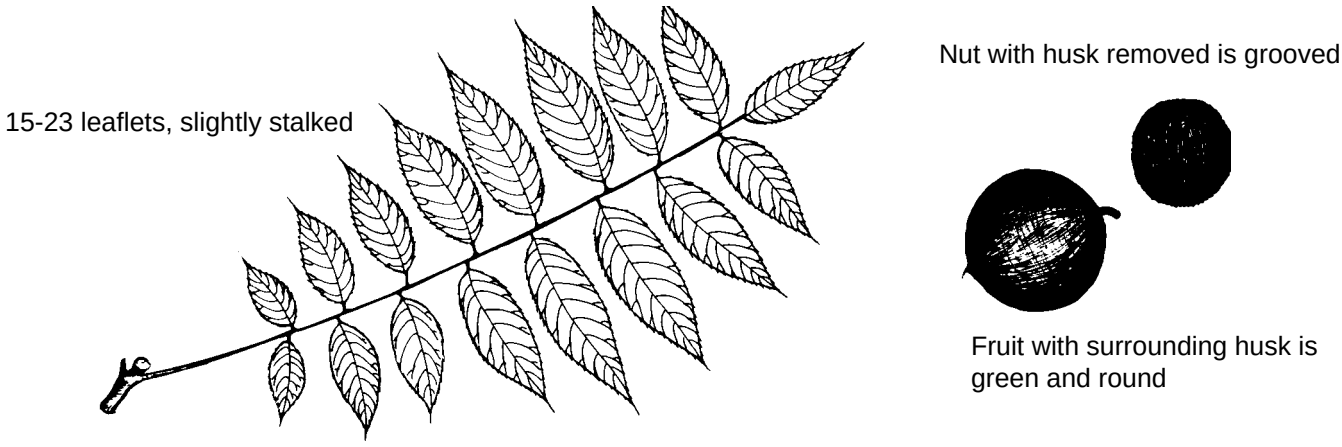

Figure 1. Typical leaf and nut characteristics of black walnut (*Juglans nigra* L.).

Species survival near or under black walnut trees is further complicated by the fact that the amount of juglone present in the soil depends on soil type, drainage, and soil micro-organisms. Competition for light and moisture under the canopy also greatly affects which species survive where.

Other trees closely related to black walnut also produce juglone, including butternut, English walnut, pecan, shagbark hickory, and bitternut hickory. However, all produce such limited quantities compared to the black walnut that toxicity to other plants is rarely observed.

Implications for Horticulture

Gardens should be located away from black walnut trees to prevent damage to susceptible plants. If proximity to such trees is unavoidable, then raised beds afford a means of protection. However, the bed must be constructed in such a way as to minimize tree root penetration into the raised portion. Care must be taken to keep the beds free of black walnut leaf litter or nuts. If a garden is separated from a black walnut tree by a rock wall, driveway, or other physical barrier, then root extension growth into the garden area may be limited and juglone toxicity problems minimized.

From observation of native stands of black walnut, decreased toxicity seems to be associated with excellent soil drainage, even among sensitive species. Thus, any steps to improve drainage, such as additions of organic matter or replacement of existing soil with a lighter type, should tend to minimize toxicity problems in a garden area.

Leaves, bark, or wood chips of black walnut should not be used to mulch sensitive landscape or garden plants. Even after a period of composting, such refuse may release small amounts of juglone.

Juglone Sensitivity in Plants

The following lists were compiled from published sources. They are based largely on observations of native woodlands, gardens, orchards, ornamental plantings, and forest plantations. Few plants have been experimentally tested for tolerance or sensitivity to juglone. Thus, the lists should be used for guidance, but not regarded as definitive.

Plants Observed to Be Sensitive to Juglone

Vegetables: asparagus, cabbage, eggplant, pepper, potato, rhubarb, tomato.

Fruits: apple, blackberry, blueberry, pear.

Landscape plants: black alder; azalea; basswood; white birch; ornamental cherries; red chokeberry; crabapple; hackberry; Amur honeysuckle; hydrangea; Japanese larch; lespedeza; lilac; saucer magnolia; silver maple; mountain laurel; pear; loblolly pine; mugo pine; red pine; scotch pine; white pine; potentilla; privet; rhododendron; Norway spruce; viburnum (few); yew.

Flowers and herbaceous plants: autumn crocus (Colchichum); blue wild indigo (Baptisia); chrysanthemum (some); columbine; hydrangea; lily; narcissus (some); peony (some); petunia; tobacco.

Field crops: alfalfa; crimson clover; tobacco.

Plants Observed to Be Tolerant to Juglone

Vegetables: lima bean; snap bean; beet; carrot; corn; melon; onion; parsnip; squash.

Fruits: black raspberry, cherry.

Landscape plants: arborvitae; autumn olive; red cedar; catalpa; clematis; crabapple; daphne; elm; euonymous; forsythia; hawthorn; hemlock; hickory; honeysuckle; junipers; black locust; Japanese maple; maple (most); oak; pachysandra; pawpaw; persimmon; redbud; rose of sharon; wild rose; sycamore; viburnum (most); Virginia creeper.

Flowers and herbaceous plants: astilbe; bee balm; begonia; bellflower; bergamot; bloodroot; Kentucky bluegrass; Spanish bluebell; Virginia bluebell; bugleweed; chrysanthemum (some); coral bells; cranesbill; crocus; Shasta daisy; daylily; Dutchman's breeches; ferns; wild ginger; glory-of-the-snow; grape-hyacinth; grasses (most); orange hawkweed; herb Robert; hollyhock; hosta (many); hyacinth; Siberian iris; Jack-in-the-pulpit; Jacob's ladder; Jerusalem artichoke; lamb's-ear; leopard's-bane; lungwort; mayapple; merrybells; morning glory; narcissus (some); pansy; peony (some); phlox; poison ivy; pot marigold; polyanthus primrose; snowdrop; Solomon's-seal; spiderwort; spring beauty; Siberian squill; stonecrop; sundrop; sweet Cicely; sweet woodruff; trillium; tulip; violet; Virginia waterleaf; winter aconite; zinnia.

For more information on the subject discussed in this publication, consult your local office of the Purdue University Cooperative Extension Service.

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