

## Landscaping and Gardening around Walnuts and Other Juglone Producing Plants

Walnuts and hickories produce the chemical juglone (5 hydroxy-1,4- naphthoquinone), which is exuded from all parts of the plant. The greatest concentration of juglone and hydroxyjuglone (a nontoxic, colorless precursor that is converted into the toxic form juglone by sensitive plants and through oxidation) is found in the vegetative buds, leaves, stems, nut hulls, and roots of the plants. Black walnut (*Juglans nigra*) and butternut (*Juglans cinerea*) are the landscape plants most recognized by gardeners as being problems for their other plants. However, English or Persian walnut (*J. regia*) and hickories (*Carya*) also produce juglone but to a lesser degree.

The production of juglone is a protective response by the plant to assure its survival. Many plants (e.g., sugar maple, tree of heaven, hackberries, sycamore, cottonwood, black cherry, red oak, black locust, sassafras, fine fescue, and American elm) produce allelochemicals to enhance their survival and reproduction by inhibiting nearby competition. The most common symptoms of juglone sensitivity in landscape and garden plants is the yellowing and wilting of leaves, especially during the hot dry periods during the growing season, ultimately resulting in wilting and death of the plant.

Juglone-induced wilting and wilting due to water stress are often confused. Wilting due to lack of water occurs slowly and can be reversed with watering. Juglone-induced wilting often occurs rapidly even when ample soil moisture is present. Juglone-induced wilting may be partial or may encompass the whole plant. Early wilting symptoms may also be reduced with supplemental water. Later in the season wilting does not respond to additional water, leaves start to brown, and the plant dies. Experimental studies have shown that juglone inhibits plant respiration, depriving sensitive plants of

needed energy and cell division as well as water and nutrient uptake.

Sensitive plants located beneath the canopy of a walnut tree are most susceptible to contact with juglone through direct root contact or accumulation of the toxin from leaves and nut hulls in poorly aerated, wet soils with limited microbial activity and organic matter. Juglone is poorly soluble in water and does not move very far in the soil. Well-drained and aerated soils with a healthy population of microbes can accelerate the metabolic decomposition of juglone. Where sensitive plants may survive outside of the canopy of a black walnut, highly sensitive plants may not tolerate small concentrations where decaying roots from a removed tree may still be releasing juglone. Juglone toxicity may persist for years after a tree is removed. So, impatience in replanting an area with juglone-sensitive plants is not advised.

### Planting around Walnuts

Understanding the site to be landscaped or developed into a garden is the first step in assuring successful plantings. Identifying your trees and shrubs will help avoid problems with allelopathic toxicity among your future landscape and garden plantings. General tips for planting around black walnuts include:

- Locating gardens well away from black walnuts.
- Creating and plant in raised beds to reduce root contact. This will require lining the bed to reduce root contact using weed fabric and filling the raised bed with new topsoil.
- Improving soil drainage with organic matter additions.
- Preventing leaves, hulls, and stems from decomposing near planting areas.

- Avoiding mulch containing walnut bark, wood, hulls, and leaves

## Plant Tolerance to Juglone

The following lists of plants tolerant to juglone were compiled from published sources. They are based on observation under various settings, but few plants have been experimentally tested for sensitivity to juglone. Many factors affect sensitivity, including level of contact, health of the plant, soil environment, and the overall site conditions. The lists provided here are strictly guides and cannot be considered complete or definitive.

### Trees Tolerant to Juglone

Most maples except silver maple (*Acer* spp)  
 Eastern Red Cedar (*Juniperus virginiana*)  
 Ohio Buckeye (*Aesculus glabra*)  
 Goldenrain Tree (*Koeleruteria paniculata*)  
 Serviceberry, Shadblow (*Amelanchier*)  
 Sweetgum (*Liquidambar styraciflua*)  
 Pawpaw (*Asimina triloba*)  
 Yellow Poplar (*Liriodendron tulipifera*)  
 River Birch (*Betula nigra*)  
 Black Gum (*Nyssa sylvatica*)  
 Hickory (*Carya* spp)  
 Virginia Pine (*Pinus virginiana*)  
 Catalpa (*Catalpa bignoniodes*)  
 Sycamore (*Platanus occidentalis*)  
 Eastern Redbud (*Cercis canadensis*)  
 Black Cherry (*Prunus serotina*)  
 Fringetree (*Chionanthus* spp.)  
 Callery Pear (*Pyrus calleryana*)  
 Flowering Dogwood (*Cornus florida*)  
 Oak species (*Quercus* spp)  
 Dogwood (*Cornus alternifolia*)  
 Staghorn Sumac (*Rhus typhina*)  
 Hawthorne (*Crataegus* spp)  
 Black Locust (*Robinia pseudoacacia*)  
 Persimmon (*Diospyros virginiana*)  
 Sassafras (*Sassafras albidum*)  
 American Beech (*Fagus grandifolia*)  
 Arborvitae (*Thuja occidentalis*)  
 White Ash (*Fraxinus americana*)  
 Canada Hemlock (*Tsuga Canadensis*)  
 Honeylocust (*Gleditsia triacanthos*)  
 American Elm (*Ulmus americana*)  
 Carolina Silverbell (*Halesia caroliniana*)  
 Blackhaw Viburnum (*Viburnum prunifolium*)

### Shrubs Tolerant to Juglone

Barberry (*Berberis* spp)  
 Hazelnut (*Corylus americana*)  
 Daphne (*Daphne* spp)  
 Forsythia (*Forsythia* spp)  
 Witchhazel (*Hamamelis* spp)  
 Rose of Sharon (*Hibiscus syriacus*)

Snowball Hydrangea (*Hydrangea arborescens*)  
 St. Johnswort (*Hypericum prolificum*)  
 American Holly (*Ilex opaca*)  
 Juniper (*Juniperus* spp)  
 Spicebush (*Lindera benzoin*)  
 Mockorange (*Philadelphus* spp)  
 Exbury Hybrid Azalea “Gibraltar” & “Balzac”  
 Pinxterbloom Azalea (*Rhododendron periclymenoides*)  
 Sumac (*Rhus copallina*)  
 Smooth Sumac (*Rhus glabra*)  
 Current (*Ribes* spp)  
 Black Raspberry (*Rubus occidentalis*)  
 Elderberry (*Sambucus Canadensis*)  
 Maple-leaved Viburnum (*Viburnum acerifolia*)  
 Koreanspice Viburnum (*Viburnum carlesii*)

### Vegetables Tolerant to Juglone

Onion  
 Beets  
 Squash and Melons  
 Carrot  
 Parsnips  
 Beans  
 Corn

### Fruit Trees Tolerant to Juglone

Cherry, Nectarine, Plum, Peach (*Prunus* spp)  
 Quince (*Cydonia oblongata*)

### Vines Tolerant to Juglone

Clematis (*Clematis* spp)  
 Virginia Creeper (*Parthenocissus quinquefolia*)  
 Wild Grape (*Vitis*)  
 Wisteria (*Wisteria* spp)

### Herbaceous Flowers Tolerant to Juglone

Yarrow (*Achillea* spp)  
 Hosta (*Hosta* spp)  
 Bugleweed (*Ajuga reptans*)  
 Spanish Bluebell (*Hyacinthoides hispanicus*)  
 Hollyhock (*Alcea rosea*)  
 St. John's Wort (*Hypericum* spp)  
 Anemone (*Anemone* spp)  
 Morning Glory (*Ipomoea* spp)  
 Jack-in-the-Pulpit (*Arisaema triphyllum*)  
 Iris (*Iris* spp)  
 European Wild Ginger (*Asarum europaeum*)  
 Shasta Daisy (*Leucanthemum x superbum*)  
 Aster (*Aster* spp)  
 Liriope or Lilyturf (*Liriope* spp)  
 Astilbe (*Astilbe* spp)  
 Lobelia (*Lobelia* spp)  
 Fibrous and Tuberous Begonia (*Begonia*)  
 Virginia Bluebell (*Mertensia pulmonariodes*)  
 Pot Marigold (*Calendula officinalis*)  
 Bee Balm (*Monarda* spp)

Bellflower (*Campanula latifolia*)  
 Grape Hyacinth (*Muscari botryoides*)  
 Glory of the Snow (*Chionodoxa lucilae*)  
 Daffodil (*Narcissus* spp)  
 Chrysanthemum (*Chrysanthemum* spp)  
 Primrose and Sundrops (*Oenothera* spp)  
 Spring Beauty (*Claytonia virginica*)  
 Cinnamon Fern (*Osmunda cinnamomea*)  
 Crocus (*Crocus* spp)  
 Phlox (*Phlox paniculata*)  
 Dutchman's Breeches (*Dicentra cucullaria*)  
 Mayapple (*Podophyllum peltatum*)  
 Bleeding Heart (*Dicentra* spp)  
 Jacob's Ladder (*Polemonium reptans*)  
 Leopard's Bane (*Doronicum* spp)  
 Solomon's Seal (*Polygonatum commutatum*)  
 Crested Wood Fern (*Dryopteris cristata*)  
 Christmas Fern (*Polystichum acrostichoides*)  
 Purple Coneflower (*Echinacea purpurea*)  
 Primrose (*Primula* spp)  
 Epimedium (*Epimedium* spp)  
 Lungwort (*Pulmonaria* spp)  
 Winter Aconite (*Eranthis hyemalis*)  
 Bloodroot (*Sanguinaria canadensis*)  
 Dog's Tooth Violet (*Erythronium* spp)  
 Siberian or Blue Squill (*Scilla siberica*)  
 Snowdrop (*Galanthus nivalis*)  
 Stonecrop (*Sedum acre*, *Sedum spectabile*)  
 Sweet Woodruff (*Galium odoratum*)  
 Lamb's Ear (*Stachys byzantia*)  
 Gentian (*Gentian* spp)  
 Meadowrue (*Thalictrum* spp)  
 Cranesbill Geranium (*Geranium sanguineum*)  
 Spiderwort (*Tradescantia virginiana*)  
 Sunflower and Jerusalem Artichoke (*Helianthus* spp)  
 Trillium (*Trillium* spp)  
 Christmas Rose (*Helleborus* spp)  
 Globeflower (*Trollius* spp)  
 Common Daylily (*Heemerocallis* spp)  
 Tulips (*Tulipa* spp)  
 Coral Bells (*Heuchera* spp)  
 Pansy and Violet (*Viola* spp)  
 Orange Hawkweed (*Hieracium auranticum*)  
 Zinnia (*Zinnia* spp)

Prepared by Dan Roman, Northampton County master  
 gardener; and Jim Sellmer, assistant professor of  
 ornamental horticulture

Penn State College of Agricultural Sciences  
 Department of Horticulture  
 102 Tyson Bldg.  
 University Park, PA 16802  
 March 21, 2003

The Horticulture Fact Sheet series is produced  
 for home gardeners and professionals by the  
 Consumer Horticulture Center at Penn State.  
 The complete series is available on the Web at  
<http://hortweb.cas.psu.edu>.

Visit Penn State's College of Agricultural Sciences on the Web: [www.cas.psu.edu](http://www.cas.psu.edu).

Where trade names appear, no discrimination is intended, and no endorsement by  
 Penn State Cooperative Extension is implied.

Issued in furtherance of Cooperative Extension Work, Acts of Congress May 8 and  
 June 30, 1914, in cooperation with the U.S. Department of Agriculture and the  
 Pennsylvania Legislature. T. R. Alter, Director of Cooperative Extension, The  
 Pennsylvania State University.

**This publication is available in alternative media on request.**

The Pennsylvania State University is committed to the policy that all persons shall  
 have equal access to programs, facilities, admission, and employment without regard  
 to personal characteristics not related to ability, performance, or qualifications as  
 determined by University policy or by state or federal authorities. It is the policy of  
 the University to maintain an academic and work environment free of discrimination,  
 including harassment. The Pennsylvania State University prohibits discrimination and  
 harassment against any person because of age, ancestry, color, disability or handicap,  
 national origin, race, religious creed, sex, sexual orientation, or veteran status.  
 Discrimination or harassment against faculty, staff, or students will not be tolerated at  
 The Pennsylvania State University. Direct all inquiries regarding the nondiscrimination  
 policy to the Affirmative Action Director, The Pennsylvania State University, 328  
 Boucke Building, University Park, PA 16802-5901, Tel 814-865-4700/V, 814-863-  
 1150/TTY.

© The Pennsylvania State University 2003