Production and Effect of Juglone Toxicity

Juglone, which occurs in all parts of the black walnut tree, can affect other plants by several means:

- Through root contact
- Through leakage or decay in the soil
- Through falling and decaying leaves
- When rain leaches and drips juglone from leaves and branches onto plants below.

Juglone is most concentrated in the buds, nut hulls and roots and, to a lesser degree, in leaves and stems. Plants located beneath the canopy of walnut trees are most at risk. In general, the toxic zone around a mature walnut tree is within 50 to 60 feet of the trunk, but can extend to 80 feet. The area affected enlarges outward each year as the tree grows.

Juglone acts as a respiration inhibitor. Affected plants cannot exchange carbon dioxide and oxygen properly, which deprives them of needed energy for metabolic activity. The resulting wilting cannot be reversed. Particularly sensitive to juglone are vegetables such as tomatoes, potatoes, eggplants and peppers, and ornamentals such as lilacs, peonies, rhododendrons and azaleas.
Symptoms

The symptoms in plants sensitive to juglone range from stunting, yellowing, to partial or total wilting, to complete death.

- Tomatoes show symptoms of yellowing and discoloration of the leaves, as well as twisting and puckering. Discoloration and darkening of internal stem tissue can also occur.

- Walnut toxicity will result in complete death in fast growing annual plants such as potatoes or tomatoes.

- Toxic reaction often occurs quickly. Highly sensitive plants can go from healthy to dead within one or two days.

- For woody plants such as shrubs and trees, symptoms on new growth can be similar in appearance to those of annual plants.

- Generally, the symptoms on older growth are more subtle and will appear as an overall decline of the plant, with eventual death possible.

- The effects of juglone toxicity sometimes mimic symptoms of various plant diseases and physiological disorders.

Controls

There is no chemical control available to stop the potentially toxic effect of juglone. *The only practical control is physical separation.* The best advice when gardening near black walnuts is to use caution. Understanding the site to be landscaped or developed into a garden is the first step in assuring the survival of plantings. General tips for planting around black walnuts include:

- **Garden location.** Locate gardens well away from black walnuts.

- **Raised beds.** Create and plant in raised beds to reduce root contact. This will require lining the bed using weed fabric and filling the raised bed with new amended soil.

- **Clean up is important.** Prevent twigs, branches, leaves, nuts, hulls, and stems from decomposing near planting areas.

- **Volunteer removal.** Pull out walnut volunteer seedlings.
• **Mulch precautions.** Do not use fresh black walnut leaves, bark and wood chips as mulch. Walnut bark can be used for mulch if it has been composted for a minimum of six months.

• **Plant selection.** Plant tolerant trees, shrubs, vines, ground covers, flowers and grasses under walnut trees, or in areas that might contain walnut trees. See the list on pages 4 to 5.

• **Adding to your compost pile.** You can compost walnut leaves because the toxin breaks down when exposed to air, water and bacteria. The toxic effect can degrade in two to four weeks. In soil, breakdown may take up to two months.

• **Is removal a solution?** No. Cutting down the tree will not solve the problem for a long time because juglone can persist in the wood until the roots are decomposed, which can take five years or more. Removing a walnut tree may not be practical when the tree is the focal point in a landscape.

• **Soil improvement.** Maintain high organic matter levels in the soil to improve drainage and to encourage healthy soil microbial populations that can metabolize toxins.

### Plants Susceptible to Juglone

The following plants are observed to be susceptible to juglone produced by walnut trees. This list is based only on observation and experience, not scientific experiments. It should be used for guidance only, not regarded as definitive.

**Trees**
- Alder, *Alnus glutinosa*
- Basswood (linden), *Tilia americana*
- Birch, White, *Betula papyrifera*
- Chokeberry, Red, *Aronia arbutifolia*
- Magnolia, Saucer, *Magnolia x soulangiana*
- Maple, Silver, *Acer saccharinum*
- Mountain Laurel, *Kalmia sp.*
- Norway Spruce, *Picea abies*
- Pine (most), *Pinus sp.*
- Russian Olive, *Elaeagnus angustifolia*
- Ornamental cherry cultivars, *Prunus*

**Shrubs**
- Amur honeysuckle, *Lonicera maackii*
- Arborvitae, *Thuja occidentalis*
- Azalea, *Rhododendron sp.*
- Cotoneaster, *Cotoneaster sp.*
- Hydrangea, *Hydrangea sp.*
- Lespedeza, *Lespedeza striata*
- Lilac, *Syringa sp.*
- Nine-Bark, *Physocarpus opulifolius*

**Pipes**
- Aristolochia, *Aristolochia macrophylla*
- Potentilla, *Potentilla fruticosa*
- Privet, *Ligustrum vulgare*
- Firethorn, *Pyracantha sp.*
- Rhododendron, *Rhododendron sp.*
- Viburnum (most), *Viburnum sp.*
- Yew, *Taxus sp.*

**Annuals**
- Petunia, *Petunia sp.*

**Perennials and Bulbs**
- Colorado Columbine, *Aquilegia caerulea*
- Chrysanthemum, *Chrysanthemum morifolium*
- Coral bells, *Heuchera sp.*

**Fruit**
- Blackberry, *Rubus sp.*
- Blueberry, *Vaccinium sp.*
- Domestic grape, *Vitis sp.*
- Pear, *Pyrus communis*
Vegetables

Alfalfa
Asparagus
Cabbage
Cucumber
Double-flowered Cole vegetables
Eggplant
Pepper
Potato

Rhubarb
Tomato

Plants Resistant or Tolerant to Juglone

The following plants are observed to grow well in close proximity to walnut trees. This list is based only on observation and experience, not scientific experiments. It should be used for guidance only, not regarded as definitive.

Trees

American Beech Fagus grandifolia
American Elm Ulmus americana
American Holly Ilex opaca
American Hornbeam Carpinus caroliniana
Black Gum Nyssa sylvatica
Black Locust Robinia pseudacacia
Black Maple Acer nigrum
Black Oak Quercus velutina
Boxelder Acer negundo
Callery Pear Pyrus calleryana
Carolina Silverbell Halesia carolina
Catalpa Catalpa bicolor
Chesnut Castanea dentata
Dogwood, Flowering Cornus florida
Flowering Dogwood Cornus florida
Fringetree Chionanthus sp.
Goldenrain Koelreuteria paniculata
Hackberry (Common) Celtis occidentalis
Hawthorn Crataegus sp.
Hemlock Tsuga canadensis
Hickory Carya sp.
Honeylocust Gleditsia triacanthos
Japanese Maple Acer palmatum, & cvs.
Lenten/Christmas Rose Helleborus sp.
Mulberry Morus sp.
Norway Spruce Picea abies
Ohio Buckeye Aesculus glabra

Pawpaw Asimina triloba
Persimmon Diospyrus virginiana
Poplar Populus sp.
Purple Leaf Sandcherry Prunus cistena
Red Maple Acer rubrum
Red Oak Quercus rubra
Redbud Cercis canadensis
River Birch Betula nigra
Sassafras Sassfras albidum
Sycamore Platanus occidentalis
Tree of Heaven Ailanthus altissima
Tuliptree Liriodendron tulipifera
White Ash Fraxinus americana
White Oak Quercus alba
Willow Salix sp.
Witchhazel Hamamelis sp.

Evergreens

Arborvitae Thuja sp.
Canadian Hemlock Tsuga canadensis
Chinese Juniper Juniperus chinensis
Red Cedar Juniperus virginiana

Herbaceous Perennials, Spring

Wildflowers and Bulbs

Anemone, American Wood Anemone quinquefolia
Aster Aster sp.
Plants Resistant or Tolerant to Juglone (cont.)

Herbaceous Perennials, Spring
Wildflowers and Bulbs cont.
Astilbe Astilbe sp.
Bee Balm Monarda sp.
Bell Flower Campanula sp.
Big Merrybells Uvularia grandiflora
Black-eyed Susan Rudbeckia hirta
Bleeding Heart Dicentra spectabilis
Bloodroot Sanguinaria canadensis
Bugleweed Ajuga reptans
Bush Clover Lespedeza sp.
Buttercup Ranunculus sp.
Christmas Fern Polystichum sp.
Chrysanthemum (some) Chrysanthemum sp.
Cinnamon Fern Osmunda cinnamomea
Common Yarrow Achillea millefolium
Coral Bells Heuchera sp.
Cranesbill Geranium sp.
Daffodil (some) Narcissus sp.
Daylily Hemerocallis sp.
Dog’s Tooth Violet Erythronium americanum
Dutchman’s Breeches Dicentra cucullaria
Epimedium Epimedium sp.
Evening Primrose Oenothera sp.
False Dragonhead Physostegia sp.
Gentian Gentian sp.
Glory-of-the-Snow Crocus Chionooodoa luciliae
Goldenrod Solidago, sp.
Gold Moss Sedum acre
Grape Hyacinth Muscari sp
Grasses most types
Hollyhock Alcea rosea
Hosta (many) Hosta sp.
Hyacinth Hyacinthus
Jack-in-the-Pulpit Arisaema
Jacob’s Ladder Polemonium reptans
Jerusalem Artichoke Helianthus tuberosus
Joe Pye Weed Eupatorium sp.
Lamb’s Ear Stachys byzantina
Leopard’s Bane Doronicum sp.
Liriope Liriope sp.
Lobelia Lobelia sp.

Lungwort Pulmonaria sp.
May Apple Podophyllum peltatum
Meadow Rue Thalictrum sp.
Milkweed, Common Asclepias syriaca
Orange Hawkweed Hieracium aurantiacum
Ostrich Fern Matteuccia struthiopteris
Pachysandra Pachysandra sp.
Peppermint Mentha piperita
Perennial Sunflower Helianthus sp.
Periwinkle Vinca minor
Phlox, Creeping Phlox subulata
Phlox, Summer Phlox paniculata
Primrose Primula sp.
Sedges Carex sp.
Sensitive Fern Onoclea sensibilis
Shasta Daisy Leucanthemum
Siberian Iris Iris sibirica
Siberian Squill Scilla siberica
Sneezewort Helanium
Snowdrop Galanthus nivalis
Solomon’s Seal Polygonatum sp.
Spanish Bluebell Endymion hispanicul
Speedwell Veronica sp.
Spiderwort Tradescantia virginiana
Spring Beauty Claytonia virginica
Stonecrop Sedum sp.
Sweet Cicely Myrrhis odorata
Sweet Woodruff Galium odoratum
Sundrops Oenothera fruticosa
Thornless Honeylocust Gleditsia triacanthos
f. inermis
Trillium Trillium sp.
Tulip (‘White Volcano’, ‘Cum Laude’, Parrot
’Blue Parrot’, Greigii ’Toronto’)
Tulipa darwin sp. (some)
Turtlehead Chelone
Violet Viola sp.
Virginia Waterleaf Hudrophyllum virginianum
Wild Ginger Asarum sp.
Windflower Anemone sp.
Winter aconite Eranthis hyemalis
Wood Fern Dryopteris sp.
Yarrow Achillea sp.
Plants Resistant or Tolerant to Juglone (cont.)

Shrubs
Adam's Needle Yucca sp.
American Barberry Berberis canadensis
Amur Honeysuckle Lonicera maackii
Arrowwood Viburnum Viburnum dentatum
Barberry Berberis sp.
Beautybush Kolkwitzia amabilis
Black Raspberry Rubus occidentalis
Blackhaw Viburnum Viburnum prunifolium
Currant Ribes sp.
Elderberry Sambucus sp.
Euonymus Euonymus sp.
Exbury Rhododendron Rhododendron hybrids
Forsythia Forsythia sp.
Fragrant Sumac Rhus aromatica
Fringe Tree Chionanthus virginicus
Hazelnut Corylus americana
Honeysuckle Lonicera sp.
Kerria Kerria japonica
Koreanspice ‘Viburnum Viburnum carlesii and cvs.
Mapleleaf Viburnum Viburnum acerfolium
Mockorange Philadelphus sp.
New Jersey Tea Ceanothus americanus
Ninebark Physocarpus opulifolius
Peony (some) Paeonia
Purple Raspberry Rubus odoratus
Quince Pseudocydonia oblonga
Rose of Sharon Hibiscus syriacus
Shrubby St. John's Wort Hypericum prolificum
Smooth Sumac Rhus glabra
Viburnum (most) Viburnum
Wild Rose Rosa sp.

Annuals
Fibrous begonia Begonia
Tuberous Begonia 'Nonstop' variety
Horned Violet Viola cornuta
Impatiens Impatiens sp.
Johnny Jump-up Viola tricolor
Morning Glory 'Heavenly Blue' Ipomoea
Pansy Viola wittrockiana
Pot Marigold Calendula officinalis
Zinnia Zinnia sp.

Fruits
Peach, Nectarine, Cherry Plum Prunus sp.
Pear Pyrus sp.
Black Raspberry Rubus occidentalis
Quince Cydonia oblongata

Vegetables
Beans
Beets
Carrots
Corn
Melons
Onions
Parsnips
Squash

Honeysuckle Vine Lonicera sp.
Morning Glory Convolvulus sp.
Red Cardinal Ipomoea multifida
Sweet Autumn Clematis terniflora
Virginia Creeper Parthenocissus sp.
Virgin's Bower Clematis virginiana
Sources


Extension Master Gardener Hotline

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For your lawn, garden and horticultural questions