Walnut and It's Toxicity Explored

By, Tom Rood

It seems everywhere we go, whether at Rochester's annual flower and garden GardenScape show, presenting one of our slide programs for daylilies, or just visiting with garden friends, the question always seems to come up "What can we do with our black walnut trees. Nothing seems to grow under them." Actually, one can do quite a bit. But it will take a little planning and perhaps a little experimenting as well. Depending upon a frame of mind, black walnuts can be either a blessing or a curse. I happen to love black walnuts and hesitate to remove them. We suggest to all to give them a even chance to show what beauty can be developed with just a little fore thought on what to plant under and near them.

As with any tree, one must consider two important things. The first is how much shade the tree will provide. Many plants require full sun for several hours each day to grow well. There are some, like hosta for one example that require some shade. Look for plants that will thrive in the amount of light available at the location to be planted. Second, most trees have extensive root systems and any planting over them will be in competition for available soil nutrients and what little rain fall escapes the tree's canopy. The tree usually wins. However, persistence in supplemental watering and fertilizing can overcome some of the deficiencies of location.
As for black walnut, and several similar nut bearing trees, they throw us a third curve ball. They can be toxic to many plants. The trees produce a chemical commonly called juglone. To grow plants under or even near black walnuts we must understand how juglone works.

Our research produced several articles concerning walnut toxicity from juglone:
UNDER THE BLACK WALNUT TREE by Frank Robinson Horticulture magazine October 1986. Mr. Robertson at that time was estate manager at Albemarle Farms, Charlottesville, VA. He is now executive director of the American Horticultural Society, Mt. Vernon, VA. Most sources quote his work, ofttimes without giving him credit.
Michigan State University's web site for black walnuts (no longer available)
The Green Thumb Garden Handbook by George (Doc) and Katy Abraham, 1971, Prentice-Hall Inc., Englewood Cliffs. NJ., page 85.
Ohio State University Extension's web site for Black Walnut Toxicity
The Dawes Arboretum, Newark, OH web site. List of trees and shrubs not affected by Black Walnut Juglone Toxicity
What appears below is an attempt at combining this research into a single meaningful one with reference to the source. The sources quoted do not always agree on the toxic effects of walnuts.
"Many years ago a quinone called juglone was isolated from the husks of walnut. Juglone was found to be highly toxic when injected into alfalfa and tomato plants and has even killed apple trees growing near walnuts. Experiments have found that a toxic effect of walnut bark causes a growth failure of tomatoes and alfalfa within the root zone of walnuts. There are, however, some conditions under which these plants may grow near walnut trees without apparent damage. A scientific term used to describe one plant's suppression of another through the secretion of a chemical in the environment is Allelopathy."[Mich]

"Juglone is a toxic substance, a napthaquinone that has been isolated in many plants in the walnut family. Some of these containing juglone are: Persian (English) Walnut- J. regia, Black Walnut- J. nigra, and Butternuts- J. cinerea,-J. sieboldiana, -J. mandshurica. There are some hickories which also yield juglone: Shag Bark- Carya ovata, Mockernut- C. alba, Pecans- C. olivae formis, and - Pterocarya caucasica." [Mich] Abraham adds C. Illinoensis.

"Wilting caused by contact with walnut roots occurs in a relatively short time, even when there is ample soil moisture. Wilting may occur on only a part of the plant, or the whole plant may be affected. It is wise to detect this early, as plants in the early stages may recover when additional water is applied. Later wilting becomes more severe, there is a browning of the leaves and wilting usually results in the death of the plant. The observed toxic effect of Walnut can also be partly offset by liberal supplies of nitrogen." [Mich]

"This toxic affect on surrounding plants appears to be related to root contact, as walnut hulls and leaves used as mulch have not shown toxic effects on plant growth. [Warning- Robertson disagrees.] Because Walnut roots do not occupy the surface layers in most soil, many shallow rooted plants growing under walnut trees don't come in contact with the roots and are not affected by them." [Mich]

You've probably always heard that you should never add black walnut sawdust [or wood chips] to the compost pile because the juglone will kill everything that grows in the compost. Abrahams says that's not necessarily true; that juglone is not found in walnut saw dust or wood chips. Nor do dead walnut trees exude juglone. Juglone is harmless to humans so you can go right ahead and safely eat fruit and vegetables grown near walnuts. [Abraham]

Robertson doesn't agree on the use of walnut residue in composting. He has this to say about black walnut saw dust, husks and leaves effecting plants. "Tomatoes growing in clean soil in pots were severely stunted when leaves and nuts fell into the pots while we were on vacation. I know what juglone can do. I have seen a 15-year-old rhododendron killed a few weeks after its owner mulched it with black-walnut husks, and roses injured by an application of compost containing black-walnut sawdust." [Robinson]

"The juglone toxin occurs in the leaves, bark, and wood of the walnut but these contain lower concentrations than the roots. Juglone is poorly soluble in water and does not move very far in the soil. Walnut leaves can be composted because the toxin breaks down when exposed to air, water and bacteria. The toxic effect can be degraded in two to four weeks. In soil, breakdown may take up to two months. Black walnut leaves may be composted separately, and the finished compost tested for toxicity by planting tomato seedlings in it. Sawdust mulch, fresh sawdust or chips from street trees prunings are not suggested for plants sensitive to juglone, such as blueberry. However, composting of bark for a minimum of six months provides a safe mulch even for plants sensitive to juglone" [Ohio]

To be on the safe side, composted material containing juglone should be allowed to breakdown over a period of time before use. This composted material can be used with plants that are not susceptible to juglone damage. If it is important to use it for general composting purposes, testing it first with a few tomato plants for a few weeks should reveal its level of toxicity.

"Juglone is a strong toxin that may prevent plants from fully utilizing energy so that the plants cannot meet the minimum energy level required for life. Juglone is released from walnuts in several ways: leaves falling and decaying; nut husks; root leakage and decay, and rain-drip from the crown. [Abraham]

"Tomatoes and alfalfa have been grown normally close to young trees. This suggests that either the toxic substance may not be formed yet in the young trees or that the roots of the young trees are few and do not come into contact with those of the plants beneath it."[Mich] This is an important observation. It may mean that susceptible shallow rooting plants might survive the killing effects of juglone as long as the plant roots do not contact or grow close to walnut roots. However planting susceptible plants under walnuts in raised beds for example makes them vulnerable

to rain-drip off the tree leaves and from falling leaves and nuts. "Tomatoes are particularly susceptible to the chemical juglone. Any tomatoes planted within the root zone of a black walnut (or closely related trees such as butternut- Juglans cinerea) will display what is known as walnut wilt. The woody stem tissue turns brown, and the plants soon wilt and die." [Robinson]
"Many plants such as tomato, potato, blackberry, blueberry, azalea, mountain laurel, rhododendron, red pine, and apple may be injured or killed within one to two months of growth within the root zone of these trees. The toxic zone from a mature tree occurs on average in a 50 to 60 foot radius from the trunk, but can be up to 80 feet. The area affected extends outward each year as the tree enlarges. Young trees two to eight feet high can have a root diameter twice the height of the tree, with susceptible plants dead within the root zone and dying at the margins." [Ohio]
"Plant roots can encounter juglone when grown within one-half to one-fourth inch of walnut roots. Many walnut roots can be found at a distance of up to two times the crown [drip] radius from the trunk, but some may extend out as far as three to four times the crown [drip] radius."[Abraham] Three to four times is not an exaggeration and should be taken into account before planting susceptible plants.
"Evidence also indicates that the toxic effect does not remain in the soil more than about one year after removal of a walnut tree." [Mich] This means that we should wait at least one full year after removing a walnut or related tree before planting susceptible plants near the tree's location.
What follows is a list of plants that have been observed surviving under black walnuts. Not all tulips nor all rhododendrons survived. Only those listed below were known to survive. Others like Tulipa cottage,'Merry Widow' and lily flowered 'West Point' and Rhododendron 'PJM' and 'Purple Gem' did not. [Robinson] The list below is predominately Robinson's with sources added for additions.

Herbaceous Perennials:
Ajuga reptans; bugleweed
Alcea rosea; hollyhock
Anemone quinquefolia; American Wood Anemone (Ohio)
Arisaema triphyllum; Jack-in-the-Pulpit (Ohio)
Asarum europaeum; European wild ginger
Astilbe
Campanula latifolia; bellflower
Celastrus; Bittersweet (Abraham)
Chrysanthemum; hardy chrysanthemum
Dicentra; Bleeding heart (Abraham)
Digitalis; Foxglove (Abraham)
Doronicum; leopard's bane
Dryopteris cristata; crested wood fern
Galium odoratum; sweet woodruff
Geranium robertianum; herb Robert
Geranium sanguineum; cranesbill
Gramineae family; Grasses (most- Ohio) (many- Abraham)
Helianthus tuberosus; Jerusalem artichoke
Hemerocallis- daylilies- (Abraham)
Heuchera xbrizoides; 'Pluie de Feu', coral bells
Hieracium aurantiacum; orange hawkweed
Hosta- general (Abraham)
Hosta forunei; 'Glauca', plantrain lily
Hosta lancifolia
Hosta marginata
Hosta undulata 'Variegata'
Hydrophyllum virginianum; Virginia waterleaf
Iris siberica; Siberian iris
Monarda didyma; bee balm

M. fistulosa; wild bergamot
Myrrhis odorata; Sweet Cicely 'Yellow Cheerfulness,' 'Geranium,' 'Tete a Tete,' 'Sundail,' and 'February Gold' (Ohio)
Oenothera fruticosa; sundrops
Onoclea sensibilis; sensitive fern
Osmunda cinnommea; cinnamon fern
Peaonia species; Peony some (Ohio)
Phlox paniculata; summer phlox
Podophyllum peltatum; Mayapple
Polemonium reptans; Jacob's ladder
Polygonatum commutatum; great Solomon's sea
Primula xpolyantha; polyanthus primrose
Pulmonaria; lungwort
Ranunculus; Buttercup (Abraham)
Sanguinaria canadensis; bloodroot
S. canadensis; 'Multiplex', double-flowered bloodroot
Sedum acre; gold moss
S. spectabile
Stachys byzantina; lamb's ear
Tiger Lily (Abraham)
Tradescantia virginiana; spiderwort
Trillium cernuum; nodding trillium
T. grandiflorum; wide wake-robin
Uvularia grandiflora; big merrybells
Viola canadensis; Canada violet
Viola sororia; woolly blue violet

Bulbs:
Chioniodoxa lucilae; glory-of-the-snow
Crocus
Endymion hispanicul; Spanish bluebell
Eranthis hyemalis; winter aconite
Galanthus nivalis; snowdrop
Hyacinthus; 'City of Harlem'
Muscari botryoides; grape hyacinth
Narcissus; 'Cheerfulness', 'Yellow Cheerfulness', 'Tete a Tete', 'Sundial', and 'February Gold'
Scilla siberica; blue squill
Tulipa Darwin; 'White Volcano', 'Cum Laude', Parrot 'Blue Parrot', and Greigii 'Toronto'

Trees:
Acer negundo; Boxelder (Ashleaf Maple) (Dawes)
Acer nigrum; Black maple (Dawes)
Acer palmatum; Japanese maple
Acer palmatum; 'Dissectum', cutleaf Japanese maple
Acer saccharum; Sugar maple (Dawes)
Asimina trioba; Pawpaw (Dawes)
Betula nigra; 'Heritage", Heritage River Birch (Dawes)
Catalpa bignoiides; common catalpa
Celtis occidentalis; common hackberry (Dawes)
Cercis canadenis; Eastern redbud (Ohio)
Cornus florida; Flowering dogwood (Dawes)
Gleditsia triacanthos f. Inermis; Thorny honey locust (Dawes)
Halesia carolina; Carolina silverbell (Dawes)
Ilex opaca; American holly (Dawes)
Juniperus chinensis; 'Pfitzeriana', Pfitzer Chinese juniper (Dawes)

Juniperus virginiana; Eastern red cedar
Koelreuteria paniculata; Goldenrain tree (Dawes)
Lindera benzoin; Spicebush (Dawes)
Liquidambar styraciflua; Sweetgum (Dawes)
Morus alba; White mulberry (Dawes)
Tsulga canadensis; Canadian hemlock
Peach, Nectarine, Cherry, Plum (Ohio)
Picea abies; Norway Spruce (Abraham)
Pinus jeffreyi; Jeffery pine (Dawes)
Platanus occidentalis; Sucamore (Dawes)
Populus species; Poplar (Dawes)
Prunus serotina; Black Cherry (Abraham)
Prunus species- Cherry (Ohio)
Pyrus calleryana; Callery Pear (Dawes)
Pyrus species- Pear (Ohio)
Quercus alba; White oak (Dawes)
Quercus imbricaria; Shingle Oak (Dawes)
Quercus rubra; Northern red oak (Dawes)
Robina pseudoacacia; Black locust (Abraham)
Sambucus canadensis; American elderberry
Tilia platyphyllos; Bigleaf linden (Dawes)
Viburnum lantana; Wayfaring tree viburnum

Vines and Shrubs:
Clematis; 'Red Cardinal'
Daphne mezereum; February daphne
Euonymus species (Ohio)
Forsythia suspensa; Weeping forsythia
Hawthorn (Abraham)
Hibiscus syriacus; rose of Sharon
Hydrangea, blue (Abrahamr)
Juniper, common (Abraham)
Kerria japonica; Kerria, 'Pleniflora', double-flower kerria (Dawes)
Kolkwitza; Beautybush (Abraham)
Lonicera maackia; Amur honeysuckle (Dawes)
Lonicera tatarica; Tartarian honeysuckle
Lonicera xylosteum; European fly honeysuckle (Dawes)
Morus; White Mulberry (Abraham)
Multiflora rose (Abraham)
Parthenocissus quinquefolia; Virginia creeper
Philadelphus; Mock orange (Abraham)
Rhododendron Exbury hybrids 'Gibraltar' and 'Balzac'
Rhododendron periclymenoides; Pinxterbloom (Ohio)
Rubus occidentalis; Black Raspberry (Ohio)
Syringa; Lilac (Abraham)
Thuja soecies; Arborvitaes (Ohio)

Annuals:
Begonia; fiberous cultivars and tuberous cultivar 'Nonstop'
Calendula officinalis; pot marigold
Ipomoea; 'Heavenly Blue', morning glory
Viola cornuta; horned violet
Viola; Pansy (Ohio)
V. xwittrockiana; pansy
Zinnia species (Ohio)

Vegetables:
Squashes, Melons, Beans, Carrots, Corn (Ohio)

Last updated: 6/7/01

top