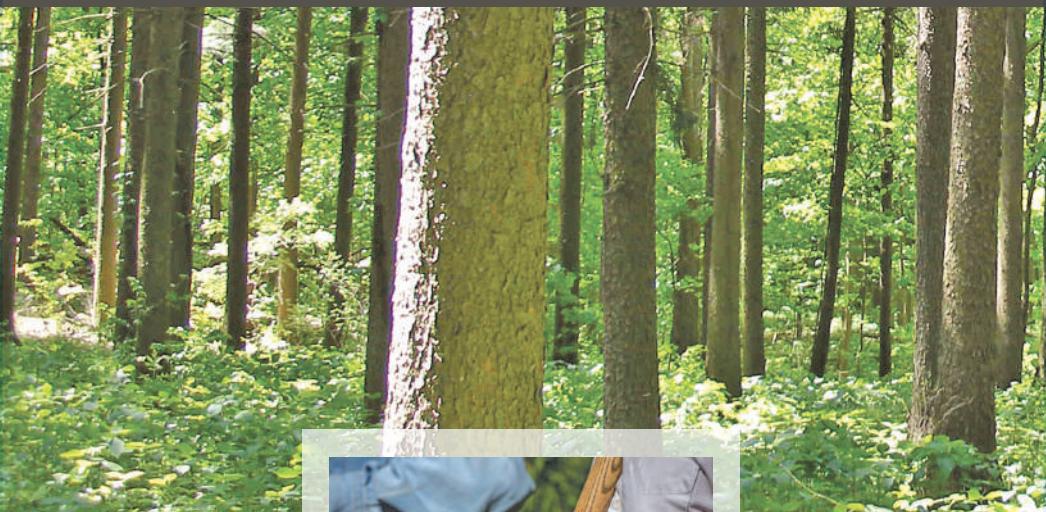


MANAGEMENT OF INVASIVE PLANTS AND PESTS OF ILLINOIS



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ACKNOWLEDGEMENTS

The Authors wish to thank the Illinois Forestry Development Council, the Illinois Department of Natural Resources, and The University of Illinois Forestry Extension which supported in part the update, and publication of this document.

Management of Invasive Plants and Pests of Illinois is an update and expansion of the original Management of Invasive Plants of Southern Illinois.

The authors wish to acknowledge the Illinois Wildlife Preservation Fund, which supported the creation of the original document.

The authors wish to thank The Morton Arboretum and Kurt Dreisilker and Clair Ryan for their edits and review of this document.

The authors wish to thank the USDA Animal Plant and Health Inspection Service which supported, in part, the update and publication of this document.

The authors wish to thank the River to River Cooperative Weed Management Area and Kevin Rohling for assisting in the development of this publication.

The Department of Natural Resources and Environmental Sciences and Extension Forestry at the University of Illinois would like to thank and acknowledge the Renewable Resources Extension Act (RREA) and the USDA National Institute of Food and Agriculture for Extension Forestry program funding.



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INTRODUCTION



Garlic mustard, *Alliaria petiolata*

What are non-native invasive species? Non-native invasive plants and non-native insects are ecologically or economically damaging exotic plants or pests, introduced to areas where they were not found historically. These plants and pests grow with little to no environmental controls to keep their population numbers low, often in part because they are free from the predators and diseases present in their native geography. They continue to increase in abundance until they cause damage by changing the habitat for wildlife and native plants or by negatively impacting forest or agricultural resources.

How can you prevent their spread? The best way to prevent the spread of invasive plants and pests is to avoid introducing them. Do not plant or introduce invasive plants or pests, and eliminate high risk pathways by not moving firewood. Learn which landscape plants are becoming invasive and avoid using them. Consider removing any existing invasive plants from your landscaping. Also, take care to prevent spreading invasive plants and pests after spending time outdoors; invasive species can hitch a ride by attaching themselves to fabric or clothing, the mud and treads on your shoes or equipment, or your pet's fur.

What can you do? Control invasive species early, when you first notice new populations, and report unusual species of concern. Be prepared to invest multiple years; control is never a one-time effort. This guide will help by making management recommendations, but always read and follow herbicide and pesticide labels.

The label is the law.

There are many ways to control invasive plants and non-native insect pests. Not all options are mentioned in this guide, and this is not an endorsement of any methods or products mentioned.

PLANT CONTROL METHODS

The negative impact of invasive plants can be reduced by focused and aggressive use of a combination of mechanical, cultural, and chemical control methods, which will support the restoration of a healthy and diverse natural habitat.

Herbicides are a valuable tool, but please use a cautious and conservative approach, applying the minimum amount of the most appropriate chemical to achieve management goals.



Take care with heavy equipment to minimize soil ruts, disturbance, and compaction, all of which can give additional opportunity for further invasion. Chainsaws, brush saws, hedge trimmers, and weed whips create less disturbance than heavy machinery. It is also critical to clean seeds and debris from equipment on-site at the end of each day to avoid spreading invasives. Weed wrenches or grubbing tools are useful on shallow-rooted species on days when the soil is moist, but take care to remove the whole root system or plants may resprout. Annual or biennial plants can be hand-pulled before the seeds are mature and actively dropping. If seeds are present at time of pulling, plants should be removed from site, or, at a minimum, piled to concentrate seeds in a single area, making follow-up treatment easier. ■

Mechanical: There are many options for mechanical treatments of invasive plants. Large machinery may be the most cost effective way to control some dense infestations of invasive trees and shrubs. Grinding or chipping, mowing or bush hogging can remove large plants, preparing stumps and later new growth for herbicide.



RESTORATION: In some cases, replanting with native plants may be necessary for restoration following treatment. When planting native species, try to use local-ecotypes of seed or plants from within 100 miles of your location.



stimulated by fire (e.g. Japanese stiltgrass, garlic mustard, tree of heaven, roundleaf bittersweet, princess tree, sericea lespedeza) unless integrated management or the appropriate timing of fire is used. Fire in combination with other methods may be the fastest way to remove some invasive populations. See 525 ILCS 37/The Illinois Prescribed Burning Act for landowner rights and restrictions on the use of prescribed fire. ■

Cultural: Prescribed fire is an important current and historical management tool for the region, promoting native plant communities and wildlife habitat. Fire can also stunt and sometimes kill invasive plants. However, integrated control with mechanical and chemical practices is necessary. Some invasive plants and populations may be



Chemical: Always read and follow herbicide label instructions. When chemically treating plants over, in, or near water only use herbicides that are labelled for use in aquatic systems. If contact with “waters of the state” (water that is not contained on the property, such as ponds that overflow during heavy rain) will occur, land managers must apply for a National Pollutant Discharge Elimination System (NPDES) permit through the Illinois EPA (<https://epa.illinois.gov/topics/forms/water-permits/pesticide.html>). Prior to any application of herbicides to water, call your local IDNR fish biologist (ifishillinois.org/FAQS/biologists.html). For information or training on the safe use of pesticides, or to obtain an Illinois Pesticide Applicator’s or Operator’s license, consult the University of Illinois Extension’s Pesticide Education Safety Program (<https://extension.illinois.edu/psep>).

Extension’s Pesticide Education Safety Program (<https://extension.illinois.edu/psep>). Take care to read the product label for instructions on how to prevent impacting pollinators during invasive species treatments.

There are three methods of chemical application discussed here — **foliar**, **cut stump**, and **basal bark**. The recommended herbicides are in liquid form and are mixed in liquid (water or oil) to give the desired percent solution; therefore, recommendations for mixing are given in a volume-to-volume (v/v) percentage. For example, 2% v/v glyphosate in water would be 2% glyphosate herbicide in 98% water to equal 100% volume of solution. See the quick mix chart at the back of this guide for more information. The recommended rates are based on the typical solutions available for purchase for each herbicide (for example, glyphosate often is sold as a 41% solution). Always read and follow label instructions. For broadcast applications over large areas, use herbicides recommended for foliar applications, but read the label for correct rate.

Foliar: Applications use a low concentration of herbicide (small amount of active ingredient mixed per volume of herbicide solution) but large amounts of herbicide solution may be required to cover all

the leaves of the plants. There is a risk of damaging non-target plants with foliar applications through over-spray. Shields may be used to focus the spray on the invasive plants. Plants must have a healthy leaf canopy; the success of foliar treatments is directly dependent upon this fact. Plants must not be under drought stress, and must be photosynthesizing (temperatures around or above 60°F) to take up herbicide. Herbicide must be applied with a pressure that minimizes drift of spray droplets, to the point of complete coverage but not until the herbicide drips off the leaf.

The addition of a nonionic surfactant may enhance control by spreading the herbicide onto the leaf surface and helping the active ingredients penetrate the waxy cuticle layer on plant leaves. Read the label to see if the herbicide already includes a surfactant.

Cut Stump: Typically, cut stump treatments of woody invasive plants utilize either glyphosate-based or triclopyr-based (such as Garlon 3a; Garlon 4; and Crossbow, mixed with 2,4-D) herbicides. Since these herbicides come in many different formulations and strengths, it is crucial that the label be consulted for the specific herbicide used to determine the correct mixing rates and instructions before use. Ready-to-use premixed formulations, such

as Pathfinder II (triclopyr ester in basal oil), are effective for both cut stump and basal bark and do not require mixing.

Plants are cut down near the ground (within 6 inches, but not so close that dirt gets on the cut surface) and the cut surface is treated with herbicide. Typical rates would be a 50% solution of glyphosate mixed with water or a 20% solution of triclopyr mixed with water (for amine formulations like Garlon 3a) or oil (for ester formulations like Garlon 4). Oil used can be commercially available basal oil (like Bark Oil Blue or AX-IT). If you plan to mix with seed or crop oil, check with the herbicide manufacturer to ensure compatibility. It is important to treat the stumps soon after cutting (ideally within 10 minutes) for best results. For small stems (less than 2-inch diameter) treat the entire cut surface just to the point that the herbicide is starting to run down the sides. For larger stems, only the outer one inch of the cut surface needs to be treated. A simple hand-pump spray bottle works for cut stump treatments but the herbicide can also be applied with a sponge or paint brush. Consider adding an dye to your herbicide solution to aid in tracking applications and preventing misses or duplicate applications.

If you are using a solution mixed with water, only use this method if

temperatures are above freezing; cold temperature can freeze the mixture and prevent it from working. Oil based solutions can be utilized anytime throughout the fall and winter, provided there is not ice or silt on the stem. However, once the plants start breaking buds in late winter/early spring, treatments may lose effectiveness; consult the herbicide label for product specifications. If using oil-based herbicides, such as triclopyr ester, the herbicide may volatize at temperatures over 85°F, and cause damage to non-target plants.

Basal Bark: It is recommended that an ester-based triclopyr herbicide (Garlon 4 or a generic formulation) in oil is used for basal bark treatments. Typical rates would be a 20% solution, though be sure to check label information for the herbicide to be used for specific recommendations. Water-based herbicide mixtures are not effective using this method. Basal bark is similar to cut stump, but removes the necessity of cutting down the plant first. Instead, the herbicide is applied directly to all sides of the bark of the plant from ground level to 15 inches high. For multi-stemmed shrubs, all of the stems need to be treated. This method does use somewhat more herbicide than cut stump but is quicker to apply. Because of the higher volume

of herbicide needed, a backpack sprayer is the ideal equipment for this method. As with cut stump, mixing in herbicide dye is a good idea to track treatments. Basal bark treatments have been shown to be effective year-round, but do not apply if there is ice or silt covering the stems. Treated plants may leaf out in the spring before dying. ■



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Biological: Biological control is a method of management to reduce, not eliminate, invasive populations. It involves the intentional release of a natural control agent, such as a predator, pathogen, or parasitoid. For invasive plants, insects are often used to reduce the competitive ability of the plant to reproduce; seed predators feed on the seeds of the plants thereby reducing plant productivity. ■



INVASIVE PLANTS

Autumn olive, *Elaeagnus umbellata*

The following section gives control recommendations for the common invasive plants in Illinois. Always verify correct identification of target species before applying control treatments. The Resources section of this guide provides links to publications and websites to aid in identification.

WOODY PLANTS:



Amur honeysuckle

AMUR HONEYSUCKLE (*Lonicera maackii*)

► **Mechanical:** Amur honeysuckle root systems are shallow. Young plants can be pulled from the ground when the soil is moist. The use of a grubbing tool can aid in pulling larger plants.

► **Cultural:** Prescribed fire may kill seedlings but generally not large plants. If impacted, plants may be stunted or may not produce seeds in the year after a fire.

► **Chemical/Foliar:** Apply 2 to 4% volume-to-volume (v/v) glyphosate in water. **Basal bark:** Plants 4 inches in diameter or less—apply a triclopyr ester formulation at a 20 to 30% v/v rate, mixed with basal oil, to the lowest 15 inches of all stems. **Cut stump:** Apply glyphosate at a 25 to 50% v/v rate in water (*preferred) or triclopyr amine in water or ester in oil at a 20 to 25% v/v rate within 10 minutes of cutting. Always read and follow the herbicide label before initiating treatment. If seeds are present on the plant, take care not to spread them during control. The control recommendations for Amur honeysuckle are also effective for the other exotic, invasive bush honeysuckle species occurring in Illinois.

AUTUMN OLIVE (*Elaeagnus umbellata*)

► **Mechanical:** Autumn olive root systems are deep. Heavy machinery may be required to remove large plants.

► **Cultural:** Prescribed fire has little impact and is not recommended for autumn olive control.

► **Chemical/Foliar:** Plants less than 6 feet tall—apply 2 to 4% v/v glyphosate in water or 1 to 2% v/v triclopyr in water. **Basal bark:** Plants 6 inches in diameter or less—apply a triclopyr ester formulation at a 20 to 30% v/v rate, mixed with basal oil, to the lowest 15 inches of all stems. **Cut stump:** Apply glyphosate at a 25 to 50% v/v rate in water or triclopyr amine in water or ester in oil at a 20 to 25% v/v rate within 10 minutes of cutting. Always read and follow the herbicide label before initiating treatment. If seeds are present on the plant, take care not to spread them during control.



Autumn olive



Common buckthorn

BUCKTHORN: COMMON AND GLOSSY

(*Rhamnus cathartica* and *Frangula alnus*)

► **Mechanical:** Buckthorn seedlings and small saplings can be pulled from areas with moist soil. Larger plants can be dug or pulled using a grubbing tool. Care should be taken to remove root crown to prevent sprouting.

► **Cultural:** Prescribed fire may kill seedlings and top-kill larger plants, but also may stimulate germination of the seed bank. In general fire alone is not an effective tool at controlling buckthorn.

► **Chemical/Foliar:** Apply 1 to 2% v/v triclopyr amine in water. Be sure to use aquatic-safe formulations when making applications over or near water. **Basal bark:** Plants 6 inches



Glossy buckthorn

in diameter or less—apply a triclopyr ester formulation at a 20 to 30% v/v rate, mixed with basal oil, to the lowest 15 inches of all stems.

Cut Stump: Apply triclopyr amine in water (preferred) or ester in oil at a 20 to 25% v/v rate or glyphosate at a 25 to 50% v/v rate in water within 10 minutes of cutting. Always read and follow the herbicide label before initiating treatment. If seeds are present on the plant, take care not to spread them during control.

CALLERY (BRADFORD) PEAR (*Pyrus calleryana*)

► **Chemical/Foliar:** Apply 2 to 4% v/v glyphosate in water or 1 to 2% v/v triclopyr in water. **Basal bark:** Plants 4 inches in diameter or less—apply a triclopyr ester formulation at a 20% v/v rate, mixed with basal oil, to the lowest 15 inches of all stems. **Cut stump:** Apply glyphosate at a 25 to 50% v/v rate in water or triclopyr amine in water or ester in oil at a 20 to 25% v/v rate within 10 minutes of cutting. Always read and follow the herbicide label before initiating treatment.



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Callery (bradford) pear

COMMON PRIVET (*Ligustrum vulgare*)

► **Mechanical:** Small infestations can be mowed or cut to control spread, though this will not eradicate a population. Young seedlings and small saplings can be hand-pulled. Larger plants can be dug or pulled using a grubbing tool. Care should be taken to remove root crown to prevent sprouting.

► **Chemical/Foliar:** Apply 2% v/v glyphosate in water or 1 to 2% v/v triclopyr amine in water. Be sure to use aquatic-safe formulations when making applications over or near water.

Basal bark: Plants 6 inches in diameter or less—apply a triclopyr ester formulation at a 20 to 25% v/v rate, mixed with basal oil, to the lowest



Common privet

15 inches of all stems. **Cut Stump:** Apply triclopyr amine in water or ester in oil at a 20 to 25% v/v rate or glyphosate at a 25 to 50% v/v rate in water within 10 minutes of cutting. Always read and follow the herbicide label before initiating treatment. If seeds are present on the plant, take care not to spread them during control.

JAPANESE BARBERRY (*Berberis thunbergii*)

► **Mechanical:** Small- to medium-sized plants can be hand-pulled fairly easily (be careful of the thorns!) Larger plants can be dug or removed with the aid of a grubbing tool. Repeated cuttings can weaken plants and reduce seed production but will not eradicate plants.

► **Cultural:** Prescribed fire is effective at killing seedlings and top-killing established plants. Repeated burns may reduce population size. Burning the base of barberry plants with a propane torch has been shown to be an effective method of control. Hold flame on the plant base for 15 to 20 seconds.

► **Chemical/Foliar:** Apply 1 to 2% v/v glyphosate in water or 1 to 2% v/v triclopyr amine in water as foliar spray. The most effective time of application is just before flowering. Alternatively, plants can be cut or mowed and allowed to sprout and regrow to 18 inches tall before applying foliar treatment. **Basal bark:** Apply a triclopyr ester formulation at a 20 to 30% v/v rate, mixed with basal oil, to the lowest 15 inches of all stems. Basal bark is not as effective as cut stump for Japanese barberry. **Cut stump:** Apply glyphosate at a 25 to 50% v/v rate in water or triclopyr amine in water or ester in oil at a 20 to 25% v/v rate within



Japanese barberry

10 minutes of cutting. Always read and follow the herbicide label before initiating treatment. If seeds are present on the plant, take care not to spread them during control.

MULTIFLORA ROSE (*Rosa multiflora*)

► **Mechanical:** Chainsaws can be used for large stands (operate with caution), but may be impractical due to difficulty in removing plants without breaking the roots, as well as the difficulty of dealing with thorns.

► **Cultural:** Prescribed fire will kill stems, and may kill seedlings, but older plants will likely resprout from roots. Prescribed fire may allow easier treatment of plants with herbicides by removing thorny overgrowth.

► **Chemical/Foliar:** Apply 2 to 4% v/v glyphosate in water or 1 to 2% v/v triclopyr in water. **Basal bark:** apply a triclopyr ester formulation at a 20% v/v rate, mixed with basal oil, to the lowest 15 inches of all stems. **Cut**

stump: Apply glyphosate at a 25 to 50% v/v rate in water or triclopyr amine in water or ester in oil at a 20 to 25% v/v rate within 10 minutes of cutting. Always read and follow the herbicide label before initiating treatment.



Multiflora rose



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Norway maple

NORWAY MAPLE (*Acer platanoides*)

► **Mechanical:** Seedlings can be pulled from the ground when the soil is moist. Cutting without herbicide is not effective as stumps will readily sprout.

► **Chemical/Foliar:** Plants less than 6 feet tall—apply 2 to 4% v/v glyphosate in water or 1 to 2% v/v triclopyr in water. **Basal bark:** Plants

6 inches in diameter or less—apply a triclopyr ester formulation at a 20 to 30% v/v rate, mixed with basal oil, to the lowest 15 inches of all stems.

Cut stump: Apply glyphosate at a 25 to 50% v/v rate in water or triclopyr amine in water or ester in oil at a 20 to 25% v/v rate within 10 minutes of cutting. Treating in warm days in winter when the sap is flowing will greatly reduce efficacy of cut stump applications.

Always read and follow the herbicide label before initiating treatment. If seeds are present on the plant, take care not to spread them during control.

PRINCESSTREE (*Paulownia tomentosa*)

► **Chemical/Foliar:** Apply 2 to 4% v/v glyphosate in water or 1 to 2% v/v triclopyr in water. **Basal bark:** Plants 6 inches in diameter or less—apply a triclopyr ester formulation at a 20% v/v rate, mixed with basal oil, to the lowest 15 inches of all stems. **Cut stump:** Apply glyphosate at a 25% to 50% v/v rate in water or triclopyr amine in water or ester in oil at a 20 to 25% v/v rate within 10 minutes of cutting. Always read and follow the herbicide label before initiating treatment.

SAWTOOTH OAK (*Quercus acutissima*)

► **Chemical/Foliar:** Apply 2 to 4% v/v glyphosate in water or 1 to 2% v/v triclopyr in water. **Basal bark:** Small plants 2 inches in diameter or less—apply a triclopyr ester formulation at a 20% v/v rate, mixed with basal oil, to the lowest 15 inches of all stems. **Cut stump:** Apply glyphosate at a 25 to 50% v/v rate in water or triclopyr amine in water or ester in oil at a 20 to 25% v/v rate within 10 minutes of cutting. Always read and follow the herbicide label before initiating treatment.



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Princesstree



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Princesstree



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Sawtooth oak



Tree of heaven



Tree of heaven



Winged burning bush

TREE OF HEAVEN (*Ailanthus altissima*)

► **Mechanical:** Repeated mowing of small plants may exhaust root systems, but larger plants should not be cut as this will cause root suckering and increase the infestation. Instead, large plants should be chemically treated (see below). Small plants can be pulled; larger plants or plants that are part of a larger root system (clonal growth) cannot be removed by pulling or digging.

► **Cultural:** Seedlings may be killed by prescribed fire. Plants older than seedling stage should not be burned without treating with herbicide first; top killing plants will cause root suckering.

► **Chemical/Foliar:** Apply 1 to 3% v/v glyphosate in water or 1 to 2% v/v triclopyr in water during the growing season when plants are actively growing and before fall leaf color change.

Basal bark: Apply a triclopyr ester formulation at a 20% v/v rate, mixed with basal oil, to the lowest 15 inches of all stems. For larger trees, girdle or frill the stem and apply herbicide directly into cut surface. Always read and follow the herbicide label before initiating treatment.

WINGED BURNING BUSH (*Euonymus alatus*)

► **Mechanical:** Plants can be pulled from the ground when the soil is moist but may root if left in contact with soil.

► **Cultural:** Prescribed fire may kill seedlings but generally not large plants.

► **Chemical/Foliar:** Apply 2 to 4% v/v glyphosate in water. **Basal bark:** Plants 4 inches in diameter or less—apply a triclopyr ester formulation at a 20 to 30% v/v rate, mixed with basal oil, to the lowest 15 inches of all stems.

Cut stump: Apply glyphosate at a 25 to 50% v/v rate in water or triclopyr amine in water or ester in oil at a 20 to 25% v/v rate within 10 minutes of cutting. Always read and follow the herbicide label before initiating treatment. If seeds are present on the plant, take care not to spread them during control.

VINES:

BLACK SWALLOW-WORT (*Cynanchum louiseae*)

► **Mechanical:** to be effective, hand pulling or digging must remove the root crown to prevent sprouting. This is most easily accomplished when plants are young. Simply cutting or mowing plants without applying herbicide can lead to aggressive sprouting. Appropriate disposal of all root crowns, root fragments, and seed pods is essential, as any of these can produce new sprouts. Fragments and seeds should be bagged and either burned or disposed of in a landfill. Plant parts should not be composted.

► **Chemical/Foliar:** Apply 2% v/v triclopyr in water. **Cut Stump:** Apply glyphosate at 50% v/v in water or triclopyr amine in water or ester in oil at 20 to 25% v/v rate within 10 minutes of cutting. Always read and follow the herbicide label before initiating treatment. If seeds are present on the plant, take care not to spread them during control.

CHINESE YAM (*Dioscorea polystachya*)

► **Mechanical:** Cutting or mowing should occur at least once per season as low to the ground as possible before bulbil production in June/July. This will not eradicate the plants, but will help prevent bulbil production for that year. Grubbing (digging) can be used for small



Black swallow-wort



Chinese yam

infestations or sensitive areas, taking care to remove all root structures and bulbils, as can mulching. If using mulch, several inches of mulch must be applied and reapplied in subsequent years to smother plants.

► **Chemical/Foliar:** Apply 2 to 4% v/v glyphosate or triclopyr in water with a 0.5 to 1% nonionic surfactant to foliage once fully expanded in late spring until the time of bulbul (reproductive structure) production in June/July. Always read and follow the herbicide label before initiating treatment.



Japanese honeysuckle

JAPANESE HONEYSUCKLE (*Lonicera japonica*)

► **Mechanical:** Root systems may be removed by pulling or digging, but removal of the entire root system is difficult and follow up treatments may be needed.

► **Cultural:** Prescribed fire can kill young plants and remove dense growth to facilitate easy treatment with herbicides. Vines can also act as ladder fuels for crown fires in tree canopies.

► **Chemical/Foliar:** Apply 1.5 to 2% glyphosate v/v in water to foliage. The best time to make this application to reduce non-target damage of native plants is during the fall after the first frost, when native plants have lost their leaves and Japanese honeysuckle is still green and healthy. Apply on a warm day when temperatures are close to or above 60°F. Alternatively, 2% triclopyr can be applied to foliage in summer through late fall. **Basal bark/cut stump:** The thick stems of large woody vines can be treated in the same way as other woody species, with 20 to 25% glyphosate (cut stump) or 10 to 20% triclopyr

(cut stump or basal bark). Always read and follow the herbicide label before initiating treatment.

JAPANESE HOPS (*Humulus japonicus*)

► **Mechanical:** Small infestations may be pulled before setting seed, although it is difficult to remove the entire root. Wearing gloves is recommended when hand-pulling this plant to avoid scratches and abrasions.



Japanese hops

► **Chemical/Foliar:** Apply 2% v/v glyphosate or triclopyr in water to plants in July or August before plants produce seed. If contact with water will occur, an NPDES permit may be necessary. Always read and follow the herbicide label before initiating treatment.

KUDZU (*Pueraria montana*)

► **Mechanical:** Very heavy grazing pressure may eradicate smaller infestations if repeated for 3 to 4 years. Cutting plants close to the ground during hot, dry summer months for several years may exhaust root reserves. Mechanical treatments lose effectiveness on old, well-established infestations.



Kudzu

► **Cultural:** Prescribed fire may be used as an initial treatment to clear old growth to allow contact with herbicides on new growth, and fire may expose hazards that are masked by the infestation.

► **Chemical/Foliar:** Apply 0.5% cloyralid in August or September when plants are flowering. Clopyralid is selective primarily to plants in the bean (Fabaceae) or aster (Asteraceae) families and is a good choice when kudzu is climbing into desirable tree species from other plant families. Aminopyralid at 0.5% v/v in water is also effective though less selective. Triclopyr or glyphosate



Roundleaf bittersweet



Roundleaf bittersweet



Wintercreeper

are somewhat effective at 4% v/v in water with repeated treatments. Always read and follow the herbicide label before initiating treatment.

ROUNDELF BITTERSWEET (*Celastrus orbiculatus*)

► **Mechanical:** Seedlings may be pulled by hand, but the root is difficult to remove completely, which will lead to resprouting.

► **Cultural:** Prescribed fire may kill seedlings but will top kill larger plants, which will stimulate root suckering. Fire without integrated treatment with herbicides may increase stem density 2 to 3 times.

► **Chemical/Foliar:** Apply 2% v/v glyphosate in water or 1 to 3% v/v triclopyr in water to healthy foliage. **Basal bark:** Apply 20 to 30% v/v solution of triclopyr ester in basal oil. **Cut stump:** Cutting the stem will stimulate root suckering (sprouting), increasing stem density. Cutting should not be done without applying herbicide, but herbicide may not translocate to the end of the root system. A 10 to 20% solution of triclopyr or a 20 to 25% solution of glyphosate can be used with follow up monitoring to ensure herbicide translocation. Always read and follow the herbicide label before initiating treatment.

Roundleaf bittersweet looks very similar to the native American bittersweet. Care should be taken to correctly identify the plant before starting control treatments. See this link for information on how to differentiate the two species: <https://uofi.box.com/v/bittersweetID>

WINTERCREEPER (*Euonymus fortunei*)

► **Mechanical:** Mowing may keep plants suppressed but will not control populations.

► **Chemical/Foliar:** Apply glyphosate (2% v/v in water) or triclopyr (1 to 2% v/v in water) during the growing season when plants are actively growing. Additional surfactant may be needed for complete control; check the herbicide label. Since wintercreeper remains green throughout the winter, foliar treatments with glyphosate may be made after the first killing frost, when native plants are dormant. **Basal bark:** For climbing plants with woody stems, the entire stem surface is rarely exposed, so basal bark treatments are not feasible. **Cut stump:** Cut a small section from the stem as it ascends the supporting tree, and remove it to expose the cut surface. Apply glyphosate at a 25 to 50% v/v rate in water or triclopyr amine in water or ester in oil at a 20 to 25% v/v rate within 10 minutes of cutting.

FORBS:

BIRDSFOOT TREFOIL (*Lotus corniculatus*)

► **Mechanical:** Mowing frequently at a height of less than 2 inches for several years will decrease population, but this will be stressful to native plants as well.

► **Chemical:** Apply 0.4 to 0.75% v/v clopyralid in water for spot spraying. Alternatively, apply aminopyralid at 2 to 8ml per gallon of water. Clopyralid and aminopyralid may persist in soil, mulch or compost for a year or more. Always read and follow the herbicide label before initiating treatment.

CANADA THISTLE (*Cirsium arvense*)

► **Mechanical:** The rhizomatous growth of this plant makes mechanical control challenging. Repeated pulling, cutting or low mowing



Birdsfoot trefoil



Canada thistle

throughout a growing season can weaken plants and may eventually control a population.

► **Cultural:** Prescribed fire is an option for control of Canada thistle. Late spring or early growing season burns have the greatest impact. For greatest success, burning should be combined with other control methods.

► **Chemical:** Foliar applications of glyphosate (1 to 2% v/v in water), clopyralid (0.2 to 0.4% in water), or aminopyralid (2 to 8ml per gallon of water) have been shown to be effective when applied during flower bud or early flower stage. Fall applications to rosettes may also be effective if leaves are in good condition. Always read and follow the herbicide label before initiating treatment. If seeds are present on the plant, take care not to spread them during control.

CROWN VETCH (*Securigera varia*)

► **Mechanical:** Mowing three times per year for two to three years may decrease stand density but not eradicate plants. For maximum effectiveness, mowing must be timed during flowering to reduce or prevent seed production.

► **Cultural:** Prescribed fire in late spring may kill seedlings but is best used in combination with herbicides, as fire may cause a flush in seedling emergence.

► **Chemical/Foliar:** Apply 0.25 to 0.4% v/v clopyralid in water for spot spraying or triclopyr at a 1 to 2% v/v in water. Alternatively, apply aminopyralid at 5 to 7 fl. oz. per acre (2 to 8 ml per gallon of water, as a spot spray rate). Clopyralid and aminopyralid may persist in

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Crown vetch

CONTINUE ON
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SPECIAL PULL OUT SECTION

Phenology is the study of seasonal natural phenomena. For plants, this can include when they initiate growth, start flowering, ripen seeds, become dormant, etc. Phenology data for invasive plants is critical information for the development of effective management programs and timing of control treatments.

This calendar summarizes phenology data of invasive plant species in southern, central, and northern Illinois. The calendar was developed based upon observations and reports from the University of Illinois Extension Forestry Program. Phenology calendars are useful for planning and scheduling but cannot replace on-the-ground scouting. Be sure to check phenology of invasive plants before applying treatments to ensure proper application timing.

Using phenology data to inform invasive plant management:

- Chemical treatments to annual or biennial plants should be applied before the plants start flowering.
- Once annual or biennial plants have fruit forming, the most effective control measure is mechanically removing the plant, making sure to remove the fruits/

seeds from the area. When the fruit start to mature and fall off of the plant, mechanical treatments should be halted.

- When fruit mature on some invasive plants, such as garlic mustard, Japanese stiltgrass, and Japanese chaff flower, care should be taken to avoid accidentally spreading the seeds of these plants.
- Chemical treatments on woody invasive plants should not be applied after bud swell/bud break until the plants have reached full leaf expansion.
- Foliar chemical treatments should be applied to healthy, green, actively-growing foliage. When the foliage starts to turn its fall color, then foliar treatments are not effective.

Phenology Calendar

Phenology Calendar

	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
Musk thistle	N	*	*	*	*	*	*	*	*	*	*	*
	C	*	*	*	*							
	S	*	*	*	*							
Roundleaf bittersweet	N		*	*	*	*	*	*	*	*		
	C	*	*	*	*	*	*	*	*	*		
	S											
Poison hemlock	N											
	C											
	S											
Princesstree	S											
Purple loosestrife	N											
	C	*	*	*	*	*	*	*	*	*	*	*
	S	*	*	*	*	*	*					
Reed canarygrass	N											
	C											
	S											
Sericea lespedeza	C											
	S											
Sweet clover	N											
	C											
	S											
Teasel	N											
	C											
	S											
Tree of Heaven	N											
	C											
	S											
Wild parsnip	N											
	C											
	S											
Winged burning bush	N	*	*	*								
	C	*	*	*	*	*	*	*	*	*	*	*
	S	*	*	*	*	*	*					
Wintercreeper	N	*	*	*	*	*	*	*	*	*	*	*
	C	*	*	*	*	*	*	*	*	*	*	*
	S											

† - Fruit of the other bush
 honeysuckle species mature
 6-8 weeks earlier

- * - No data
- [Grey Box] - Dormant
- [Grey Box] - New Germinates
- [Light Orange Box] - Rosette
- [Orange Box] - Bud swell
- [Dark Orange Box] - Bud break
- [Light Green Box] - Leaf Emergence

- [Dark Green Box] - Vegetative Growth
- [Dark Green Box] - Bolting
- [Light Blue Box] - Flower bud
- [Light Blue Box] - Flower
- [Yellow Box] - Seed/Fruit Immature
- [Dark Brown Box] - Seed/Fruit Mature
- [Dark Purple Box] - Leaf color/senescence

N- Northern, C- Central, S- Southern

Note: Some species not included in calendar due to insufficient phenology data

NOTES

soil, mulch or compost for a year or more. Always read and follow the herbicide label before initiating treatment.

DAME'S ROCKET (*Hesperis matronalis*)

► **Mechanical:** Once plants have started to bolt, they are easily removed by hand pulling. Pulled plants that have begun to flower must be bagged and taken off site, since seeds may still form after pulling. Cutting flowering plants at ground level will reduce the amount of seed produced.

► **Cultural:** Prescribed fire in late spring may kill seedlings and reduce the number of rosettes. However, once leaf litter is removed by fire, there may be a flush of new seedling emergence. Following up with herbicide treatment may exhaust the seedbank faster.

► **Chemical/Foliar:** Apply 1 to 3% glyphosate v/v or 1 to 2% triclopyr amine v/v mixed with water to plants in rosette or bolting stage. Treatments are not effective after plants are flowering. Once seeds are mature, they are easily spread, and entering patches is not recommended. Always read and follow the herbicide label before initiating treatment.

FIG BUTTERCUP (*Ficaria verna*)

► **Mechanical:** For small infestations, plants may be pulled up by hand or dug up using a hand trowel or shovel. It is very important to remove all bulblets and tubers. When conducting mechanical removal, care should be taken to minimize soil disturbance as much as possible. For this reason, mechanical control may be inappropriate for large infestations in high quality natural areas.



Dame's rocket

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Fig buttercup

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► **Chemical:** Apply 2 to 3% glyphosate v/v in water in late winter through early spring. Applications prior to or just at the beginning of flowering are most effective. Be sure to use aquatic-safe formulations when making applications over or near water.

GARLIC MUSTARD (*Alliaria petiolata*)

► **Mechanical:** Once plants have started to bolt, they are easily removed by hand pulling. Pulled plants that have begun to flower must be bagged and taken off site, since seeds may still form after pulling. Cutting flowering plants at ground level will reduce the amount of seed produced.

► **Cultural:** Prescribed fire in late spring may kill seedlings and reduce the number of rosettes. However, once leaf litter is removed by fire, there may be a flush of new seedling emergence. Following up with herbicide treatment may exhaust the seedbank faster.

► **Chemical/Foliar:** Apply 1 to 3% glyphosate v/v mixed with water to plants in rosette or bolting stage. Alternatively, a 1.5% solution of triclopyr may be used in the fall or spring on rosettes or during bolting or flowering stage. Late herbicide applications during or just past flowering has been shown to significantly reduce seed viability. Once seeds are mature, they are easily spread, and entering patches of garlic mustard is not recommended. Always read and follow the herbicide label before initiating treatment.



Garlic mustard



Japanese chaff flower

JAPANESE CHAFF FLOWER (*Achyranthes japonica*)

► **Mechanical:** Small plants can be hand pulled. Mowing plants to ground level may delay or

reduce seed production but will not kill plants. Follow up with herbicide may be required.

► **Chemical/Foliar:** Apply a 2% v/v solution of glyphosate or triclopyr in water to plants anytime from emergence until seed production begins. Once plants begin to produce seed, movement through infestations is not advisable due to risk of spreading seed. Always read and follow the herbicide label before initiating treatment.

JAPANESE HEDGE PARSLEY (*Torilis japonica*)

► **Mechanical:** Pull or mow prior to flowering to help reduce seed spread. Remember to monitor site for additional seedlings.

► **Chemical:** Treating foliage with 2% v/v glyphosate or triclopyr in water is effective if done early in the spring or on resprouts after cutting. Recommendations are also effective on spreading hedge parsley.

JAPANESE KNOTWEED (*Fallopia japonica*)

► **Chemical/Foliar:** Apply glyphosate to small plants at a 4 to 8% v/v in water. Large plants may be cut to ground level about 6 weeks before treatment is scheduled; short regrowth may make herbicide application easier. **Cut stump:** For large plants, cut stump applications of 20 to 25% v/v glyphosate in water or 20 to 25% v/v triclopyr ester in oil may be used. Japanese knotweed stems are hollow, so a small amount (~1 ml) of herbicide should be dripped into the hollow stem. Always read and follow the herbicide label before initiating treatment.

LEAFY SPURGE (*Euphorbia virgata*)

► **Biological control:** The U.S. Department



Japanese hedge parsley



Japanese knotweed



Leafy spurge

of Agriculture has shown success using six natural enemies of leafy spurge imported from Europe. These include a stem and root-boring beetle (*Oberea erythrocephala*), four root-mining flea beetles (*Aphthona* spp.) and a shoot-tip gall midge (*Spurgia esulae*). Large scale field-rearing and release programs are carried out cooperatively by federal and state officials in many northern states. The results are not as immediate as when herbicides are used but, if pesticide use is kept to a minimum, large numbers of these agents build up within a few years and have shown impressive results.



Musk thistle

► **Chemical:** Apply picloram at 0.5 to 1% v/v in water to flowering plants. Glyphosate at 2 to 4% v/v in water may be effective with repeated treatments. Always read and follow the herbicide label before initiating treatment.

MUSK THISTLE (*Carduus nutans*)

► **Mechanical:** Root crowns can be hand-chopped with a sharp shovel after plants bolt and before flowering. Although labor intensive, plants may not regrow.

► **Chemical/Foliar:** Apply 1 to 2% glyphosate or triclopyr v/v in water to rosettes, bolting or flowering plants in the spring and to rosettes in the fall. Always read and follow the herbicide label before initiating treatment.

POISON HEMLOCK (*Conium maculatum*)

This species is extremely poisonous if ingested. Dermal exposure may cause skin irritation. Take precautions during any treatment.



Poison hemlock

► **Mechanical:** Plants may be pulled if it is possible to remove the entire tap root. Also, root systems of individual plants may be chopped

with a sharp shovel a few inches below the ground. Mowing may be used as a treatment but only if mature seeds are not present on plants. Plants may still flower and seed unless multiple mowing treatments are used. Mowing alone will suppress but not control populations.

► **Cultural:** Prescribed fire may kill seedlings and help native plants compete, but it may also cause a flush of poison hemlock germination. Fire should be used in conjunction with other treatments.

► **Chemical/Foliar:** Apply 1 to 2% v/v triclopyr or glyphosate in water to plants during any growth stage except during seed formation. Always read and follow the herbicide label before initiating treatment.

PURPLE LOOSESTRIFE (*Lythrum salicaria*)

► **Biological control:** Four different weevils have been approved for and are in use as biological control agents for purple loosestrife. While these species will not eradicate a population, they can aid in limiting the abundance of loosestrife and reducing negative impacts to native ecosystems. Contact the Illinois Natural History Survey or the US Department of Agriculture for more information on biological control of purple loosestrife.

► **Mechanical:** Mowing three times per growing season before flowering may suppress plants and prevent seed production, but cut stems must be disposed of properly as it may resprout. Pulling or digging may be used to remove root systems but becomes especially difficult on larger plants.



Poison hemlock



Purple loosestrife

► **Chemical/Foliar:** Apply 1 to 1.5% v/v aquatic-safe glyphosate in water during the growing season. Fall treatments may be most effective but should be done before seed production and/or the first killing frost. Alternatively, apply 1 to 2% v/v triclopyr amine in water during the growing season. Applications from the period of bud formation to midflowering may be most effective. If contact with water will occur, an NPDES permit may be necessary. Always read and follow the herbicide label before initiating treatment.



Sericea lespezeza

SERICEA LESPEDEZA (*Lespedeza cuneata*)

► **Mechanical:** Mowing during flowering stage before seed production may suppress but not control populations if done for 2 to 3 years. Do not mow if seeds have formed. Young individual plants may be pulled. Grazing with high stocking densities may be an effective control, although cattle will only eat early spring growth. Heavy grazing with goats may kill adult plants after repeated treatments, although goats may spread seed to new areas if they graze on reproductive plants.

► **Cultural:** Prescribed fire may kill seedlings but cause a flush of growth from the seedbank. If used in combination with herbicide, this can exhaust the seedbank more quickly than by using herbicide alone. Growing season fires have shown promise as a technique to reduce population densities.

► **Chemical/Foliar:** Apply 0.4% triclopyr + fluroxypyr while plants are actively growing. 2% v/v of triclopyr can provide some control but is not as effective as the triclopyr/fluroxypyr mix. Applications during flower bud formation

are most effective. Always read and follow the herbicide label before initiating treatment.

SPOTTED KNAPWEED (*Centaurea biebersteinii*)

► **Mechanical:** Hand-pulling is effective in controlling small infestations of knapweed. Plants must be pulled annually before seed set until the seedbank is exhausted. The entire plant should be pulled to prevent sprouting from roots. Repeated mowing or cutting of plants can be effective in reducing seed production by reducing the number of seed producing plants. Cutting should be done several times during the growing season and before seed production begins.

► **Chemical:** Apply clopyralid (0.2 to 0.4% v/v in water) or aminopyralid (2 to 8 ml per gallon of water) to rosettes in fall or to plants in spring before flowering. Glyphosate at 2% v/v in water or triclopyr at 3% v/v in water can provide some control with repeated treatments. Always read and follow the herbicide label before initiating treatment.

SWEET CLOVER (*Melilotus* spp.)

► **Mechanical:** Small amounts of sweet clover can be controlled by hand-pulling before second-year plants flower. Low mowing of second-year plants as they start to flower can reduce population size.

► **Cultural:** Spring burns in consecutive years may help reduce sweet clover. Additional control efforts may be needed if burns do not control seedlings. A single burn may only stimulate the seed bank without controlling new germinates so follow up treatments would be necessary.



Spotted knapweed



Sweet clover



Teasel

► **Chemical:** Foliar applications of aminopyralid (2 to 8ml per gallon of water), clopyralid (0.2 to 0.4% in water), or triclopyr+2,4-D (1 to 2% in water) have been shown to be effective when applied before flowering when plants are fully leafed out and actively growing. Always read and follow the herbicide label before initiating treatment. If seeds are present on the plant, take care not to spread them during control.



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*Wild parsnip

*There is a danger when the skin is exposed to the plant sap in the presence of sunlight. Take care to avoid skin exposure, especially when removing, pulling, mowing or damaging the plant. Severe dermal rash and blisters can occur as a result of this exposure.

TEASEL (*Dipsacus* spp.)

► **Mechanical:** Mowing is not an effective treatment; plants will still flower even with repeated mowing. Small rosettes can be dug out of the ground; large rosettes are difficult to remove by digging. Once flowering has begun, inflorescences (flower heads) can be cut from the plant and bagged, and roots may be chopped 1 to 2 inches below the soil surface. If inflorescences are left on site, seeds may still form.

► **Cultural:** Prescribed fire alone may cause a flush of growth from the seedbank. However, fall fires may increase the visibility of rosettes for herbicide treatment.

► **Chemical/Foliar:** Apply glyphosate (1.5 to 2% v/v in water), triclopyr (2% v/v in water) or aminopyralid (2 to 8 ml per gallon of water) to rosettes or bolting plants. Treatments are typically ineffective on flowering plants. Treatment on rosettes through fall and winter can provide additional selectivity while other native vegetation is dormant. Always read and follow herbicide label before initiating treatment.

WILD PARSNIP (*Pastinaca sativa*)

► **Mechanical:** Remove plants by cutting the entire root just below ground level with a sharp shovel or spade. In moist soil, plants can be

hand-pulled. Mowing populations at flowering can reduce or prevent seed set.

► **Cultural:** Prescribed fire can help reduce a population. It will top kill plants and may stimulate growth of competing native plants.

► **Chemical:** Apply 2,4-D (1% v/v in water) or glyphosate (1.5 to 2% v/v in water) to plants before flowering. This treatment application is also effective on fall rosettes. Always read and follow the herbicide label before initiating treatment.

GRASSES:

COMMON REED/PHRAGMITES

(Phragmites australis)

► **Mechanical:** Mowing stands without herbicide treatment will increase the density of Phragmites. The deep, lateral root system makes grubbing (digging) an inefficient method of control.

► **Cultural:** Burning stands without also using herbicide treatments will increase the density of Phragmites.

► **Chemical/Foliar:** A National Pollutant Discharge Elimination System (NPDES) permit may be needed in any situation where an herbicide may contact water. Apply 1 to 1.5% v/v aquatic safe glyphosate in water (up to 6 pints per acre). Alternatively, 1 to 1.5% solution of aquatic safe imazapyr, such as Habitat (up to 6 pints per acre) can be used for a more effective yet more costly treatment than glyphosate. Imazapyr and glyphosate may be combined 1:1 and mixed with water to make a 1 to 1.5% solution (3 pints glyphosate, 3 pints imazapyr per acre). Optimal treatment time is



Common reed



Japanese stiltgrass

in the fall during flowering. Plants may be mowed to the ground or burned 6 weeks prior to treatment and allowed to regrow until 24 inches or more in height to make application easier. Always read and follow the herbicide label before initiating treatment.

JAPANESE STILTGRASS (*Microstegium vimineum*)

► **Mechanical:** Stiltgrass roots are very shallow, and plants are easy to pull. Mowing or weed whipping is an effective treatment if done late in the season but before plants flower.

► **Cultural:** Following prescribed fire, there will be a flush of germination from the seedbank. Follow up treatment with herbicides or mechanical methods are necessary to prevent the development of a more dense infestation. Integrated methods, using prescribed fire and herbicides, may lessen the duration of the infestation.

► **Chemical/Foliar:** To reduce non-target damage to broad leaved native plants, apply a grass-specific herbicide, such as sethoxydim or clethodim, at a 1.5% rate in mid-to-late summer until the time that seeds begin to mature on the plant. Once seeds have begun to mature, entry into infestations is not recommended due to the increased risk of spreading seed. Alternatively, apply glyphosate at a 1 to 1.5% v/v in water. Glyphosate is non-selective and will kill all plants contacted but is available in aquatic safe formulations, which may be necessary if stiltgrass is growing near water. If herbicide will contact water, an NPDES permit may be necessary. Always read and follow the herbicide label before initiating treatment.



Johnsongrass

JOHNSONGRASS (*Sorghum halepense*)

► **Mechanical:** Plants have deep rhizomes (lateral root systems) and may be difficult to pull. Repeated mowing may exhaust the energy reserves in root systems.

► **Chemical/Foliar:** The best time to control Johnsongrass is from June through mid-August, at a height of 18 inches tall to early flowering stage. Apply glyphosate at 2% v/v in water. Alternatively, sulfosulfuron may be used at a rate of 1 to 1.5 ounces per 100 gallons with a 0.25% rate of nonionic surfactant.

REED CANARYGRASS (*Phalaris arundinacea*)

► **Mechanical:** Individually cutting small plants at ground level during flowering may provide some control.

► **Cultural:** Repeated prescribed fire can be used as an effective control if native plants that may be able to compete are present. It may be necessary to use 5 to 6 years of fire before control is evident. Integrated use of herbicide will increase effectiveness.

► **Chemical/Foliar:** Apply 2% v/v glyphosate in water during the early spring before native species begin to emerge or just before flowering. Mowing or burning can be used as a pretreatment prior to herbicide application to remove thatch and stimulate new growth to aid in herbicide uptake. Regrowth should reach a minimum height of 18 inches before herbicide treatment. If herbicide will contact water, an NPDES permit may be necessary. Always read and follow the herbicide label before initiating treatment.



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Reed canarygrass

ADDITIONAL
RESOURCES
ON PAGE 55

TREE PEST THREATS



Emerald ash borer feeding galleries.

Non-native invasive forest pests threaten our trees, natural forests and can change the composition of our natural communities. Our woodlands and wildlife have not developed with non-native invasive pests, and there is little defense against invasions, oftentimes allowing newly introduced pests to spread rapidly. Trees, plants and wildlife depend on a healthy community.

ASIAN LONGHORNS BEETLE

(*Anoplophora glabripennis*)

Asian longhorned beetle is a destructive wood-boring pest of maple and other hardwood species, killing thousands of trees. The beetle has been found in six States: New York, Illinois, New Jersey, Massachusetts, Ohio, and South Carolina. USDA Animal Plant and Health Inspection Service (APHIS) and its cooperators have eradicated infestations in Illinois; New Jersey, parts of New York and Massachusetts.

Life Cycle

Over the course of a year, beetle larvae develop into adults. The pupal stage lasts 13 to 24 days, usually in May or June. After adult beetles emerge, generally in July and August, from the pupae, they chew their way out of the tree, leaving round exit holes approximately $\frac{3}{8}$ of an inch in diameter: (e.g. size of a dime). Once they have exited a tree, they feed on its leaves and bark for 10 to 14 days before mating and laying eggs. August is “Tree Check” month; check your trees for any round exit holes and adult beetles.



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Asian longhorned beetle

Identification

- Body is 1 to 1½ inches in length, metallic black body, with white spots
- Six legs (may be a blueish color)
- Long antennae with black and white stripes, longer than the body length

Signs and Symptoms

- Sawdust at the base of infested trees and branches
- Oozing sticky sap
- Round holes in trees from where beetles crawl out of the wood
- Shallow rubbed pits in the bark (egg sites)

► **Chemical:** Please contact a certified arborist in your area for proper management control. USDA APHIS and its partners use a generic insecticide, imidacloprid, on trees known to be hosts or infested and according to product labels. Imidacloprid products cannot be applied to any *Tilia* spp. Read and follow all label directions. Do not apply chemicals at higher rates than listed on the label.

EMERALD ASH BORER (*Agrilus planipennis*)

Emerald ash borer, *Agrilus planipennis*, is a non-native invasive borer from northeast Asia threatening North American ash trees (*Fraxinus*).

Life Cycle

Adult beetles, metallic green and ½ inch long, begin emerging in mid-June leaving 0.1 to 0.2 inch (0.25 to 0.5 cm) “D” shaped emergence holes. Females lay eggs 2 weeks after emergence. Eggs are light-yellow, turning to brownish-yellow before hatching. Eggs hatch in 1 to 2 weeks, and the tiny larvae bore through the bark, disrupt the flow of nutrients to the tree, eventually



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Emerald ash borer

killing it. The creamy white larvae are 1 to 1.25 inches long with flat D-shaped heads and broad, segmented bodies.

► **Biological:** Three species of biocontrol have been researched and are currently being deployed. They include *Spathius agrili* (Hymenoptera: Braconidae), *Oobius agrili* (Hymenoptera: Encyrtidae), and *Tetrastichus planipennisi* (Hymenoptera: Eulophidae). This is a long-term management method rather than one targeted at immediate control. In dense populations, woodpeckers consume many larvae. Learn more at www.emeraldashborer.info.

► **Chemical:** Although there are chemical controls available for use over wide areas, several products have been tested for protection of individual trees (see chart below).



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Emerald ash borer
D-shaped exit hole

APPLICATION METHOD	BRAND NAME	INSECTICIDE ACTIVE INGREDIENT	GENERAL RECOMMENDED TIMING OF APPLICATION	CHEMICAL LIFE (APPLICATION)
Soil injection or drench	Bayer Advanced/ Ferti-lome	Imidacloprid	Spring Fall	1 year
Granular soil drench	Green Light Product Line	Dinotefuran	Spring-early Summer	1 year
Trunk injection	TREE-age	Emamectin benzoate	Spring Summer	2 years
Soil injection or drench	Merit/Xylect	Imidacloprid	Spring Fall	1 to 2 years*
Soil injection or basal trunk spray	Safari or Transtect	Dinotefuran	Spring	1 year

CHART KEY

- Find it at your local hardware store or garden center.
- Call a professional, licensed, or certified pesticide applicator. These treatments are restricted products and not available to homeowners.

Information based on *Emerald Ash Borer: Homeowner Guide to Insecticide Selection, Use, and Environmental Protection* (Minnesota Department of Agriculture)

*For a full listing of insecticides, application timing, and suggested tree size, reference *Insecticide Options for Protecting Ash Trees from Emerald Ash Borer*, available at mortonarb.org/EAB



Larvae of spongy moth



Spongy moth

SPONGY MOTH (*Lymantria dispar*)

Currently established in North America, is a European native that was accidentally introduced into New England in the late 1800's.

Life Cycle

The spongy moth life cycle has four stages: egg, larva, pupa, and adult moth. The spongy moth female lays between 500 to 1000 eggs in tree bark, picnic tables, stone, and other outdoor objects. In spring (April to May), eggs hatch and the larvae (caterpillar) emerge, and climb up the trees to feed on leaves. Caterpillars are 1 to 2 inches long, with hair like structures along their body, with five pairs of blue spots and six pairs of red spots along their back. The larval stage lasts for approximately 40 days. In early summer (June to July), the larvae can take up 14 days to transform into adult spongy moths. Larvae chew holes in leaves, and can eat entire leaves except for the larger veins and midribs. Male moths have a wingspread of about 1 inch and female wingspread is up to 2 inches; female moths are larger than males, but they do not fly. Adults have less than two weeks to mate and lay egg masses before they die. Spongy moth pests can severely defoliate trees (preferred hosts are oak trees) within a season; stress from repeated defoliation, drought and other threats can cause tree death.

► **Mechanical:** Use of burlap bands around the trunk of the tree can be used to trap larvae and can afford some protection to individual trees.

► **Biological:** Introduced insect parasites and predators, viruses, and adverse weather conditions, help control the spongy moth.

► **Chemical:** A number of treatment options are available for suppression of spongy moth; the Illinois Department of Agriculture, along with the Slow the Spread (STS) Foundation, and USDA APHIS place pheromone traps to monitor populations throughout the growing season. Each year, the monitoring surveys are reviewed and eradication treatments are decided for the following year. The goal is to slow the spread of spongy moth through an integrated pest management (IPM) approach. Learn more about IPM strategies here: <https://agr.illinois.gov/insects/pests/lymantriadispar.html>. Control methods for spongy moth and flighted spongy moth are the same. The potential threat spread differs—flighted spongy moth females can fly, so the potential spread is greater than the spongy moth.

FLIGHTED SPONGY MOTH COMPLEX

(*Lymantria dispar asiatica*) Flighted Spongy Moth, including *Lymantria dispar asiatica*, *Lymantria dispar japonica*, *Lymantria albescens*, *Lymantria umbrosa*, and *Lymantria postalba* are exotic pests and are similar to the spongy moth found in portions of Northern Illinois. Each female moth can lay hundreds of eggs that yield caterpillars that may feed on more than 500 trees and shrubs. Females are active fliers, and potentially could spread more rapidly throughout the United States. Flighted spongy moth is not known to occur in the United States.

Identification

- Mature caterpillars range from 2 to 3½ inches in length and have two rows of blue and red spots on their backs.



Flighted Spongy Moth

© John Gent, Bugwood.org

- Adult male moths have grayish-brown wings and a wingspan of 1½ inches. Adult female moths are white and larger, with wingspans of up to 3½ inches.

Signs and Symptoms

- Egg masses are found on tree trunks, limbs and leaves, as well as on outdoor objects, stones, walls, logs, and lawn furniture. Egg masses are buff colored and average 1½ inches by ¾ inches wide, but can be as small as a dime.
- Caterpillars feed on tree and shrub leaves.
- Defoliated trees during the growing season.

© Steven Karovich, Bugwood.org



Japanese beetle

© Jon Yuschock, Bugwood.org



Japanese beetle

► For control information, please refer to European spongy moth.

JAPANESE BEETLE (*Popillia japonica*) Identification

The adult Japanese beetle is just under ½ inch long and has a shiny, metallic-green body and bronze-colored wing covers. There are six small tufts of white hairs along its side.

► **Mechanical:** Physically remove beetles from plants in the early morning and at dusk (beetles are inactive). Drop them into a container of soapy water to eliminate the pheromone they release to attract other beetles. Japanese beetle traps are not recommended because the pheromone used tends to bring more Japanese beetles into the area than are captured in the trap.

► **Biological:** Grubs may be biologically controlled with the use of milky spore disease, *Bacillus papillae*, which is available in several formulations such as Milky spore powder, Japidemic, and Doom. This disease is introduced to the soil so when the grubs begin feeding, they catch the

disease, turn milky white, and later die. However, effectiveness of these products varies greatly.

► **Chemical:** Before choosing a chemical product make sure Japanese beetle control is listed on the label. Imidacloprid products now cannot be applied to any *Tilia* spp. Read and follow all label directions. Do not apply chemicals at higher rates than listed on the label. For more information regarding chemical control of adult Japanese beetles or their grubs, contact your local U of I Extension office (www.extension.uiuc.edu) or the plant clinic at www.mortonarb.org.

SPOTTED LANTERNFLY (*Lycorma delicatula*)

NEW pest of concern. The spotted lanternfly is a plant hopper native to China, India and Vietnam. Pest has been confirmed in Illinois. In the U.S., the spotted lanternfly has the potential to greatly impact grape, tree fruit, plant nursery and timber industries.

Life Cycle

The spotted lanternfly overwinters in egg masses laid on bark, stone, and other surfaces. The first of four immature stages, or instars, begin emerging from the egg masses in mid-May. The first life stage, nymph, is black with white spots and wingless. As it grows, the spotted lanternfly develops red patches in addition to the white spots. Nymphs jump or crawl on any woody or non-woody plant they come across to feed. In the fall, adults prefer tree of heaven (*Ailanthus altissima*) as their primary food source, mating and egg-laying location.

Signs and Symptoms

- Plants ooze or weep and have a fermented odor
- Buildup of sticky fluid (honeydew) on plants



© Lawrence Barringer, Bugwood.org

Spotted lanternfly



© Lawrence Barringer, Bugwood.org

Third instar life-stage of spotted lanternfly



EARLY DETECTION
of the spotted
lanternfly is vital to
the effective control
of this pest and
the protection of
agriculture and
natural resources-
related businesses.

and on the ground underneath infested plants
• Sooty mold on infested plants

This is a serious pest, if you suspect, or see this pest, email: lanternfly@illinois.edu, or contact Illinois Department of Agriculture at 815-787-5476 for phone-in reporting.

TWOLINED CHESTNUT BORER

(Agrius bilineatus)

Identification

Twolined chestnut borer is a native insect and can invade a stressed oak tree, often contributing to the decline and potentially the death of the tree. Adult twolined chestnut borers are slender, black beetles with a bluish to greenish hue that are $\frac{1}{5}$ to $\frac{1}{2}$ inch long with two faint, yellowish stripes along their back. Larvae live under the bark in trees.



© Robert Haack, Bugwood.org

Twolined chestnut borer

Life Cycle

The twolined chestnut borer has one generation per year: adults are active from April to August, adults fly to the top of oak trees, feed on leaves before mating. Females lay their eggs in bark, larvae hatch within 1 to 2 weeks. In August to October, larvae burrow into the outer bark to overwinter in trees.

► **Cultural:** Adult beetles are most active from late April in Southern Illinois to early June in Northern Illinois. Keep trees healthy and vigorous to fight off borers. Water healthy and declining oaks on a regular basis during dry growing seasons. Do not prune oak trees during the growing season.

QUICK REFERENCE GUIDE FOR MIXING HERBICIDES*

**Always read and follow label information for any herbicide being used.*

HOW TO USE THIS REFERENCE GUIDE: The chart below gives the amount of herbicide needed to obtain different commonly used solution strengths for many of the standard sprayer sizes. Each row represents a different mix amount (in gallons) with each column representing different solution strengths (given in v/v % solution).

MIXING THE HERBICIDE: Be sure to wear the proper safety gear (eye protection, chemical gloves, and long sleeves, but read label information for exact safety gear requirements) when handling, mixing, or applying herbicide. To mix herbicide, add one-third to one-half of water needed for mix, then add the amount of herbicide denoted in chart and add the remaining amount of water needed to reach desired mix amount. Read the label for information on necessity and rates for additives, such as surfactants and penetrants.

FLUID OUNCES OF HERBICIDE NEED FOR DESIRED SOLUTION

MIX AMOUNT	1%	2%	3%	5%	10%	15%	20%
1 gallon	1.25	2.5	4	6.5	13	19	26
2 gallons	2.5	5	8	13	26	38	51
3 gallons	4	8	12	19	38	58	77
4 gallons	5	10	15	26	50	77	102
5 gallons	6.5	13	19	32	64	96	128
10 gallons	13	25	38	64 (2 qt)	128 (1 gal)	192 (1.5 gal)	256 (2 gal)
15 gallons	19	38	58	96 (3 qt)	192 (1.5 gal)	288 (1.75 gal)	384 (3 gal)
30 gallons	38	77	115	192 (1.5 gal)	384 (3 gal)	576 (4.5 gal)	768 (3.6 gal)
100 gallons	128 (1 gal)	256 (2 gal)	384 (3 gal)	640 (5 gal)	1280 (10 gal)	1920 (15 gal)	2560 (20 gal)

CONVERSION REFERENCE CHART

1 gallon = 128 ounces

1 gallon = 4 quarts = 8 pints = 16 cups

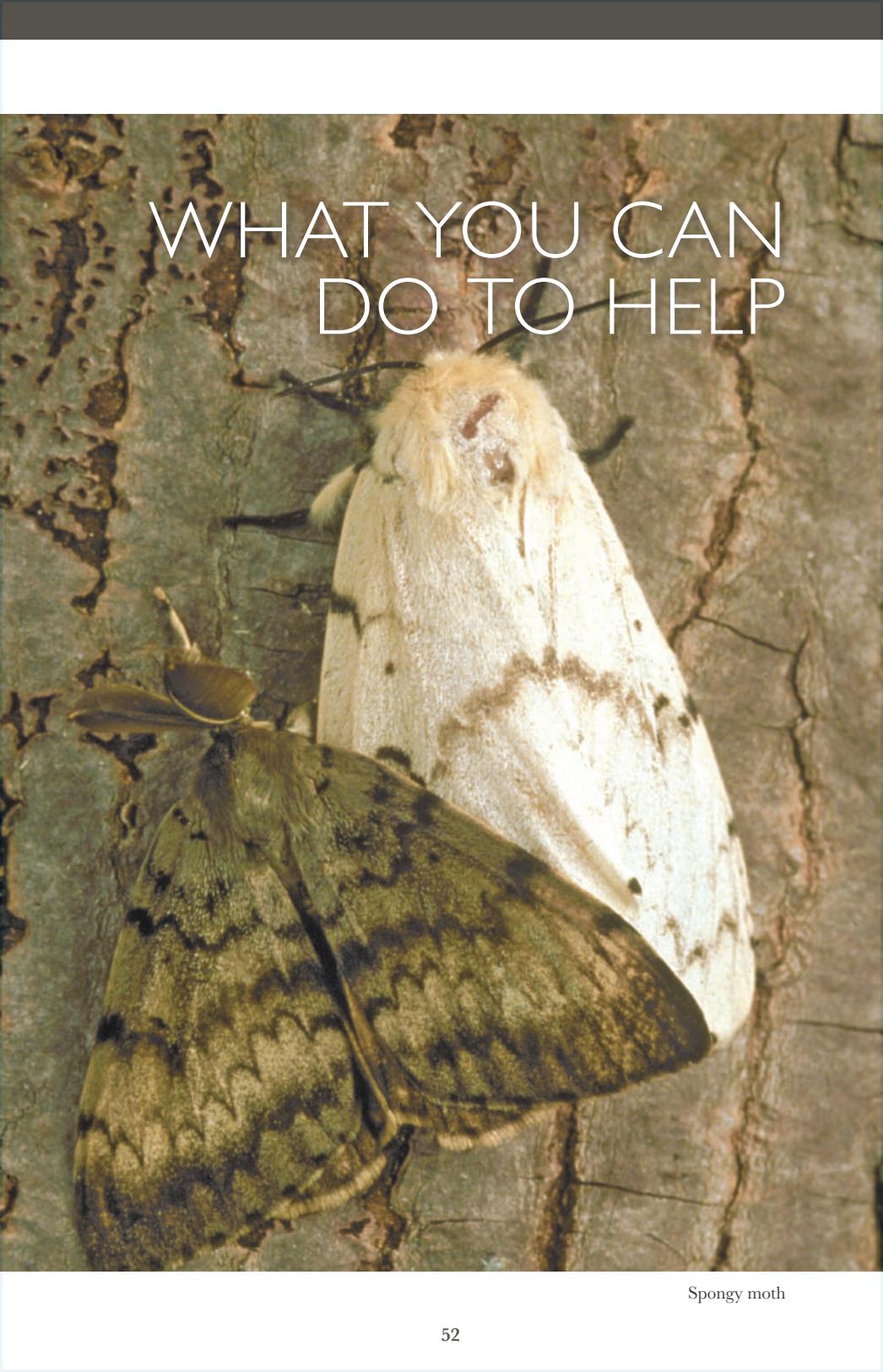
1 quart = 32 ounces

1 quart = 2 pints = 4 cups

1 pint = 16 ounces

1 pint = 2 cups

1 cup = 8 ounces



WHAT YOU CAN DO TO HELP

Spongy moth

When it comes to preventing the spread of invasive pests, you play an important role in stopping the spread.

Pests can move from place to place on firewood, cars and trucks, and boats; they can be hidden in fruit, vegetables, plants, and on outside furniture. Don't accidentally move non-native invasive pests; buy certified wood, inspect your vehicle, outdoor furniture, equipment and produce for egg masses.

The first step is to be aware of the pests that might be a threat in your area. Cooperate with any regulations or quarantines that might be in effect.

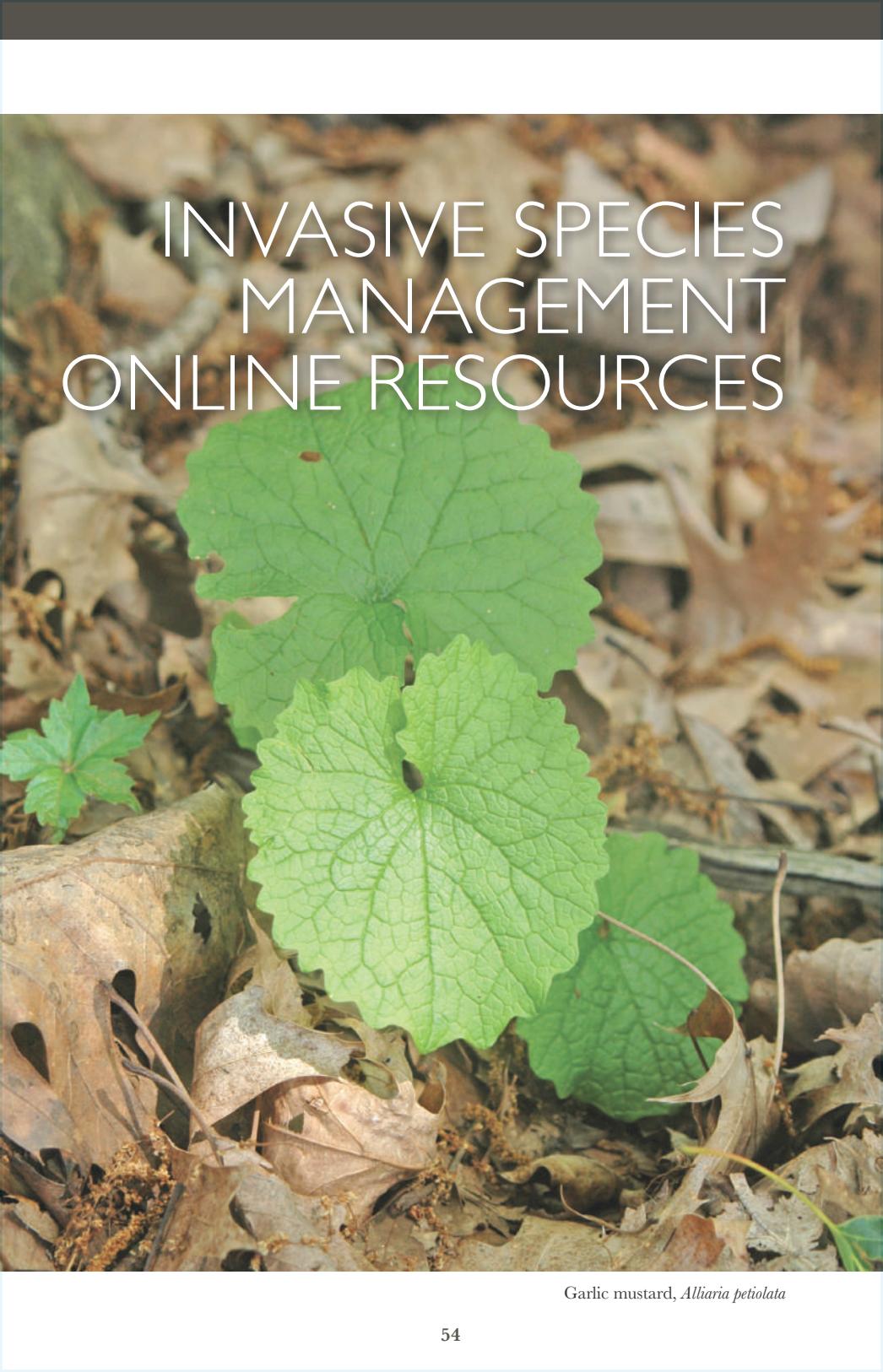
Preventing the introduction and establishment of invasive species in a new area is everyone's responsibility. There are important, simple things to be aware of:

- Invasive pests can easily be transported on living plants or fresh products such as fruit.
- Many pests can be found in dead plant material including firewood, lumber, and wood packaging material. Avoid movement of these materials to help slow the spread of pests.

Ways to help stop the spread of invasive species:

- **Buy only certified, pest-free nursery products whenever possible.** Buy your plants from a reputable source and avoid planting and spreading invasive species at all costs.
- **Avoid** walking through areas where there are non-native invasive plants and pests to avoid **spreading seeds and cocoons**.
- **Report any suspicious invasive pest sightings** to the Illinois Department of Agriculture, local land manager or local USDA APHIS office, or local University of Illinois Extension office, or the plant clinic at The Morton Arboretum or your local Illinois Department of Natural Resources District Forester.
- **Don't move firewood.** Buy or use firewood close to your home and/or campsite. Learn more www.dontmovefirewood.org
- **Clean your boots, gear, tires and equipment** after working a site to make sure you are not spreading seeds, insects or spores to a new location. See PlayCleanGo.org for more information.

INVASIVE SPECIES MANAGEMENT ONLINE RESOURCES



Garlic mustard, *Alliaria petiolata*

MAPPING RESOURCES:

eddmaps.org

This site has distribution maps for Illinois and the entire U.S. both by county and point mapping. This site compiles user data to make the maps updated and closer to reality. You can enter new records into this system to help highlight the spread and control of invasive species.

apps.bugwood.org

This site has multiple apps that can be used for mapping and reporting invasive species.

CONTROL INFORMATION:

www.mipn.org/control/

This website, from the University of Wisconsin and the Midwest Invasive Plant Network, gives information on control techniques for invasive plants.

https://www.srs.fs.usda.gov/pubs/gtr/gtr_srs131.pdf

A Management Guide for Invasive Plants in Southern Forests. This guide, developed by the US Forest Service gives great basic information on controlling invasive plant species and gives detailed recommendations for 53 invasive plant species.

SPREAD PREVENTION:

<https://www.fs.usda.gov/eng/pubs/pdf/05511203.pdf>

Vehicle Cleaning Technology for controlling the Spread of Noxious Weeds and Invasive Species. This publication from the US Forest Service gives great information about technologies and equipment to use to clean equipment and remove seeds and other plant material. Slow the Spread of spongy moth, www.gmsts.org, in cooperation with the USDA Forest Service, have implemented a integrated pest management strategy to minimize the rate at which spongy moth spreads into uninfested areas.

IDENTIFICATION:

invasive.org

Center for invasive species: Information, mapping and resources on invasive species and ecosystem health.

hungrypests.com

USDA APHIS Hungry Pests website offers information on non-native pests and high risk pathways. The web site also has K-12 Hungry Pest curriculum. This is the website for the Illinois Invasive Species Awareness Month. It gives lists of invasive species in Illinois as well as links to pictures and more information.

<https://extension.illinois.edu/sites/default/files/fieldguidetostiltgrass.pdf>

Field Guide to the Identification of Japanese Stiltgrass with Comparisons to Other Look-a-Like Species. This guide gives detailed information and full color images on how to distinguish Japanese Stiltgrass, an invader rapidly moving through Illinois, with look-a-like species.

wiki.bugwood.org/Archive:IPSF

A Field Guide to the Identification of Invasive Plants in Southern Forests. This book, developed by the US Forest Service gives very detailed information on how to identify 53 different invasive species. While a few of these only occur south of Illinois, many of them can be found within the state.

<http://midwestherbaria.org/portal/checklists/checklist.php?cl=4892>

Aquatic Invasive Plant Guide Species List

A specimen-based guide to aquatic invasive plants and their look-alikes.



MANAGEMENT OF INVASIVE PLANTS AND PESTS OF ILLINOIS