



# Invasive Plant Phenology Report

## March 2016

Christopher W. Evans, Extension Forestry and Research Specialist  
Department of Natural Resources and Environmental Sciences



This University of Illinois Extension Technical Forestry Bulletin series provides monthly reports on the development of invasive plant species in Illinois. Reports are summarized by region and produced from field observations collected between the 8th and 14th of each month.

Phenology is the study of seasonal natural phenomena. This observational project tracks the phenology of invasive plant species in Illinois throughout the growing season, noting when plants initiate growth, start flowering, ripen seeds, become dormant, etc. Data on the phenology of invasive plants is critical information for the development of effective management programs.

### March 2016 General Summary

This spring appears to be advanced as compared to recent previous springs. Species are 'greening up' earlier than has happened the last couple of years. Most of the woody invasive shrubs are expanding their leaves in southern Illinois and central Illinois and starting bud swell in northern Illinois.

### Regional Reports

#### South

- Mimosa (*Albizia julibrissin*) – Bud break, leaves starting to expand
- Garlic mustard (*Alliaria petiolata*) – Basal rosettes expanding, plants near bolting stage
- Japanese barberry (*Berberis thunbergii*) – Bud break, leaves starting to expand
- Oriental bittersweet (*Celastrus orbiculatus*) - Dormant
- Poison hemlock (*Conium maculatum*) – Basal rosettes expanding but plants are not bolting yet
- Autumn olive (*Elaeagnus umbellata*) – Partial leaf out, ½ expansion
- Rose of Sharon (*Hibiscus syriacus*) – Dormant
- Japanese honeysuckle (*Lonicera japonica*) – Partial leaf out, ½ expansion
- Bush honeysuckle (*Lonicera maackii*) – Partial leaf out. ¾ expansion

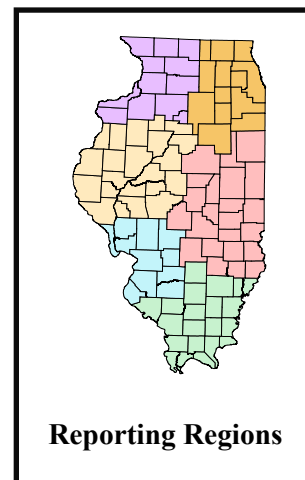
- Japanese stiltgrass (*Microstegium vimineum*) – Seedlings germinated, still only with cotyledon leaf
- Callery (Bradford) pear (*Pyrus calleryana*) – Full bloom, leaves starting to emerge
- Multiflora rose (*Rosa multiflora*) – Partial leaf out, ¼ - ½ expansion

#### Southwest

- Bush honeysuckle (*Lonicera maackii*) – Partial leaf out. ¾ expansion

#### West Central

- Garlic mustard (*Alliaria petiolata*) - - Basal rosettes expanding but plants are not bolting yet
- Autumn olive (*Elaeagnus umbellata*) – Bud swell
- Bush honeysuckle (*Lonicera maackii*) – Bud break, leaves starting to expand
- Reed canary grass (*Phalaris arundinacea*) - Dormant
- Multiflora rose (*Rosa multiflora*) – Partial leaf out



### Interested in becoming an invasive plant phenology observer?

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**East Central**

- Garlic mustard (*Alliaria petiolata*) - Basal rosettes expanding but plants are not bolting yet
- Bull thistle (*Cirsium vulgare*) – Some green rosettes observed
- Poison hemlock (*Conium maculatum*) – Basal rosettes starting to expand but plants are not bolting yet
- Bush honeysuckle (*Lonicera maackii*) – Bud break, leaves starting to expand
- Moneywort (*Lysimachia nummularia*) – Active vegetative growth
- Wild parsnip (*Pastinaca sativa*) – Basal rosettes starting to expand but plants are not bolting yet
- Multiflora rose (*Rosa multiflora*) – Partial leaf out

**Northwest**

- Garlic mustard (*Alliaria petiolata*) - - Basal rosettes expanding but plants are not bolting yet
- Japanese barberry (*Berberis thunbergii*)
- Bush honeysuckle (*Lonicera maackii*) – Bud break, leaves starting to expand

**Northeast**

- Poison hemlock (*Conium maculatum*) - Dormant
- Common teasel (*Dipsacus fullonum*) - Dormant
- Autumn olive (*Elaeagnus umbellata*) – Starting bud break in portions of region
- Lesser celandine, aka fig buttercup (*Ficaria verna*) – Leaves are sprouting but no flowering observed yet
- Yellow sweet flag iris (*Iris pseudacorus*) - Dormant
- Bush honeysuckle (*Lonicera maackii*) – Bud swell, some leaf emergence observed
- Birdsfoot trefoil (*Lotus corniculatus*) – Dormant
- Purple loosestrife (*Lythrum salicaria*) – Dormant

- White sweet clover (*Melilotus albus*) – Dormant
- Yellow sweet clover (*Melilotus officinalis*) – Dormant
- Wild parsnip (*Pastinaca sativa*) - Dormant
- Reed canary grass (*Phalaris arundinacea*) – Shoots starting to emerge
- Phragmites (*Phragmites australis*) - Dormant
- Common buckthorn (*Rhamnus cathartica*) – Bud swell
- Multiflora rose (*Rosa multiflora*) - Dormant
- Crownvetch (*Securigera varia*) - Dormant

**Common and scientific names adhere to:**

ITIS (Integrated Taxonomic Information System). 2016. Online Database (<http://www.itis.gov>, 1 January 2016). Smithsonian Institution, Washington, DC.

**Invasive plant observations used to produce this report were provided by the following individuals:**

Michelle Berg Vogel, Tricia Bethke, Mike Davis, Marge Evans, Caleb Grantham, Jim Hinchey, Molly Lovelock, Denise Oberle, Phyllis Schulte, Karen Shelley, Eric Smith, Nick Seaton

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## April 2016

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### April 2016 General Summary

This advanced spring continues. Many of the species in the south are flowering and species in the north are starting leaf emergence.

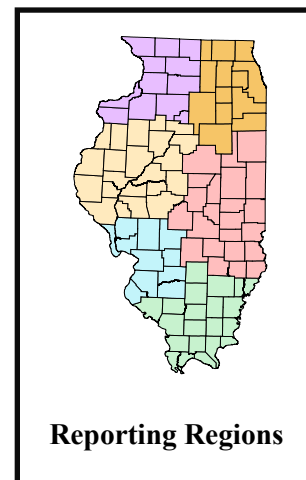
### Regional Reports

#### South

- Tree of Heaven (*Ailanthus altissima*) - Bud break and leaf emergence
- Mimosa (*Albizia julibrissin*) – Partial leaf out, ½ expansion
- Garlic mustard (*Alliaria petiolata*) – Full flower, no seed pods observed yet
- Oriental bittersweet (*Celastrus orbiculatus*) - Partial leaf out, ½ – ¾ expansion
- Poison hemlock (*Conium maculatum*) – Basal rosettes large but plants are not bolting yet
- Autumn olive (*Elaeagnus umbellata*) – Full leaf expansion, full flower but past peak
- Sericea lespedeza (*Lespedeza cuneata*) - New shoots growing, up to 12" tall
- Japanese honeysuckle (*Lonicera japonica*) – Full leaf expansion, no flowers observed
- Bush honeysuckle (*Lonicera maackii*) – Full leaf expansion, flower buds present, some flowering observed
- Japanese stiltgrass (*Microstegium vimineum*) – Plants 2"-

3" tall with 1-3 leaves

- Paulownia (*Paulownia tomentosa*) - Flowering, some trees in full flower, others just starting
- Phragmites (*Phragmites australis*) - New growth 20"-24" tall
- Callery (Bradford) pear (*Pyrus calleryana*) – Past bloom, nearing full leaf expansion
- Multiflora rose (*Rosa multiflora*) – Full leaf expansion



#### Southwest

- Tree of Heaven (*Ailanthus altissima*) - Bud swell and bud break
- Garlic mustard (*Alliaria petiolata*) – Bolting, starting to flower
- Autumn olive (*Elaeagnus umbellata*) – Full leaf expansion, Flowering
- Japanese hops (*Humulus japonicus*) - Seedlings emerging, up to 4" long
- Sericea lespedeza (*Lespedeza cuneata*) - Dormant
- Bush honeysuckle (*Lonicera maackii*) – Full leaf expansion, flower buds present
- Callery (Bradford) pear (*Pyrus calleryana*) – Flowering, past

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peak (25% of flowers remaining)

- Multiflora rose (*Rosa multiflora*) – Close to full leaf expansion, no flower buds present

#### West Central

- Autumn olive (*Elaeagnus umbellata*) – Full leaf expansion, no flowering reported
- Bush honeysuckle (*Lonicera maackii*) – Full leaf expansion, no flowering reported
- White mulberry (*Morus alba*) - Bud swell
- Multiflora rose (*Rosa multiflora*) – Full leaf expansion, no flowering reported

#### East Central

- Garlic mustard (*Alliaria petiolata*) – Plants starting to bolt, some in flower
- Bush honeysuckle (*Lonicera maackii*) – Full leaf expansion, no flower buds present
- Reed canary grass (*Phalaris arundinacea*) – New shoots plentiful
- Multiflora rose (*Rosa multiflora*) – Close to full leaf expansion, no flower buds present

#### Northwest

- Tree of Heaven (*Ailanthus altissima*) - Bud swell
- Garlic mustard (*Alliaria petiolata*) – Some plants bolting. Several with flower buds
- Japanese barberry (*Berberis thunbergii*) - Full leaf expansion, flower buds present
- Poison hemlock (*Conium maculatum*) – Basal rosettes expanding
- Bush honeysuckle (*Lonicera maackii*) – Bud break and leaves starting to emerge
- Common buckthorn (*Rhamnus cathartica*) – Bud break and leaves starting to emerge
- Multiflora rose (*Rosa multiflora*) – Bud break and leaves starting to emerge

#### Northeast

- Garlic mustard (*Alliaria petiolata*) – Some plants bolting.
- Teasel (*Dipsacus* sp.) - Rosettes expanding
- Japanese knotweed (*Fallopia japonica*) - Shoots just starting to emerge from the ground
- Lesser celandine, aka fig buttercup (*Ficaria verna*) – Full flower
- Yellow sweet flag iris (*Iris pseudacorus*) - Dormant
- Bush honeysuckle (*Lonicera maackii*) – Partial leaf out, ½ expansion
- Birdsfoot trefoil (*Lotus corniculatus*) - Dormant
- Purple loosestrife (*Lythrum salicaria*) - Dormant
- Sweet clovers (*Melilotus albus* and *M. officinalis*) - Dormant
- Wild parsnip (*Pastinaca sativa*) - Dormant
- Reed canary grass (*Phalaris arundinacea*) - Green shoots developing
- Phragmites (*Phragmites australis*) - Dormant
- Callery (Bradford) pear (*Pyrus calleryana*) – Full flower
- Common buckthorn (*Rhamnus cathartica*) – Bud break and leaves starting to emerge
- Multiflora rose (*Rosa multiflora*) – Bud swell
- Crownvetch (*Securigera varia*) - Dormant

**Invasive plant observations used to produce this report were provided by the following individuals:**

Bob Arevalo, Tricia Bethke, Joan Cox, Marge Evans, S.A. Fenwick, Carol Froeming, Jim Hinch, Sandy Humbert, Peter Lazar, Molly Lovelock, Bill Klunk, Melvin Konrath, Denise Oberle, Rosemary Phillips, and Phyllis Schulte

#### About the author(s):

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## May 2016

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### May 2016 General Summary

The southern portions of the state are moving out of the spring blooming period, while many of the invasive species in the northern regions are coming into peak bloom. Full leaf expansion is complete for invasive shrubs across the state, which means that herbicide treatments should be effective for all woody invaders.

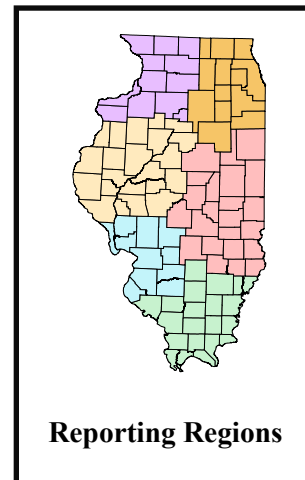
### Regional Reports

#### South

- Japanese chaff flower (*Achyranthes japonica*) - Plants actively growing, 12-14 inches tall. No flowers observed
- Tree of Heaven (*Ailanthus altissima*) - Full leaf expansion and active stem elongation. No flowering observed
- Mimosa (*Albizia julibrissin*) – Nearing full leaf expansion, no flowering observed
- Garlic mustard (*Alliaria petiolata*) – Flowering near completion. Only a few flowers observed. Unripe seed pods present on most second year plants
- Musk thistle (*Carduus nutans*) - Plants in full flower
- Poison hemlock (*Conium maculatum*) – Flowering stalks full height and most plants in bloom
- Queen Anne's lace (*Dacus carota*) - Starting to flower
- Chinese yam (*Dioscorea polystachya*) - Leaves expanding and vines actively elongating. No bulbil production

observed

- Teasel (*Dipsacus* spp) - Full rosettes with flowering stalks starting to form. No flowering observed
- Autumn olive (*Elaeagnus umbellata*) – Plants past bloom with no flowers observed. Immature fruit forming
- Dames rocket (*Hesperis matronalis*) - Plants in full flower
- Sericea lespedeza (*Lespedeza cuneata*) - Plants 18-24" tall, no flowering observed
- Japanese honeysuckle (*Lonicera japonica*) – Plant in full bloom in sunny sites, just starting to bloom in shade
- Bush honeysuckle (*Lonicera maackii*) – Past bloom, only a few plants have flowers remaining. Immature fruit present
- Sweet clovers (*Melilotus albus* and *M. officinalis*) - Plants are starting to flower
- Japanese stiltgrass (*Microstegium vimineum*) – Plants 2"-6" tall
- White mulberry (*Morus alba*) - Immature fruit present
- Paulownia (*Paulownia tomentosa*) - A few plants still blooming though most are past bloom
- Phragmites (*Phragmites australis*) - New growth 4'-6' tall. No flowers observed



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- Callery (Bradford) pear (*Pyrus calleryana*) – Immature fruit present
- Black locust (*Robinia pseudoacacia*) - Plants past bloom with no remaining flowers observed
- Multiflora rose (*Rosa multiflora*) – Plants are in full bloom

#### Southwest

- Poison hemlock (*Conium maculatum*) – Flowering stalks nearing full height (some up to seven feet tall) and flower buds formed on most second year plants, with a few starting to flower
- Autumn olive (*Elaeagnus umbellata*) – Plants past bloom with no flowers observed. Immature fruit forming
- Japanese hops (*Humulus japonicus*) - Vines actively growing, many now over two feet long
- Sericea lespedeza (*Lespedeza cuneata*) - Plants actively growing, many over 14" tall
- Japanese honeysuckle (*Lonicera japonica*) – Full leaf expansion and actively elongating vines. Flower buds present but no flowers observed
- Bush honeysuckle (*Lonicera maackii*) – Near past bloom. Only a few flowers remain. Immature fruit present
- Multiflora rose (*Rosa multiflora*) – Full leaf expansion, in full flower
- Black locust (*Robinia pseudoacacia*) - Past peak for blooms, only ~10% of flowers remain. First flowering in region observed 4/28/2016
- Curly dock (*Rumex crispus*) - In full flower

#### West Central

- Garlic mustard (*Alliaria petiolata*) - Flowering past peak. Seed pods forming
- Bush honeysuckle (*Lonicera maackii*) – In full flower, just past peak flowering
- Reed canary grass (*Phalaris arundinacea*) - Plants actively growing but no flowers or flower development observed
- Multiflora rose (*Rosa multiflora*) – Plants just starting to flower

#### East Central

- Garlic mustard (*Alliaria petiolata*) – Plants in full flower with seed pods starting to form
- Poison hemlock (*Conium maculatum*) – Flower stalks bolting, some plants in flower
- Autumn olive (*Elaeagnus umbellata*) – Plants past bloom with no flowers observed. Immature fruit forming
- Dames rocket (*Hesperis matronalis*) - Plants in full flower
- Bush honeysuckle (*Lonicera maackii*) – Plants in full

flower with some immature fruit forming

- Multiflora rose (*Rosa multiflora*) – Full leaf expansion, starting to bloom

#### Northwest

- Tree of Heaven (*Ailanthus altissima*) - Partial leaf out, 3/4 expansion
- Garlic mustard (*Alliaria petiolata*) – Plants in full flower with seed pods starting to form
- Japanese barberry (*Berberis thunbergii*) - Full leaf expansion, Immature fruit present
- Oriental bittersweet (*Celastrus orbiculatus*) - Full leaf expansion, flower buds forming
- Poison hemlock (*Conium maculatum*) – Plants starting to bolt, now 2'-3' tall but no flowers observed
- Queen Anne's lace (*Dacus carota*) - Rosettes actively expanding, no flowering stalk formed yet
- Burning bush (*Euonymus alatus*) - Plants in full flower
- Bush honeysuckle (*Lonicera maackii*) – Full leaf expansion. Flower buds forming with some plants starting to flower
- Common buckthorn (*Rhamnus cathartica*) – Full leaf expansion with flower buds forming
- Multiflora rose (*Rosa multiflora*) – Full leaf expansion with flower buds forming

#### Northeast

- Garlic mustard (*Alliaria petiolata*) – Plants in full flower with seed pods starting to form
- Japanese barberry (*Berberis thunbergii*) - Full leaf expansion
- Canada thistle (*Cirsium arvense*) - Plants actively growing, now 6"-8" inches tall
- Poison hemlock (*Conium maculatum*) – Rosettes actively growing, flowering stalks not yet forming
- Teasel (*Dipsacus* sp.) -Expanding rosettes, plants ~12" tall beginning to form flowering stalk
- Autumn olive (*Elaeagnus umbellata*) – Plants in full flower in open areas, just starting to flower in more shaded environments
- Lesser celandine, aka fig buttercup (*Ficaria verna*) – Plants past flowering, starting to senesce
- Yellow sweet flag iris (*Iris pseudacorus*) - Actively growing, but not flowering
- Bush honeysuckle (*Lonicera maackii*) – Full leaf expansion with flower buds forming. Plants starting to bloom

- Birdsfoot trefoil (*Lotus corniculatus*) - Actively growing, not yet in flower
- Purple loosestrife (*Lythrum salicaria*) - Actively growing, not yet in flower
- Sweet clovers (*Melilotus albus* and *M. officinalis*) - growing, not yet in flower
- Wild parsnip (*Pastinaca sativa*) - Starting to flower
- Reed canary grass (*Phalaris arundinacea*) - New growth 12"-15" tall, not flowering
- Phragmites (*Phragmites australis*) - Plants actively growing, forming stalks are 18"-24" tall
- Common buckthorn (*Rhamnus cathartica*) – Full leaf expansion, flower buds present
- Multiflora rose (*Rosa multiflora*) – Full leaf expansion and new canes actively growing. No flowers observed
- Crownvetch (*Securigera varia*) - Plants actively growing, flower buds present

#### 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

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### June 2016 General Summary

June is a transition month for invasive species in Illinois. Most of the woody invaders have finished flowering across the state. Garlic mustard has moved from flowering to fruiting and is already dropping seeds in the southern region. Teasel is close to flowering throughout Illinois, making it the perfect time to find and treat this invader.

### Regional Reports

#### South

- Japanese chaff flower (*Achyranthes japonica*) - Plants actively growing, 24+ inches tall. No flowers observed
- Mimosa (*Albizia julibrissin*) – Plants just starting to flower
- Garlic mustard (*Alliaria petiolata*) – Siliques (seed pods) dried and actively dropping seed. Foliage is yellowing or browning throughout most plants
- Poison hemlock (*Conium maculatum*) – Plants nearly done blooming, most plants in seed
- Queen Anne's lace (*Dacus carota*) - Full bloom
- Chinese yam (*Dioscorea polystachya*) - Vines actively elongating. No bulbil production observed
- Teasel (*Dipsacus* spp) - Plants finished bolting and flower heads forming but no open flowers observed yet
- Autumn olive (*Elaeagnus umbellata*) – Immature fruit continues to develop

- Sericea lespedeza (*Lespedeza cuneata*) - Plants over 36" tall, starting to form side branches. Plants just starting to flower

- Japanese honeysuckle (*Lonicera japonica*) – Plants still flowering but past peak

- Bush honeysuckle (*Lonicera maackii*) – Immature fruit continues to develop

- Sweet clovers (*Melilotus albus* and *M. officinalis*) - Yellow sweet clover past peak for flowering with fruits forming on many plants. White sweet clover in full bloom

- Japanese stiltgrass (*Microstegium vimineum*) – Plants 12"-18" tall and actively growing.

- Paulownia (*Paulownia tomentosa*) - Seed capsules fully formed but not ripe

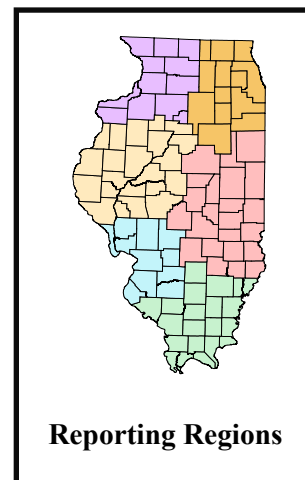
- Reed canary grass (*Phalaris arundinacea*) - Past bloom, seeds forming

- Phragmites (*Phragmites australis*) - Plants 8'-10' tall. No flowers observed

- Multiflora rose (*Rosa multiflora*) – Past bloom, immature fruit developing

- Johnsongrass (*Sorghum halepense*) - Full bloom

- Hedge parsley (*Torilis japonica*) - Full bloom



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*Southwest*

- Tree of Heaven (*Ailanthus altissima*) - Past flowering. Fruit nearly full size but not yet mature
- Musk thistle (*Carduus nutans*) - Past peak bloom, starting to set seed. Flower heads actively drooping
- Oriental bittersweet (*Celastrus orbiculatus*) - Active vegetative growth (only seedlings observed)
- Poison hemlock (*Conium maculatum*) – Past peak bloom. Fruit starting to form
- Autumn olive (*Elaeagnus umbellata*) – Immature fruit continues to develop
- Japanese knotweed (*Fallopia japonica*) - Starting to bloom
- Japanese hops (*Humulus japonicus*) - Vines actively growing, some over six feet long. Flower buds forming
- Sericea lespedeza (*Lespedeza cuneata*) - Plants now over three feet tall. Flower buds forming
- Bush honeysuckle (*Lonicera maackii*) – Immature fruit continues to develop
- Sweet clovers (*Melilotus albus* and *M. officinalis*) - Both yellow and white sweet clover in full bloom
- Reed canary grass (*Phalaris arundinacea*) - Flower heads fully formed
- Phragmites (*Phragmites australis*) - Plants 4’-5’ tall. No flowers observed
- Black locust (*Robinia pseudoacacia*) - Past flowering. Seed pods developing
- Crownvetch (*Securigera varia*) - Full bloom
- Johnsongrass (*Sorghum halepense*) - Flower heads forming. Some plants starting to bloom

*West Central*

- Garlic mustard (*Alliaria petiolata*) - Past flowering. Immature seed pods formed
- Musk thistle (*Carduus nutans*) - Full flower
- Bush honeysuckle (*Lonicera maackii*) – Past flowering, immature fruit developing
- Sweet clovers (*Melilotus albus* and *M. officinalis*) - Yellow sweet clover in full bloom, white sweet clover blooming but not yet at peak
- Wild parsnip (*Pastinaca sativa*) - Most plants in full flower with some areas past peak
- Reed canary grass (*Phalaris arundinacea*) - Full flower
- Multiflora rose (*Rosa multiflora*) – Plants nearly finished flowering. Only a few flowers remain. Immature fruit developing

- Puncture vine (*Tribulus terrestris*) – Starting bud formation

*East Central*

- Garlic mustard (*Alliaria petiolata*) – Past flowering, immature seed pods present
- Canada thistle (*Cirsium arvense*) - Past flowering, starting to set seed
- Bull thistle (*Cirsium vulgare*) - Plants bolting and starting to form flower buds
- Poison hemlock (*Conium maculatum*) – Full bloom. Some plants starting to set seed
- Teasel (*Dipsacus* spp) - Plants bolting and flower heads forming but no open flowers observed yet
- Bush honeysuckle (*Lonicera maackii*) – Past flowering. Immature fruit developing
- Sweet clovers (*Melilotus albus* and *M. officinalis*) - Yellow sweet clover in full bloom, white sweet clover blooming but not yet at peak
- Wild parsnip (*Pastinaca sativa*) - Full bloom
- Multiflora rose (*Rosa multiflora*) – Past flowering
- Crownvetch (*Securigera varia*) - Flowering in some areas, starting to set seed in others

*Northwest*

- Garlic mustard (*Alliaria petiolata*) – Past flowering, seed pods and leaves starting to dry
- Japanese barberry (*Berberis thunbergii*) - Immature fruit continue to develop
- Poison hemlock (*Conium maculatum*) – Full bloom
- Queen Anne’s lace (*Dacus carota*) - Flower stalks forming but no flowers yet
- Teasel (*Dipsacus* spp) - Plants bolting and flower heads forming but no open flowers observed yet
- Burning bush (*Euonymus alatus*) - Immature fruit present
- Bush honeysuckle (*Lonicera maackii*) – Nearly past flowering, blooms actively dropping. Immature fruit present
- Common buckthorn (*Rhamnus cathartica*) – Immature fruit present
- Multiflora rose (*Rosa multiflora*) – Nearly past flowering, blooms actively dropping. Immature fruit present

*Northeast*

- Garlic mustard (*Alliaria petiolata*) – Seed pods beginning to ripen and turn brown. Plants starting to yellow
- Poison hemlock (*Conium maculatum*) – Starting to flower
- Teasel (*Dipsacus* sp.) -Plants bolting, flower heads not visible yet

- Japanese knotweed (*Fallopia japonica*) - Full leaf expansion, no flowers observed
- Lesser celandine, aka fig buttercup (*Ficaria verna*) – Plants fully dormant
- Dames rocket (*Hesperis matronalis*) - Near past flowering. Most plants actively forming siliques (seed pods)
- Yellow sweet flag iris (*Iris pseudacorus*) - Slightly past bloom
- Bush honeysuckle (*Lonicera maackii*) – Past bloom, immature fruit forming
- Birdsfoot trefoil (*Lotus corniculatus*) - Peak bloom in some areas, just starting to bloom in others
- Purple loosestrife (*Lythrum salicaria*) - Full leaf expansion, not yet in flower
- Sweet clovers (*Melilotus albus* and *M. officinalis*) - Yellow sweet clover in full bloom. White sweet clover just starting to flower
- Wild parsnip (*Pastinaca sativa*) - Peak bloom, some seed starting to form
- Reed canary grass (*Phalaris arundinacea*) - Flowering and some seed starting to form
- Common buckthorn (*Rhamnus cathartica*) – Past bloom, immature fruit developing
- Multiflora rose (*Rosa multiflora*) – Plants in various stages of flowering. Some plants in full bloom, others are dropping petals. Others completely past bloom
- Crownvetch (*Securigera varia*) - Full bloom

### 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

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# Invasive Plant Phenology Report

## July 2016

Christopher W. Evans, Extension Forestry and Research Specialist  
Department of Natural Resources and Environmental Sciences



This University of Illinois Extension Technical Forestry Bulletin series provides monthly reports on the development of invasive plant species in Illinois. Reports are summarized by region and produced from field observations collected between the 8th and 14th of each month.

Phenology is the study of seasonal natural phenomena. This observational project tracks the phenology of invasive plant species in Illinois throughout the growing season, noting when plants initiate growth, start flowering, ripen seeds, become dormant, etc. Data on the phenology of invasive plants is critical information for the development of effective management programs.

### July 2016 General Summary

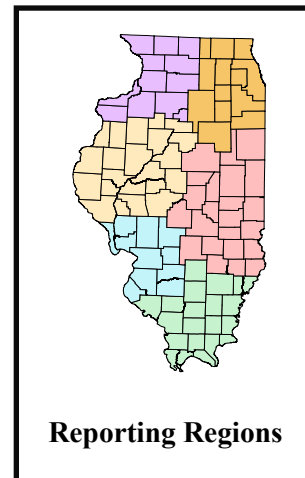
July moves us fully into the summer throughout the state. Garlic mustard is now dropping seeds throughout the state. Many of the woody plants are starting to form ripe fruit and summer plants such as teasel are in full bloom. A note on one format change for this month's report—Since several species of bush honeysuckle occurs in Illinois, the specific species will be specified when known, otherwise the report will just state *Lonicera* sp.

### Regional Reports

#### South

- Japanese chaff flower (*Achyranthes japonica*) - Plants actively forming side branches. No flowers observed
- Tree of Heaven (*Ailanthus altissima*) - Fruit clusters not yet dried
- Mimosa (*Albizia julibrissin*) – Full bloom
- Garlic mustard (*Alliaria petiolata*) – Plants fully senesced. Most seeds have already dropped
- Poison hemlock (*Conium maculatum*) – Most plants fully senesced with dry fruit that are actively dropping seed
- Queen Anne's lace (*Dacus carota*) - Still blooming heavily, but many plants forming seed
- Chinese yam (*Dioscorea polystachya*) - Bulbils forming in leaf axils

- Teasel (*Dipsacus* spp) - Both species in full bloom. Central flowers on common teasel are finished flowering and starting seed production
- Autumn olive (*Elaeagnus umbellata*) – Some plants have ripe fruit, others are actively ripening but most plants have only immature fruit
- Sericea lespedeza (*Lespedeza cuneata*) - Plants continuing to form side branches
- Privet (*Ligustrum* spp.) - Past flowering, immature fruit present
- Japanese honeysuckle (*Lonicera japonica*) – Some flowers still remain, though well past peak
- Amur honeysuckle (*Lonicera maackii*) – Immature fruit continues to develop, no ripening observed
- Birdsfoot trefoil (*Lotus corniculatus*) - Peak bloom, fruit developing
- Sweet clovers (*Melilotus albus* and *M. officinalis*) - Most plants past flowering and actively dropping seed. A few yellow sweet clover still have flowers
- Japanese stiltgrass (*Microstegium vimineum*) – Plants 18"-24" tall, actively growing. No flowering observed



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- Paulownia (*Paulownia tomentosa*) - Seed capsules fully formed but not ripe
- Beefsteak plant (*Perilla frutescens*) - Plants 18"-48" tall, no flowering observed
- Reed canary grass (*Phalaris arundinacea*) - Seeds drying and actively dropping
- Phragmites (*Phragmites australis*) - Plants 8'-10' tall. No flowers observed
- Multiflora rose (*Rosa multiflora*) – Immature fruit developing
- Crownvetch (*Securigera varia*) - Past peak flowering, starting fruit development
- Johnsongrass (*Sorghum halepense*) - Past peak flowering, seeds starting to form

#### Southwest

- Tree of Heaven (*Ailanthus altissima*) - Fruits mature and just starting to dry
- Poison hemlock (*Conium maculatum*) – Plants yellowing as they senesce. One plants with flowers remaining observed
- Autumn olive (*Elaeagnus umbellata*) – Plants heavily loaded with fruit, fruit still immature but expanding. Currently ¼" long and 1/8" wide
- Japanese hops (*Humulus japonicus*) - Mature vines over 10 ft long, flowers are starting to open on a few vines
- Sericea lespedeza (*Lepedeza cuneata*) - Plants vigorously growing, now over 3 feet tall. Flower buds forming but not yet open
- Amur honeysuckle (*Lonicera maackii*) – Immature fruit developing, approximately 5/32" diameter. Some individuals are starting a second flowering period
- Black locust (*Robinia pseudoacacia*) - Seeds pod are just starting to mature, most are still green. Average length about 4"

#### West Central

- Garlic mustard (*Alliaria petiolata*) - Plants senesced, actively dropping seed
- Musk thistle (*Carduus nutans*) - Most have gone to seed and dispersed, some with flowers or seeds still on plant
- Queen Anne's lace (*Dacus carota*) - Full bloom
- Bush honeysuckle (*Lonicera spp.*) – Ripe fruit present
- Sweet clovers (*Melilotus albus* and *M. officinalis*) - Yellow sweet clover mostly forming seed, but flowers remain on just a few plants. White sweet clover plants either flowering or just past

- Wild parsnip (*Pastinaca sativa*) - Mostly in seed, but some new flowers developing, especially on plants previously mowed
- Reed canary grass (*Phalaris arundinacea*) - Past flowering. Seeds maturing, with some plants actively dropping seed
- Multiflora rose (*Rosa multiflora*) – Plants past flowering. Immature fruit developing

#### East Central

- Garlic mustard (*Alliaria petiolata*) – Fruit dry, some plants already dropped their seed. First year rosettes observed
- Amur honeysuckle (*Lonicera maackii*) – Immature fruit present
- Multiflora rose (*Rosa multiflora*) – Past flowering, no mature fruit observed

#### Northwest

- Garlic mustard (*Alliaria petiolata*) – Plants almost totally dry, just a few greenish leaves left at the bottom of the plants. Seed heads opening and starting to drop seed
- Japanese barberry (*Berberis thunbergii*) - No mature fruit observed
- Poison hemlock (*Conium maculatum*) – Flowers heads drying, seeds formed. Plants starting to senesce
- Queen Anne's lace (*Dacus carota*) - Full bloom
- Teasel (*Dipsacus spp*) - Flowering, some seed heads finished flowering, but fruit still developing, not yet ripe
- Burning bush (*Euonymus alatus*) - No mature fruit observed
- Bush honeysuckle (*Lonicera sp.*) – Likely Morrow's or Tartarian honeysuckle, Mature, ripe fruit present
- Multiflora rose (*Rosa multiflora*) – Past flowering, immature fruit present

#### Northeast

- Goutweed (*Aegopodium podagraria*) - Seeds beginning to yellow, leaves beginning to crisp
- Garlic mustard (*Alliaria petiolata*) – Fruits dried and actively dropping seed
- Canada thistle (*Cirsium arvense*) - Approximately 50% of seed is fully ripe and seeds are starting to disperse
- Poison hemlock (*Conium maculatum*) – Immature fruit present
- Queen Anne's lace (*Dacus carota*) - Larger individuals in full flower, smaller individuals with developed, but unopened heads
- Teasel (*Dipsacus sp.*) -Just starting to flower in some areas of the region. Other areas report full flower

- Japanese knotweed (*Fallopia japonica*) - Full leaf expansion, plants reaching full height. Flower buds developing. Some plants the flower stalks are well developed and near opening. Other plants the flower stalks are just starting to bud
- Lesser celandine, aka fig buttercup (*Ficaria verna*) – Plants fully dormant
- Yellow sweet flag iris (*Iris pseudacorus*) - Immature fruit present
- Amur honeysuckle (*Lonicera maackii*) – Immature fruit forming. A few individual plants had a few flowers remaining
- Morrow's honeysuckle (*Lonicera morrowii*) - Fruit mature, fully ripe
- Birdfoot trefoil (*Lotus corniculatus*) - Flowering and producing seed
- Purple loosestrife (*Lythrum salicaria*) - Full bloom
- Sweet clovers (*Melilotus albus* and *M. officinalis*) - Most individuals are past peak flower, though some flowers remain. Early seed development with immature, green fruit
- Wild parsnip (*Pastinaca sativa*) - Immature fruit present
- Reed canary grass (*Phalaris arundinacea*) - Seed heads are papery and seed is ripe and being dispersed
- Phragmites (*Phragmites australis*) - Plants 5'-6' tall. No flowers observed
- Common buckthorn (*Rhamnus cathartica*) – Green, immature fruit present. Some reporters noted ripe fruit present
- Multiflora rose (*Rosa multiflora*) – Immature fruit developing
- Crownvetch (*Securigera varia*) - Full bloom

### 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

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# Invasive Plant Phenology Report

## August 2016

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### August 2016 General Summary

August is a transition month between the flowering and fruit set of summer and the senescence and move to dormancy of fall. Many of the spring blooming plants are now either completely dormant or starting to shut down for the year and the fruit of summer-blooming plants are ripening. Not many species are actively flowering at this point, with the exception of a few of the summer-blooming plants like teasel, bull thistle and purple loosestrife and the fall-flowering invasives, such as Japanese chaff flower.

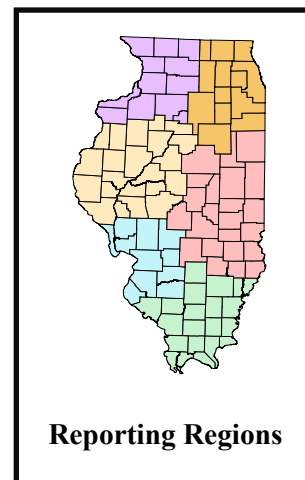
### Regional Reports

#### South

- Japanese chaff flower (*Achyranthes japonica*) - Full bloom
- Mimosa (*Albizia julibrissin*) – Past peak flowering. Only a few flowers remain, mostly immature, green seed pods
- Garlic mustard (*Alliaria petiolata*) – Second year plants completely dry and dormant. Fruit are dry and open and almost all seeds have fallen
- Poison hemlock (*Conium maculatum*) – Plants dormant, seeds mostly completely fallen off
- Queen Anne's lace (*Dacus carota*) - Past flowering, seeds actively dropping and second year plants drying
- Teasel (*Dipsacus* spp) - Common teasel past flowering, fruit mature and starting to release seeds. Plants nearly

completely dry. Cutleaf teasel past peak flowering. Older flower heads are drying and starting to release seed. Leaves are starting to yellow

- Autumn olive (*Elaeagnus umbellata*) – Most plants with ripe fruit, though some are still only near ripe
- Sericea lespedeza (*Lespedeza cuneata*) - Flowering, near peak
- Privet (*Ligustrum* spp.) - Immature, green fruit present
- Japanese honeysuckle (*Lonicera japonica*) – Plants still sporadically flowering
- Amur honeysuckle (*Lonicera maackii*) – Immature, green fruit present
- Birdsfoot trefoil (*Lotus corniculatus*) - Most plants with mature or green fruit, some plants still flowering
- Sweet clovers (*Melilotus albus* and *M. officinalis*) - Second year plants of both yellow and white sweet clover are completely dry and dormant and most seeds have fallen
- Japanese stiltgrass (*Microstegium vimineum*) – Plants are near full height but no flowering observed
- Reed canary grass (*Phalaris arundinacea*) - Seeds actively dropping from plant. Nearly all have already fallen. Flowering stalks starting to yellow. Non-flowering portions still green and actively growing



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- Phragmites (*Phragmites australis*) - Full height, just starting to flower
- Kudzu (*Pueraria montana*) - Full bloom. Petals starting to fall off flowers
- Crownvetch (*Securigera varia*) - Nearly past flowering, only a few sporadic flowers remain. Most plants in fruit
- Johnsongrass (*Sorghum halepense*) - Past flowering, seeds mature and actively dropping

#### Southwest

- Autumn olive (*Elaeagnus umbellata*) – Fruit nearly ripe, pale red and soft
- Japanese hops (*Humulus japonicus*) - Plants flowering. Some plants have seeds starting to develop. Mature vines over 10ft long
- Sericea lespedeza (*Lespedeza cuneata*) - Flower buds developing but not yet open
- Amur honeysuckle (*Lonicera maackii*) – Immature, green fruit present
- Black locust (*Robinia pseudoacacia*) - Seeds pods mature. Average length about 4". All seed pods completely dry and over 50% have fallen

#### West Central

- Garlic mustard (*Alliaria petiolata*) - Plants dormant, actively dropping seed
- Musk thistle (*Carduus nutans*) - Plants with fully mature seed that are actively dispersing
- Queen Anne's lace (*Dacus carota*) - Some plants in flower, some past flowering
- Sweet clovers (*Melilotus albus* and *M. officinalis*) - Yellow sweet clover past flowering and now producing fruit. White sweet clover has a few plants still flowering, most producing fruit
- Wild parsnip (*Pastinaca sativa*) - Second year plants dry. Fruits fully formed and mature and seeds actively dropping
- Reed canary grass (*Phalaris arundinacea*) - Mature fruit, seeds actively dropping
- Multiflora rose (*Rosa multiflora*) – Small fruits forming, some are starting to ripen

#### East Central

- Garlic mustard (*Alliaria petiolata*) - Plants dormant, actively dropping seed
- Poison hemlock (*Conium maculatum*) – Second year plants turning yellow and starting to dry. Seeds are actively falling
- Teasel (*Dipsacus* spp) - Past peak of flowering and seed

heads start to turn brown

- Sweet clovers (*Melilotus albus* and *M. officinalis*) - Both species are beginning to go dormant and going to seed. Plant have black spots on the stems, indicating the start of senescence
- Crownvetch (*Securigera varia*) - Fruit is curling and ripening. No flowering observed
- Hybrid cattail (*Typha x glauca*) - Fruit beginning to get lighter in color and a few have feathery seeds starting

#### Northwest

- Garlic mustard (*Alliaria petiolata*) – First year rosettes green and growing. Second year flowering stalks totally dry and dormant. Fruit actively dropping seed with about 1/2 of fruit already opened and lost seed
- Japanese barberry (*Berberis thunbergii*) - Unripe fruit present, some leaves starting to change color
- Poison hemlock (*Conium maculatum*) – Second year plants dry and dormant. Seed heads dried, falls apart easily and are actively dropping seed
- Queen Anne's lace (*Dacus carota*) - Plants past flowering, seed heads forming
- Teasel (*Dipsacus* spp) - Past flowering, seed heads forming
- Burning bush (*Euonymus alatus*) - Unripe fruit present
- Bush honeysuckle (*Lonicera* sp.) – Likley Tartarian or morrow's honeysuckle. Berries with ripe fruit that are starting to dry and wrinkle
- Amur honeysuckle (*Lonicera maackii*) - Immature, green fruit present
- Common buckthorn (*Rhamnus cathartica*) – Immature, green fruit present
- Multiflora rose (*Rosa multiflora*) – Unripe fruit present, just starting to turn reddish

#### Northeast

- Garlic mustard (*Alliaria petiolata*) – Fruit dry, opening, and actively dropping seed. Basal rosettes recently germinated and are still small
- Spotted knapweed (*Centaurea stoebe*) - Flowering
- Canada thistle (*Cirsium arvense*) - Seed is mature, 'fluffy' and actively dispersing. Some plants observed with new blooms
- Bull thistle (*Cirsium vulgare*) - Full bloom
- Poison hemlock (*Conium maculatum*) – Past flowering, fruit developing
- Teasel (*Dipsacus* sp.) - Flowering ranges from full flower to past bloom. Large quantities of rosettes noted. Cutleaf teasel – most have flowers and half gone to seed on top



part of plant. Bottom leaves of flowering plants are yellowing

- Lesser celandine, aka fig buttercup (*Ficaria verna*) – Plants fully dormant
- Yellow sweet flag iris (*Iris pseudacorus*) - Immature fruit present
- Bush honeysuckle (*Lonicera sp.*) – Likley Tartarian or morrow's honeysuckle. Mature fruit starting to dry and wrinkle
- Amur honeysuckle (*Lonicera maackii*) – Immature, green fruit present
- Birdfoot trefoil (*Lotus corniculatus*) - Past flowering, fruit forming
- Purple loosestrife (*Lythrum salicaria*) - Full bloom
- Sweet clovers (*Melilotus albus* and *M. officinalis*) - Both species past flowering and producing fruit
- Wild parsnip (*Pastinaca sativa*) - Mature fruit present
- Reed canary grass (*Phalaris arundinacea*) - Mature seed present
- Phragmites (*Phragmites australis*) - Plants 5'-6' tall with flower plumes developing
- Common buckthorn (*Rhamnus cathartica*) – Green, immature fruit present.
- Multiflora rose (*Rosa multiflora*) – Immature fruit developing
- Crownvetch (*Securigera varia*) - Plant flowering, but past peak, and producing fruit

### 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

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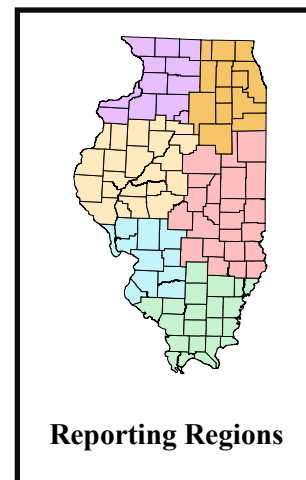
For September, across Illinois the transition into fall is ongoing with most of the invasive plants we are tracking either already dormant or in seed. The common invasive shrubs, such as bush honeysuckle, autumn olive, and common buckthorn all have ripe fruit and, in some sections, the fruit are starting to fall. Very few invasive plants are actively in bloom, with purple loosestrife and sericea lespedeza being the main exceptions.

### Regional Reports

#### South

- Japanese chaff flower (*Achyranthes japonica*) - Flowering spikes elongating and only a few flowers remain at the tip. Most of the spike has immature green fruit
- Mimosa (*Albizia julibrissin*) – Seed pods full size and starting to turn brown
- Garlic mustard (*Alliaria petiolata*) – Second year plants completely dry and dormant. Fruit are dry and open and seeds have fallen
- Poison hemlock (*Conium maculatum*) – Plants dormant, seeds have fallen
- Queen Anne’s lace (*Dacus carota*) - Plants completely dry
- Teasel (*Dipsacus* spp) - Plants completely dry and dropping seed

- Autumn olive (*Elaeagnus umbellata*) – Fruit fully ripe and starting to fall
- Sericea lespedeza (*Lespedeza cuneata*) - Past peak flower with most plants having only a few flowers remaining. Immature, green fruit forming
- Privet (*Ligustrum* spp.) - Fruit still green and immature
- Japanese honeysuckle (*Lonicera japonica*) – A few flowers can still be found on plants
- Amur honeysuckle (*Lonicera maackii*) – Most plants with fully ripe fruit. Some plants fruit are not yet fully ripe and bright red. Some leaves starting to drop.
- Birdsfoot trefoil (*Lotus corniculatus*) - Past flowering, mature seed pods
- Sweet clovers (*Melilotus albus* and *M. officinalis*) - Second year plants of both yellow and white sweet clover are completely dry and dormant and seeds have fallen. First year plants actively growing
- Japanese stiltgrass (*Microstegium vimineum*) – ‘Boot stage’ flowers forming but not erupted from stem yet
- Paulownia (*Paulownia tomentosa*) - Fruit pods still green and unopened
- Reed canary grass (*Phalaris arundinacea*) - Seed completely



### Interested in becoming an invasive plant phenology observer?

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fallen and plants showing significant die back, particularly plants with flowering stems

- Phragmites (*Phragmites australis*) - Flower heads transitioning to seeds
- Kudzu (*Pueraria montana*) - In flower, mostly lower on vines
- Crownvetch (*Securigera varia*) - Past flowering, plants starting to die back
- Johnsongrass (*Sorghum halepense*) - Seeds have completely fallen off of most plants. Some plants starting to yellow

#### Southwest

- Autumn olive (*Elaeagnus umbellata*) – All fruit starting to dry, 90% have fallen. Remaining fruit is shriveled and juicy
- Japanese hops (*Humulus japonicus*) - Seed heads are fully formed, starting to dry. 10% of seeds have fallen
- Sericea lespedeza (*Lespedeza cuneata*) - Full bloom
- Amur honeysuckle (*Lonicera maackii*) – Fruit ripe
- Black locust (*Robinia pseudoacacia*) - All seed pods completely dry and over 90% have fallen

#### West Central

- Autumn olive (*Elaeagnus umbellata*) – Fruit mostly ripe
- Amur honeysuckle (*Lonicera maackii*) – Fruit mostly ripe, some still ripening. Some plants show second flowering period
- Multiflora rose (*Rosa multiflora*) – Leaves still dark green, no signs of yellowing

#### East Central

- Garlic mustard (*Alliaria petiolata*) - Second year plants completely dormant, some first year rosettes growing
- Autumn olive (*Elaeagnus umbellata*) – Fruit present. Some plants with ripe fruit, others ripening
- Amur honeysuckle (*Lonicera maackii*) – Berries ripening, leaves still dark green
- Multiflora rose (*Rosa multiflora*) – Leaves starting to yellow
- Crownvetch (*Securigera varia*) - Seed pods dark and ripe. Most leaves are still green, but stems are starting to darken

#### Northwest

- Garlic mustard (*Alliaria petiolata*) – 1st year plants – small rosettes, second year plants – dry, only seed stalk remaining with seeds actively falling
- Poison hemlock (*Conium maculatum*) – Plants totally

dried, seeds heads dried and most seeds have fallen. First year rosettes still present

- Queen Anne's lace (*Dacus carota*) - Plants totally dried
- Bush honeysuckle (*Lonicera sp.*) – Likely Tartarian or morrow's honeysuckle. Berries have dropped or been eaten, Leaves still green
- Amur honeysuckle (*Lonicera maackii*) - Red berries starting to darken
- Common buckthorn (*Rhamnus cathartica*) – Fruit ripe
- Multiflora rose (*Rosa multiflora*) – Fruit ripening, starting to color

#### Northeast

- Garlic mustard (*Alliaria petiolata*) – Second year plants totally dried
- Teasel (*Dipsacus sp.*) - Second year plants almost fully brown, seed is dispersed. Rosettes are present
- Bush honeysuckle (*Lonicera sp.*) – Likely Tartarian or morrow's honeysuckle. Fruit ripe, some yellowing of leaves
- Amur honeysuckle (*Lonicera maackii*) – Fruit ripe
- Birdsfoot trefoil (*Lotus corniculatus*) - Seed pods are brown and mature
- Purple loosestrife (*Lythrum salicaria*) - Past full bloom, some flower stalks with seed maturing at bottom
- Sweet clovers (*Melilotus albus* and *M. officinalis*) - Plants completely dried
- Wild parsnip (*Pastinaca sativa*) - Plants drying
- Reed canary grass (*Phalaris arundinacea*) - Plants are browning at base, but still green near top
- Phragmites (*Phragmites australis*) - Seed heads full, but seeds still immature, leaves starting to yellow
- Common buckthorn (*Rhamnus cathartica*) – Fruit ripe
- Multiflora rose (*Rosa multiflora*) – Fruit fully developed

#### 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

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# Invasive Plant Phenology Report

## October 2016

Christopher W. Evans, Extension Forestry and Research Specialist  
Department of Natural Resources and Environmental Sciences



This University of Illinois Extension Technical Forestry Bulletin series provides monthly reports on the development of invasive plant species in Illinois. Reports are summarized by region and produced from field observations collected between the 8th and 14th of each month.

Phenology is the study of seasonal natural phenomena. This observational project tracks the phenology of invasive plant species in Illinois throughout the growing season, noting when plants initiate growth, start flowering, ripen seeds, become dormant, etc. Data on the phenology of invasive plants is critical information for the development of effective management programs.

### October 2016 General Summary

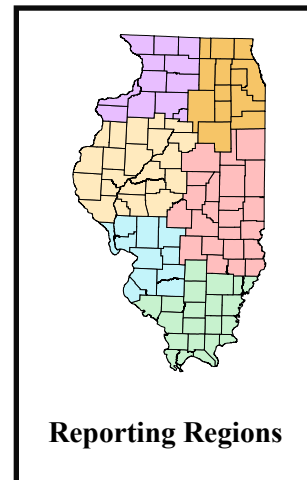
October moves us fully into fall as our invasives are done flowering, most fruit are ripe, and even the woody plants are showing signs of shutting down for the dormant season. As the leaves continue to change color and the weather becomes colder, foliar sprays are becoming less of an option. This is the ideal time to conduct cut stump or basal bark treatments.

### Regional Reports

#### South

- Japanese chaff flower (*Achyranthes japonica*) - Fruit spikes fully formed. Fruit still green and not easily detaching from plant. Leaves showing some signs of yellowing
- Mimosa (*Albizia julibrissin*) – Fruit dark brown and mature. Leaves still dark green
- Garlic mustard (*Alliaria petiolata*) – Second year plants dormant. Rosettes still green
- Poison hemlock (*Conium maculatum*) – Plants dormant, seeds have fallen
- Queen Anne’s lace (*Dacus carota*) - Plants completely dry
- Teasel (*Dipsacus* spp) - Plants completely dry and dropping seed
- Autumn olive (*Elaeagnus umbellata*) – Fruit fully ripe and starting to fall off. Plants just starting to have a few leaves yellowing or thinning

- Wintercreeper (*Euonymus fortunei*) - Fruit turning white as it ripens but not yet open
- Sericea lespedeza (*Lespedeza cuneata*) - Fruit dark brown and mature. Leaves starting to turn light green to yellow in color
- Privet (*Ligustrum* spp.) - Fruit still green, showing no signs of ripening. Leaves dark green with only a few starting to yellow
- Japanese honeysuckle (*Lonicera japonica*) – Still mostly dark green leaves. A few flowers still blooming. Fruit green with no ripe fruit found
- Amur honeysuckle (*Lonicera maackii*) – Fruit fully ripe and bright red. Plants showing some signs of leaf drop though most of the leaves are still dark green
- Birdsfoot trefoil (*Lotus corniculatus*) - Plants still mostly green. Fruit mature and actively falling
- Sweet clovers (*Melilotus albus* and *M. officinalis*) - Second year plants of both yellow and white sweet clover are completely dry and dormant and seeds have fallen. First year plants actively growing
- Japanese stiltgrass (*Microstegium vimineum*) – Plants in high light have mature, ripe seed and foliage is actively turning colors. Plants in more shaded conditions have fruit



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that are either still green and immature or just starting to ripen and senescence not as advanced

- Paulownia (*Paulownia tomentosa*) - Fruit capsules starting to darken and turn brown but still not opened. Leaves still dark green
- Reed canary grass (*Phalaris arundinacea*) - Seed completely fallen and plants showing significant die back, particularly plants with flowering stems
- Multiflora rose (*Rosa multiflora*) – Fruit ripe. Leaves just starting to thin and yellow
- Crownvetch (*Securigera varia*) - Leaves starting to yellow though mostly plants are still green
- Johnsongrass (*Sorghum halepense*) - Majority of fruit have fallen off. Leaves starting to change colors and plant starting to dry up and senesce

#### Southwest

- Autumn olive (*Elaeagnus umbellata*) – Almost all fruit have fallen. Plants starting to senesce as leaves are thinning and changing color
- Japanese hops (*Humulus japonicus*) - Seed heads are fully formed and drying with 50% seeds falling, Some plants are starting to senesce
- Sericea lespedeza (*Lespedeza cuneata*) - 50% of plants have seeds that are dry and falling. The rest of the plants have fruit that are still green and just starting to dry
- Amur honeysuckle (*Lonicera maackii*) – All fruit ripe and starting to dry and fall
- Black locust (*Robinia pseudoacacia*) - All seed pods completely dry and 99% have fallen

#### West Central

- Tree of Heaven (*Ailanthus altissima*) - Fruit dry and starting to fall. Leaves still dark green
- Garlic mustard (*Alliaria petiolata*) - Second year plants completely dormant, some first year rosettes growing
- Musk thistle (*Carduus nutans*) - Dormant
- Queen Anne's lace (*Dacus carota*) - Plants completely dry
- Autumn olive (*Elaeagnus umbellata*) – Fruit ripe on most plants
- Amur honeysuckle (*Lonicera maackii*) – – Fruit bright red, ripe and abundant . Some plants losing significant fruit to dropping or being eaten by birds
- Sweet clovers (*Melilotus albus* and *M. officinalis*) - Second year plants of yellow sweet clover are completely dry and dormant. White sweet clover has ripe fruit that is actively fallen

- Wild parsnip (*Pastinaca sativa*) - Plants senesced and dormant
- Reed canary grass (*Phalaris arundinacea*) - Seed completely fallen and plant starting to turn brown
- Multiflora rose (*Rosa multiflora*) – Fruit ripening, turning red-orange in color and nearly fully ripe

#### East Central

- No report submitted this month for this region

#### Northwest

- Garlic mustard (*Alliaria petiolata*) – 1st year plants – small rosettes, second year plants – dry, only seed stalk remaining with seeds actively falling
- Japanese barberry (*Berberis thunbergii*) - Fruits starting to ripen from yellow to red. Plants in shaded areas still with green fruit. Some plants starting to drop leaves and change color.
- Oriental bittersweet (*Celastrus orbiculatus*) - Fruit maturing and leaves still green
- Poison hemlock (*Conium maculatum*) – Plants totally dried, seeds heads dried and most seeds have fallen. First year rosettes 6”-8” tall
- Queen Anne's lace (*Dacus carota*) - Plants totally dried
- Teasel (*Dipsacus* spp) - Plants completely dry and dropping seed
- Autumn olive (*Elaeagnus umbellata*) – Fruit ripe, plants starting to senesce
- Burning bush (*Euonymus alatus*) - About half of the fruit turning red and half already split open
- Japanese hops (*Humulus japonicus*) - Fruits maturing, foliage still green
- Bush honeysuckle (*Lonicera* sp.) – Most plants with fully ripe fruit or fruit that has already fallen. Some plants with fruit still ripening. Some leaves beginning to yellow, particularly those grown in open environments. Shaded plants still dark green
- White mulberry (*Morus alba*) - Foliage still dark green
- Sweet clovers (*Melilotus* spp.) - First year plants actively growing and rather robust. Some approaching 30”
- Wild parsnip (*Pastinaca sativa*) - Rosettes in full sun are yellowing. Those in shade are still green
- Reed canary grass (*Phalaris arundinacea*) - Late-seasons greening occurring, no signs of second bloom
- Common buckthorn (*Rhamnus cathartica*) – Fruit ripe, Some plants starting to change color
- Multiflora rose (*Rosa multiflora*) – Fruit fully ripe. Leaves just beginning to curl and yellow

**Northeast**

- Garlic mustard (*Alliaria petiolata*) – Second year plants totally dried
- Teasel (*Dipsacus* sp.) - Second year plants dry, seed is dispersed. Rosettes are present
- Autumn olive (*Elaeagnus umbellata*) – Fruit ripe, plants just starting to senesce
- Tartarian honeysuckle (*Lonicera tatarica*) – Fruit has fallen or been eaten, Approximately 5% of leaves starting to yellow
- Amur honeysuckle (*Lonicera maackii*) – Fruit ripe, leaves still dark green
- Purple loosestrife (*Lythrum salicaria*) - Mature seed
- Sweet clovers (*Melilotus albus* and *M. officinalis*) - Plants completely dried
- Wild parsnip (*Pastinaca sativa*) - Plants dormant
- Reed canary grass (*Phalaris arundinacea*) - Upper portions of plants browning
- Phragmites (*Phragmites australis*) - 5-6 feet tall. Seed heads developed. Most plants with seed that is not ripe but some plants have seed actively dropping. Only a few leaves starting to show signs of yellowing
- Common buckthorn (*Rhamnus cathartica*) – Fruit ripe
- Multiflora rose (*Rosa multiflora*) – Fruit fully developed, no signs of senescence

**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

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# Invasive Plant Phenology Report

## November 2016

Christopher W. Evans, Extension Forestry and Research Specialist  
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### November 2016 General Summary

November moves many of our Illinois invasive plants into dormancy. Most of the woody plants have senesced. Seed has fallen on many plants. Many of the biennial plants have actively growing rosettes.

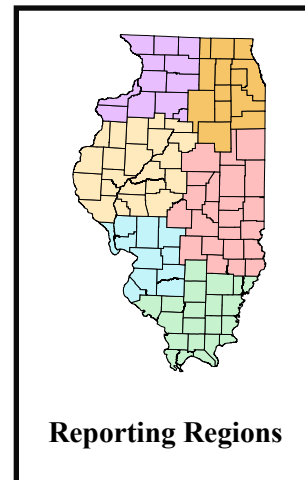
### Regional Reports

#### South

- Japanese chaff flower (*Achyranthes japonica*) - Plants completely dry and dormant. Dried stems remain standing with no leaves. Fruit dried, still on plant but easily falls off
- Mimosa (*Albizia julibrissin*) – Plant completely defoliated. Fruit dark brown and mature
- Poison hemlock (*Conium maculatum*) – Second year plants dormant, seeds have fallen. First year rosettes actively growing and robust
- Queen Anne's lace (*Dacus carota*) - Plants completely dry
- Teasel (*Dipsacus* spp) - Second year plants completely dry and have dropped seed. Rosettes actively growing
- Autumn olive (*Elaeagnus umbellata*) – Fruit fully ripe and falling off. Most plants showing thinning foliage or significant yellowing of leaves. Other plants still mostly green
- Burning bush (*Euonymus alatus*) - Plants bright red, in full

fall color. Fruit open and seeds falling off

- Wintercreeper (*Euonymus fortunei*) - Fruit ripe and open, seeds actively falling
- Sericea lespedeza (*Lespedeza cuneata*) - Plants completely dry and dormant. Fruit dry and open, dropping seed
- Privet (*Ligustrum* spp.) - Fruit ripe. Leaves starting to show some yellowing but still mostly green
- Japanese honeysuckle (*Lonicera japonica*) – No flowers observed. Fruit ripe. Leaves still dark green
- Amur honeysuckle (*Lonicera maackii*) – Fruit becoming over mature and starting to dry. Leaves mostly green, though starting to fade to lighter green or yellow
- Birdsfoot trefoil (*Lotus corniculatus*) - Plants dormant
- Sweet clovers (*Melilotus albus* and *M. officinalis*) - Second year plants of both yellow and white sweet clover are completely dry and dormant and seeds have fallen. First year plants actively growing
- Japanese stiltgrass (*Microstegium vimineum*) – Plants completely dry and dormant. Seeds have fallen
- Paulownia (*Paulownia tomentosa*) - Fruit capsules mature, dried, and open. Actively releasing seeds. Plants nearly completely defoliated



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- Multiflora rose (*Rosa multiflora*) – Fruit ripe. Leaves showing significant yellow. In most plants, 30%-40% of leaves remain
- Crownvetch (*Securigera varia*) - Leaves 90% defoliated
- Johnsongrass (*Sorghum halepense*) - Plants completely dry and dormant. All seeds have fallen off

#### Southwest

- Autumn olive (*Elaeagnus umbellata*) – Plants are just starting to senesce. About 10% of the leaves have turned yellow and no thinning observed yet. All fruit has fallen or been eaten on monitored plants
- Japanese hops (*Humulus japonicus*) - Plants are mostly in seasonal senescent decline. Only about 20% of leaves are still green. Remaining foliage gray or yellow. Most all seeds have dried and already fallen
- Sericea lespedeza (*Lespedeza cuneata*) - Most of sampled plants have seeds that are dry and readily falling. About 50% of all leaves are yellow. Foliage is slowly thinning
- Japanese honeysuckle (*Lonicera japonica*) – Fruit are dark green to black and juicy on most vines. All leaves are green and show no signs of decline. Foliage is full. Observed a few vines (<1%) with white and yellow blossoms
- Amur honeysuckle (*Lonicera maackii*) – About 50% of fruit is still on plants and full. Remaining balance of fruit are either completely dry or fallen. Foliage is full, green, and vibrant
- Black locust (*Robinia pseudoacacia*) - All seed pods have fallen. Only a trace of foliage remains

#### West Central

- Tree of Heaven (*Ailanthus altissima*) - 80% of mature trees have lost all leaves but samara still on branches. Saplings mostly still with green leaves but starting to yellow. Seedlings still bright green
- Garlic mustard (*Alliaria petiolata*) - Second year plants completely dormant, first year rosettes green and growing
- Autumn olive (*Elaeagnus umbellata*) – Some plants starting to turn color and thin foliage. Ripe fruit present but much have already fallen or been eaten
- Amur honeysuckle (*Lonicera maackii*) – Leaves still green, with some yellowing. Fruit bright red
- Sweet clovers (*Melilotus albus* and *M. officinalis*) - Flowering plants totally dried and dormant
- Reed canary grass (*Phalaris arundinacea*) - Seed completely fallen and plant turning brown

- Multiflora rose (*Rosa multiflora*) – Some plants defoliated, others with leaves turning color and thinning. Fruit ripe

#### East Central

- Garlic mustard (*Alliaria petiolata*) – First year rosettes have formed and are green
- Poison hemlock (*Conium maculatum*) – Healthy green rosettes
- Amur honeysuckle (*Lonicera maackii*) – Leaves still green with very few leaves starting to yellow. Fruit ripe and falling
- Wild parsnip (*Pastinaca sativa*) - Healthy green rosettes
- Multiflora rose (*Rosa multiflora*) – Most leaves have fallen but some green leaves remain
- Crownvetch (*Securigera varia*) - Green leaves still present

#### Northwest

- Garlic mustard (*Alliaria petiolata*) – 1st year plants – actively growing rosettes, second year plants – dry, only seed stalk remaining with seeds already fallen
- Japanese barberry (*Berberis thunbergii*) - Most fruits are ripened. Foliage is yellow in dense shade, dropped in open woods
- Oriental bittersweet (*Celastrus orbiculatus*) - Fruit maturing. Leaves yellowing
- Russian olive (*Elaeagnus angustifolia*) – Many fruits have been eaten. Leaves have dropped for the most part
- Autumn olive (*Elaeagnus umbellata*) – Many fruits have been eaten. Leaves have dropped for the most part
- Burning bush (*Euonymus alatus*) - Fruit still present, leaves just starting to change on some plants, others with about half the leaves red
- Japanese knotweed (*Fallopia japonica*) - Fruit mature, plants in shade have died back for the year. Plants in sun have yellow leaves
- Japanese hops (*Humulus japonicus*) - Leaves withered and dried
- Bush honeysuckle (*Lonicera sp.*) – Fruit darkening and many have fallen. Plants in woodlands turning yellow, plants in open areas dropping leaves
- White mulberry (*Morus alba*) - Foliage changing color
- Sweet clovers (*Melilotus spp.*) - First year plants actively growing and rather robust. Some approaching 30"
- Wild parsnip (*Pastinaca sativa*) - Rosettes in sun and shade are yellowed
- Reed canary grass (*Phalaris arundinacea*) - Late-seasons greening occurring, no signs of second bloom
- Common buckthorn (*Rhamnus cathartica*) – Some plants

still green, others have mostly dropped leaves. Fruit ripe

- Multiflora rose (*Rosa multiflora*) – Fruit fully ripe. Leaves thinning

#### Northeast

- Garlic mustard (*Alliaria petiolata*) – Rosettes growing and green
- Teasel (*Dipsacus* sp.) - Second year plants dry, seed is dispersed. Rosettes are present
- Autumn olive (*Elaeagnus umbellata*) – Fruit ripe, Leaves starting to yellow, especially on larger plants
- Tartarian honeysuckle (*Lonicera tatarica*) – Leaves are about 50% yellowed and dropping
- Amur honeysuckle (*Lonicera maackii*) – Fruit ripe. Mix of dull green and yellow leaves
- Purple loosestrife (*Lythrum salicaria*) - Mature seed
- Sweet clovers (*Melilotus albus* and *M. officinalis*) - Plants completely dried
- White mulberry (*Morus alba*) - Leaves yellowing and falling
- Reed canary grass (*Phalaris arundinacea*) - Nearly all seed dropped
- Phragmites (*Phragmites australis*) - Most stands are yellowed or brown. Some plants still green. Seed heads mature with seed dispersing
- Common buckthorn (*Rhamnus cathartica*) – Fruit ripe, mostly dropped or been eaten. Leaves starting to drop or turn color
- Multiflora rose (*Rosa multiflora*) – Fruit fully developed, fruit on some plants have already fallen or been eaten

#### 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.
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### December 2016 General Summary

December is truly the dormant season for almost all invasive plants in Illinois. Only a few hardy species, such as wintercreeper and Japanese honeysuckle are retaining a significant amount of leaves. Rosettes of biennial plants, such as teasel, poison hemlock, and garlic mustard are also green, though buried in snow over large portions of the state.

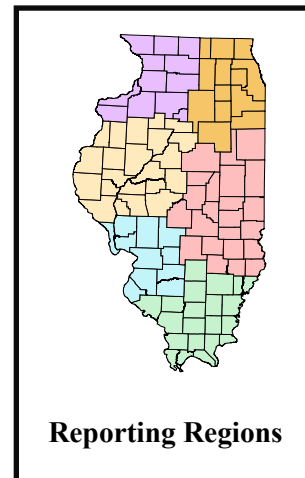
### Regional Reports

#### South

- Japanese chaff flower (*Achyranthes japonica*) - Plants completely dry and dormant. Dried stems remain standing with no leaves. Fruit dried, actively falling off
- Mimosa (*Albizia julibrissin*) – Plant completely defoliated. Fruit dark brown and mature
- Garlic mustard (*Alliaria petiolata*) - Rosettes are large in size, easily visible and green
- Oriental bittersweet (*Celastrus orbiculatus*) - Fruit still present on vines. Leaves are either fallen off or brown and shriveled
- Poison hemlock (*Conium maculatum*) – Second year plants dormant, seeds have fallen. First year rosettes actively growing and robust
- Queen Anne's lace (*Dacus carota*) - Plants completely dry
- Teasel (*Dipsacus* spp) - Second year plants completely

dry and have dropped seed. Rosettes actively growing

- Autumn olive (*Elaeagnus umbellata*) – Most of the fruit has fallen off or been eaten. Plants mostly defoliated. Some plants still retain a few leaves that are either brown and shriveled or yellowed
- Wintercreeper (*Euonymus fortunei*) - Fruit ripe and open, seeds actively falling
- Sericea lespedeza (*Lespedeza cuneata*) - Plants completely dry and dormant. Fruit dry and open, dropping seed
- Japanese honeysuckle (*Lonicera japonica*) – No flowers observed. Fruit ripe. Leaves still dark green, though foliage thinning since hard freeze
- Amur honeysuckle (*Lonicera maackii*) – Almost all leaves have fallen. Most of the fruit has been eaten or fallen. What remains is mostly shriveled. A few plants are still holding on to some yellow leaves
- Birdsfoot trefoil (*Lotus corniculatus*) - Plants dormant
- Sweet clovers (*Melilotus albus* and *M. officinalis*) - Second year plants of both yellow and white sweet clover are completely dry and dormant and seeds have fallen. First year plants actively growing



### Interested in becoming an invasive plant phenology observer?

The University of Illinois Extension Forestry Program relies on observations from volunteers to produce the monthly invasive plant phenology report. Anyone interested in becoming a volunteer observer should contact Chris Evans, Extension Forester at (618) 695-3383 or [cwevans@illinois.edu](mailto:cwevans@illinois.edu). Volunteers are asked to make monthly observations on three to four invasive species in their area.

- Japanese stiltgrass (*Microstegium vimineum*) – Plants completely dry and dormant. Seeds have fallen
- Paulownia (*Paulownia tomentosa*) - Fruit capsules mature, dried, and open with nearly all seeds dispersed. Plants completely defoliated
- Multiflora rose (*Rosa multiflora*) – Some fruit remaining on plants, leaves defoliated
- Johnsongrass (*Sorghum halepense*) - Plants completely dry and dormant. All seeds have fallen off

#### Southwest

- Poison hemlock (*Conium maculatum*) – First year rosettes are full and actively growing
- Autumn olive (*Elaeagnus umbellata*) – About 20% of foliage remains and is thinning quickly. All fruit has fallen or been eaten on monitored specimens
- Wintercreeper (*Euonymus fortunei*) - Vines with full and vibrant leaves
- Sericea lespedeza (*Lespedeza cuneata*) - All sampled plants have seeds that are dry and readily falling. All leaves have fallen
- Japanese honeysuckle (*Lonicera japonica*) – About 20% of fruit remains on vines, about half are still juicy. All leaves are green and show no signs of decline. Foliage is full and vibrant. No blossoms observed
- Amur honeysuckle (*Lonicera maackii*) – Leaves are yellowing and slightly thinning on woodland edge. Shrubs in understory show very little, if any decline or thinning. All fruit has fallen or been eaten
- Multiflora rose (*Rosa multiflora*) – Leaves thinning near base of shrubs, but remaining leaves (about 50%) are vibrant and green at ends of stems. Shrubs at the woodland edge and open areas are in slightly more seasonal decline

#### West Central

- Garlic mustard (*Alliaria petiolata*) - Second year plants completely dormant, first year rosettes green and growing
- Amur honeysuckle (*Lonicera maackii*) – Leaves mostly gone, but some wilted green leaves remain and just a few dried berries
- Reed canary grass (*Phalaris arundinacea*) - Mostly gone brown, but still green near water
- Multiflora rose (*Rosa multiflora*) – Leaves mostly gone, some fruit remain on plant

#### East Central

- Garlic mustard (*Alliaria petiolata*) – First year rosettes still green
- Amur honeysuckle (*Lonicera maackii*) – all plants, mature and immature still have some green leaves, mature plants are losing their berries

#### Northwest

- Garlic mustard (*Alliaria petiolata*) – Rosettes stayed lush green until first hard freeze, currently buried under several inches of snow
- Russian olive (*Elaeagnus angustifolia*) – Some plants held on to leaves until first hard freeze (Dec 1). Some leaves remain on plant but are obviously freeze killed
- Autumn olive (*Elaeagnus umbellata*) – Some plants held on to leaves until first hard freeze (Dec 1). Some leaves remain on plant but are obviously freeze killed
- Bush honeysuckle (*Lonicera sp.*) – Held on to leaves until first had freeze (about Dec 1). December 7- Leaves remain on plant and green/yellow but are obviously freeze killed

#### Northeast

- Teasel (*Dipsacus sp.*) - Some falling over pods still on stalk
- Amur honeysuckle (*Lonicera maackii*) – Some leaves still on plant, most leaves left are yellowish-green. No berries noted
- Common buckthorn (*Rhamnus cathartica*) – Some plants with a green leaves remaining

### 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

**Common and scientific names adhere to:**

ITIS (Integrated Taxonomic Information System). 2016. Online Database (<http://www.itis.gov>, 1 January 2016). Smithsonian Institution, Washington, DC.

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