



**GUIDE FOR
ROADSIDE INTEGRATED
VEGETATION MANAGEMENT**
of
**PROHIBITED NOXIOUS
WEEDS IN OHIO**



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DISCLAIMER

Distribution of prohibited noxious weeds and recommended controls are based on available research, field observations, and professional opinion at the time of writing this Guide. Specific products mentioned in this Guide are not an endorsement or recommendation. Worksheets contained in this Guide are designed to assist the applicator in planning for an application and in no way guarantee vegetation control results.

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CAUTION STATEMENT

Maintain caution around prohibited noxious weeds. Some prohibited noxious weeds are toxic and can cause allergic reactions or can cause abrasions and cuts. The use of pesticides is always subject to strict standards and practices. Make sure to read the label and safety data sheet (SDS) before mixing or applying any pesticides. When handling or applying pesticides, always wear proper personal protective equipment (PPE) as required by the label, SDS, and the Ohio Department of Transportation (ODOT). Make sure to follow all safety standards instituted by ODOT, the Ohio Department of Agriculture, and Ohio law. Remember: The Label is the Law!







HOW TO USE THIS GUIDE



HOW TO USE THIS GUIDE

INTRODUCTION

The Guide for Roadside Integrated Vegetation Management (RIVM) of Prohibited Noxious Weeds in Ohio was designed for the Ohio Department of Transportation (ODOT) as a practical field guide for identifying and controlling Ohio's prohibited noxious weeds and selected invasive plants. Each of Ohio's 21 prohibited noxious weeds [Ohio Administrative Code (Chapter 901:5-37)] are included in this Guide in alphabetical order by common name. Scientific names were acquired from the Integrated Taxonomic Information System (ITIS.2016. <http://www.itis.gov>).

The goal of RIVM is to encourage compatible and low-maintenance vegetation cover, such as grass, that, when established, can prevent undesirable weeds and woody vegetation from dominating the roadside landscape.

All RIVM activities should focus on controlling the reproduction and spread of noxious weeds and incompatible vegetation and encouraging desirable vegetation to thrive. As the term 'integrated' suggests, there is no single defined method that is suitable for this goal. Therefore, a purposeful, well-thought-out approach of vegetation management that uses several control methods could be implemented at various times of the year based on the season and target plant life cycle, followed by planting and proper maintenance of desirable vegetation. The results of a RIVM program will enhance roadside and motorist safety and aesthetics, and will reduce ODOT's workload once desirable vegetation is established.

PROHIBITED NOXIOUS WEED IDENTIFICATION AND CONTROL

Information on each of Ohio's 21 prohibited noxious weeds are presented on two pages. On the first page for each weed, a title box contains the plant's common and botanical names and indicates the plant's life cycle. The following subsections described below are provided for each plant to aid plant identification and control: *Plant Description*, *Seasonal Identification*, *Similar-Looking Species*, *RIVM Level of Concern*, *Where to Find*, and *Control Methods*.

Plant Description: Describes the life cycle and appearance of the plant. *Plant Description* features include: leaf, stem, flower, fruit/seed, reproduction, and why it is noxious.







Seasonal Identification: Focuses on when the plant is most noticeable and what it looks like at that time. As each weed displays seasonal traits that can help in verifying identification, this section describes what the plant looks like in each season. The level of difficulty to identify the plant in every season is rated from easy to difficult.

Similar-Looking Species: Lists and briefly describes other plants that resemble each prohibited noxious weed. This section points out the similarities and differences of those look-alike plants to help rule out or confirm identification. Look-alike plants, if also noxious or invasive, should be controlled.

RIVM Level of Concern: This table displays a scale of factors that evaluates the level of vegetation management concerns to ODOT. Each weed is compared to the other weeds in this Guide. A level of concern rating is assigned to each weed relative to each other based on field observations, research, and professional opinion. A rating from low to high is assigned to each of these six factors:

- **Ohio Distribution** (presence throughout Ohio counties)
- **Roadside Distribution** (presence throughout the right-of-way)
- **Growth** (growth rate and/or mature height)
- **Seeds** (number of seeds, ability to spread, and/or years of viability)
- **Ability to Dominate** (plant's ability to take over an area and outcompete other plants)
- **Difficulty of Control** (plant characteristics or adaptations which make the plant challenging to eliminate)

RIVM LEVEL OF CONCERN

| | |
|---|-----------------------|
|  | OHIO DISTRIBUTION |
|  | ROADSIDE DISTRIBUTION |
|  | GROWTH |
|  | SEEDS |
|  | ABILITY TO DOMINATE |
|  | DIFFICULTY OF CONTROL |


 LOW → HIGH

Where to Find: Indicates regions in Ohio where the weed may be found and the type of growing conditions the weed prefers.

Control Methods: Provides options for *Mechanical*, *Chemical*, and *Cultural* control of the prohibited noxious weed. The *Recommendation Summary* section provides further discussion of the plant's life cycle and how it relates to control, how the plant responds to treatment, and what can occur upon failure to control.

On the second page of each of Ohio's 21 prohibited noxious weeds, the following subsection is presented:

Seasonal Identification: Photographs with descriptive overviews for field identification.

INVASIVE PLANT IDENTIFICATION AND CONTROL

Five additional invasive plants known to be a nuisance on ODOT's right-of-way are presented after the 21 Ohio prohibited noxious weeds. This condensed section includes only the *Plant Description*, *Where to Find*, and *Control Methods* subsections.

APPLICATOR GUIDANCE

This section offers important information and reference materials related to planning and making herbicide applications. It contains these subsections:

General RIVM Guidelines and Level of Concern: Provides tips to follow when integrating herbicides into a prohibited noxious weed RIVM program. A table rates each of the 21 Ohio prohibited noxious weeds using factors that concern ODOT: Ohio distribution, roadside distribution, growth, seeds, ability to dominate, and difficulty of control.

Plant Life Cycles and Chemical Control Timing: The 21 Ohio prohibited noxious weeds and 5 invasive plants in this Guide are sorted in the Plant Life Cycle table. For each plant, an herbicide type is recommended for treatment. In the Chemical Control Timing table, each life cycle is shown on a seasonal timeline from seed germination to dieback, with icons indicating primary (most important window) and secondary (backup window if the primary window was missed) timing for herbicide applications.

Common RIVM Herbicides: Contains a table of commonly used roadside vegetation management herbicides by herbicide type, chemical name, and trade name.

Calibration Guidance for Directed Herbicide Applications: Provides guidance for directed herbicide applications when using a spray gun or backpack sprayer. Included on this page are a table that lists typical flow rates and spray times that can be used to help calibrate equipment and a completed worksheet illustrating how to estimate the time needed to spray 1 acre.

Calibration Guidance for Broadcast Herbicide Applications: Provides information for spray truck applications emphasizing calibration, application and flow rates, nozzle adjustment and aim, and ground speed. Two tables and completed worksheets are provided. One table converts acres into lane miles based on spray nozzle width. The second table estimates the time needed to spray 1 acre based on ground speed and spray nozzle width. Completed worksheets demonstrate how to mix the proper amount of herbicide solution based on tank size and how to estimate the quantity of herbicide solution to mix based on available work hours.

Guidance for Preparing an Herbicide Mixture: Lists some basic reminders for the licensed applicator that affect planning an application such as the size of the area, the type of herbicide, determination of proper application rates, and the total mix volume based on size of area to be treated. Completed worksheets show how to calculate the gallons of water to be added to the solution based on the herbicide per acre rate and herbicide percent solution.

Daily Pesticide Report (M&R-629): ODOT's required form to be completed daily when making herbicide applications. Example of a completed worksheet is provided.

Area Conversions: Tables to assist in converting acres into miles or linear feet depending on nozzle spray width, and to convert lane miles into linear feet, and acres into square feet.

Volume Conversions and Mix Rates: Tables convert common liquid volumes to ounces, pints, quarts, or gallons, and help determine mix rates for different percent solutions based on various total desired gallons of herbicide solution.

APPLICATOR WORKSHEETS

The following worksheets can be used to plan directed and broadcast herbicide treatments:

- **Calibration for Spray Gun or Backpack Sprayer** (time to spray 1 acre or 1,000 square feet based on flow rates)
- **Production Based on Tank Size** (number of acres to be treated with a full tank of herbicide solution)
- **Production Based on Work Hours** (number of acres to be treated with the available daily work hours)
- **Herbicide Per Acre Rate** (gallons of water needed to mix an herbicide solution based on labeled herbicide as a per acre rate)
- **Herbicide Percent Solution** (gallons of water needed to mix an herbicide solution based on labeled herbicide as a percent)

ODOT's required Daily Pesticide Report form is included in this Guide for reference:

ODOT's Daily Pesticide Report (M&R-629)

GLOSSARY OF TERMS

Terms from this Guide and terms related to RIVM are defined.

NOTES

Extra pages are provided to take notes and make calculations.





**PROHIBITED NOXIOUS WEED
IDENTIFICATION AND CONTROL**

APPLE OF PERU (*Nicandra physalodes*)



SUMMER
ANNUAL



PLANT DESCRIPTION

Apple of Peru, or shoofly, is a broadleaf summer annual weed that can be seen from late summer to fall as an upright 3–4 foot tall plant with vibrant blue–purple flowers. Apple of Peru can also be seen as a seedling during early to midsummer. Apple of Peru is easily identified by its distinct bluish flowers and green, lantern-like seed bladder.

LEAF: The leaves are arrowhead shaped with an elongated tip and shallow, rounded lobes.

STEM: The stem and branches are smooth, thick, and hollow with pronounced vertical ribs. As the plant matures, it develops branches and produces flowers.

FLOWER: Apple of Peru's flowers are bell shaped with five bluish–purple petals and a white center with five yellow pollen heads.

FRUIT/SEED: After pollination, the flower petals fall off and a single berry full of seeds develops within the papery bladder.

REPRODUCTION: Seeds are the primary means of reproduction with most seeds dropping below the parent plant. Mature apple of Peru can produce up to one million seeds per plant. Those seeds can stay viable in the soil for up to 20 years.

WHY IT IS NOXIOUS: Apple of Peru is an agricultural crop invader with a history of herbicide resistance. It is poisonous to many insects, hence the common name shoofly.

SEASONAL IDENTIFICATION

WHEN TO FIND: Apple of Peru is most noticeable when it is flowering in late summer and early fall. Its distinct flower and lantern-shaped seed bladder make it easy to identify in these seasons.

SPRING IDENTIFICATION = DIFFICULT

Apple of Peru may germinate by late spring. Leaves are often covered in fine white hairs. Seedlings are just beginning to develop shallow round lobes in spring.

SUMMER IDENTIFICATION = EASY TO MODERATE

Arrowhead-shaped leaves with rounded lobes are attached to branching, smooth, hollow stems with vertical ribs. Bluish, bell-shaped flowers develop by late summer with green, five-sided bladders at each flower base.

FALL IDENTIFICATION = EASY

After flowering, the petals drop and each papery bladder develops a seed-filled berry. As the fruit ripens, the bladder turns brown, opens, and drops the fruit.

WINTER IDENTIFICATION = MODERATE TO DIFFICULT

This plant may only persist as a plant skeleton or seed into winter.

SIMILAR-LOOKING SPECIES

JIMSONWEED (*Datura stramonium*) flowers are similar, but they are long and skinny. The fruit is football shaped with sharp prickles.

VELVETLEAF (*Abutilon theophrasti*) has a crown-like and upright seed capsule that looks similar from a distance to apple of Peru's seed capsule, but the flower is yellow and the leaves are fuzzy.

COMMON MORNING GLORY (*Ipomoea* spp.) flowers are similar to apple of Peru, but this plant grows as a creeping vine.

RIVM LEVEL OF CONCERN

| | |
|--|-----------------------|
| | OHIO DISTRIBUTION |
| | ROADSIDE DISTRIBUTION |
| | GROWTH |
| | SEEDS |
| | ABILITY TO DOMINATE |
| | DIFFICULTY OF CONTROL |

LOW → **HIGH**

WHERE TO FIND:

Apple of Peru is not prevalent in the state but has been found in northwest Ohio in agricultural fields, primarily in soybean fields. This weed is primarily an agricultural concern at this point.

CONTROL METHODS:

MECHANICAL: Mow in summer before flower and seed head development to reduce seed production. Hand pull individual plants.

CHEMICAL: Make directed applications in late summer with selective herbicides before seeds are produced. Apple of Peru can develop herbicide resistance.

CULTURAL: Plant tall fescue in fall; allow the grass to grow tall in summer.

RECOMMENDATION SUMMARY:

Apple of Peru is a summer annual weed that has shown an ability to develop resistance to commonly used ALS-inhibiting herbicides. For best control results, apply herbicide in midsummer to late summer before fruit develops. Since apple of Peru has a long flowering and fruit production period, continue applications after flowering to reduce seed production. Monitor herbicide applications for effectiveness due to apple of Peru's ability to develop herbicide resistance. If a second application is necessary due to poor herbicide results, use alternate herbicides with different modes of action. Mow only to reduce seed production. Hand pull to control individual plants. Plant tall fescue in fall and allow to grow tall in summer to provide competition with apple of Peru. Failure to control apple of Peru will allow individual plants to produce up to one million seeds that can remain dormant in the soil for up to 20 years.

SEASONAL IDENTIFICATION

APPLE OF PERU (*Nicandra physalodes*)

LATE SPRING



Apple of Peru emerges later than most summer annuals. The young leaf is difficult to identify. Note small lobes beginning to develop.

SUMMER



All leaves are longer than they are wide and shaped like an arrowhead with rounded lobes. The leaf tip is elongated with a rounded point.

SUMMER



Stems are smooth, hollow, and sturdy with distinct vertical ribs. Branching occurs towards the middle to top of the plant as it prepares to flower.

LATE SUMMER - EARLY FALL



Bluish-purple flowers emerge late in the season with five petals, a white center, and five yellow pollen heads. Note the distinct green bladder at the base of the flower.

LATE SUMMER - FALL



After flowering, the petals fall off the flowers and the bladder closes. Note the lantern-shaped bladder has five folded edges. After ripening, the bladder turns brown and opens to reveal the seed-filled berry.

FALL



After the plant produces fruit and dies, it can stay standing into early winter and may still have papery bladders attached. Note the large number of seeds per berry. Dormant seeds can remain viable for up to 20 years.

CANADA THISTLE

(*Cirsium arvense*)



PLANT DESCRIPTION

Canada thistle, or creeping thistle, is a broadleaf perennial weed that can be seen from spring to fall as single-stemmed, upright, 3–5 foot tall flowering plant with purple flowers and spine tipped leaves. It can also be seen as a seedling, or as a shoot from its spreading root system in spring or fall. Canada thistle is smaller than other thistles but forms dense colonies that are easily noticed when in flower or in seed.

LEAF: Canada thistle leaves are dark green with a whitish midrib and are covered in fine hairs on the upper surface. The leaves are wavy and lobed with a prominent spine on each lobe.

STEM: Stems are hairless with vertical ridges that develop branches as the weed prepares to flower.

FLOWER: Purple, upright flowers with green oval bases bloom at the ends of branches in early summer. Flowers look like small shaving brushes or pom-poms.

SEED: Cottony, white, and fluffy seeds develop by midsummer.

REPRODUCTION: Seeds are primarily dispersed by wind, but this perennial weed also spreads by sending up vegetative root sprouts from a large, spreading root system. A mature Canada thistle plant is capable of producing thousands of seeds that remain viable in the soil for up to 20 years.

WHY IT IS NOXIOUS: Canada thistle produces a prolific amount of long-term, viable windblown seeds. With a high tolerance to mowing and a wide range of habitat preference, Canada thistle presents a maintenance problem for roadside vegetation management as well as agricultural and neighboring lands.

SEASONAL IDENTIFICATION

WHEN TO FIND: Canada thistle can be found from spring until snowfall but is easiest to notice in flower from early to late summer. Dead plants with seeds stand into fall.

SPRING IDENTIFICATION = EASY TO MODERATE

Seedlings or root sprout leaves are dark green, slender, and spine-tipped. The upper surface of the young leaves are covered with fine white hairs.

SUMMER IDENTIFICATION = EASY

As single-stemmed plants grow tall, flower branches develop near the top of the plant. Purple flowers emerge at the ends of branches and resemble a shaving brush. Seeds are produced by midsummer to late summer.

FALL IDENTIFICATION = EASY

Canada thistle dies aboveground, turning brown and usually holding cottony seed heads until they detach and are taken by wind. Dense colonies are easy to spot.

WINTER IDENTIFICATION = EASY TO MODERATE

In unmowed areas, dead plant skeletons can be seen standing until snowfall.

SIMILAR-LOOKING SPECIES

BULL THISTLE (*Cirsium vulgare*) has spiny leaves like Canada thistle, but bull thistle is much larger at maturity. Covered in hairs on upper and lower surfaces, the leaves are much more pointed and deeply lobed and flowers are pink.

MUSK THISTLE (*Carduus nutans*) also has spiny leaves but has much larger pink flowers compared to Canada thistle. Stems are covered in spine-tipped leaf wings. Leaf lobes may feature several wings and several spines per lobe. Flowers are globe shaped and often nod or bend under their own weight.

RIVM LEVEL OF CONCERN

| | |
|---|-----------------------|
| ● | OHIO DISTRIBUTION |
| ● | ROADSIDE DISTRIBUTION |
| ◐ | GROWTH |
| ● | SEEDS |
| ◐ | ABILITY TO DOMINATE |
| ◐ | DIFFICULTY OF CONTROL |

○ ◐ ◑ ●

LOW → HIGH

WHERE TO FIND:

Canada thistle is common and widespread in Ohio. It is found growing in moderately dry and dry soils with full sun. Look at the edge of the road under rails, in mowed areas, on infrequently mowed slopes, and adjacent properties.

CONTROL METHODS:

MECHANICAL: Mow to reduce seed production and to maintain visibility if needed; expect regrowth.

CHEMICAL: Make directed or broadcast applications from spring to early summer with selective herbicide. Use residual selective herbicide with dense colonies or along guardrails.

CULTURAL: Plant tall fescue in early fall, allow to grow tall in spring.

RECOMMENDATION SUMMARY:

Canada thistle is a difficult-to-control perennial weed that spreads by wind-blown seeds and an extensive, spreading root system. For best control results, make herbicide applications in late spring before flowers bloom. If ideal timing is missed, fall applications before hard frost will provide adequate control. Make directed applications to dense colonies or patches growing away from the road edge and broadcast applications to Canada thistle growing in turf or under guardrails and signs. Because Canada thistle is a perennial and can sprout from root fragments, hand pulling or mowing has little effect. Only mow for height reduction and seed reduction if necessary. Plant tall fescue in fall and allow to grow tall in spring. Failure to control Canada thistle can result in new infestations from wind-blown seed or formation of dense colonies by spreading root rhizomes. Dense colonies are difficult to control and seeds can remain viable in soil for up to 20 years.

SEASONAL IDENTIFICATION

CANADA THISTLE (*Cirsium arvense*)

SPRING



Seedlings and vegetative root sprouts are prevalent in spring. Look for lobed leaves with spine tips and hairs on upper leaf surface.

SPRING - FALL



Leaves have hairs on the upper surface and are wavy and lobed with prominent spines at the tip of each lobe. Stems are hairless.

SUMMER



Plants are single stemmed until they develop flower buds. As flowers emerge, branches develop on the upper portion of the plant.

SUMMER



Round, green flower buds turn purple and produce attractive purple flower petals. Flowers look like a shaving cream brush.

LATE SUMMER



Canada thistle colonies in seed are quite noticeable. The flowers develop into white puffs of cottony seeds that are dispersed by wind.

FALL - WINTER



Canada thistle retains aboveground form until the first heavy snow fall. Since this is a perennial weed, the root system remains alive underground.

CRESSLEAF GROUNDSEL

(*Packera glabella*)



PLANT DESCRIPTION

Cressleaf groundsel, or butterweed, is a broadleaf winter annual weed that can be seen in late spring to early summer as a 2–3 foot tall plant with terminal groups of yellow flowers. Seedlings germinate in fall and overwinter as a rosette before maturing in spring to early summer. Cressleaf groundsel can be easily identified by its yellow flowers and distinct leaf shape.

LEAF: The leaves vary in shape and size but typically have multiple deep, rounded lobes with scalloped edges. The tip of the leaf is usually the broadest point.

STEM: The stems are smooth, hollow, and slender with vertical ridges. Stems and leaves may have a purple tinge, especially when they are younger. As cressleaf groundsel matures, branching occurs in upward angles while flower buds develop.

FLOWER: Flowers are daisy like with small yellow petals and yellow centers and are produced in groups mostly at the ends of branches.

SEED: After flowering, seeds form in cottony tufts at the center of the flowers.

REPRODUCTION: Seeds serve as the primary means of reproduction and can be dispersed long distances by wind. Mature cressleaf groundsel can produce thousands of seeds that can stay viable for up to three years.

WHY IT IS NOXIOUS: Cressleaf groundsel is a member of a plant family that is known to possess a chemical compound that is toxic to the liver. Cressleaf groundsel poses a threat to livestock.

SEASONAL IDENTIFICATION

WHEN TO FIND: Cressleaf groundsel is most noticeable in large colonies from late spring or early summer when it is flowering. Spring seedlings and fall rosettes have a distinct leaf.

SPRING IDENTIFICATION = MODERATE

Overwintered seedlings/rosettes are found to be green after snow melts before most other Ohio plants turn green. The leaves have many lobes with toothed margins. Leaves and stems may have a purple tinge.

SUMMER IDENTIFICATION = EASY

As the plant matures, upward angled branches and flower buds develop. Yellow flowers emerge in clusters at the ends of branches and produce cottony, wind-dispersed seeds. After producing seed, cressleaf groundsel collapses and decomposes by midsummer.

FALL IDENTIFICATION = MODERATE

Seeds germinate in late summer or fall and emerge as a rosette or seedling. Leaves on rosettes or seedlings are often purple.

WINTER IDENTIFICATION = DIFFICULT

This plant persists as a rosette or seedling through winter.

SIMILAR-LOOKING SPECIES

COMMON GROUNDSEL (*Senecio vulgaris*) has a very similar leaf, flower, and general appearance. The difference is that the leaves grow in the upper portions of the stem, unlike cressleaf groundsel.

DANDELION (*Taraxacum officinale*) has similar seeds. When the flower goes to seed the seed head has a similar cottony tuft appearance. The lobes of the leaves are not as deep as those of cressleaf groundsel.

YELLOW ROCKET (*Barbarea vulgaris*) yellow flowers grow in similar form at the top of the plant. The seeds form in bean pods.

RIVM LEVEL OF CONCERN

| | |
|--|-----------------------|
| | OHIO DISTRIBUTION |
| | ROADSIDE DISTRIBUTION |
| | GROWTH |
| | SEEDS |
| | ABILITY TO DOMINATE |
| | DIFFICULTY OF CONTROL |

LOW → HIGH

WHERE TO FIND:

Cressleaf groundsel is common in Ohio and is considered an agriculture problem, not a maintenance concern for ODOT's right-of-way. This weed is typically found in wet soils or seasonally flooded agriculture fields and can grow in full sun or part shade of open woods.

CONTROL METHODS:

MECHANICAL: Mow for seed reduction in the spring.

CHEMICAL: Make broadcast applications in fall with selective herbicide as rosettes and seedlings form. Broadcast pre-emergent herbicide to soils of infested areas in early summer before seeds germinate.

CULTURAL: Plant tall fescue in fall and allow to grow tall in summer. Improve drainage.

RECOMMENDATION SUMMARY:

Cressleaf groundsel is a winter annual weed that germinates in fall, overwinters as a rosette, and produces flowers and seeds by late spring to early summer. Chemical control is the best option for this weed. Apply broadcast herbicide applications in fall as rosettes and seedlings are actively growing. Spring application to rosettes and seedlings can also be effective. If a large colony produces seed, prevent future germination by making pre-emergent herbicide applications to soil in late summer before seeds germinate. Make broadcast applications to large populations growing in turf or open fields with broadleaf selective herbicide. Mow to reduce flower and seed production. Plant tall fescue in fall and allow to grow tall the following summer to reduce seed germination and to provide competition for space and resources. Increase drainage in wet turf or fields to reduce ideal habitat for this weed. Failure to control cressleaf groundsel will allow prolific amounts of windblown seeds to spread into adjacent properties. This plant is toxic to livestock.

SEASONAL IDENTIFICATION

CRESSLLEAF GROUNDSEL (*Packera glabella*)

FALL - SPRING



Young cressleaf groundsel is found as a low-growing seedling or rosette from fall to spring. Leaves and stems typically have a purple tint or are completely purple.

SPRING



Stems are smooth, hollow, and have vertical ridges like celery. Branches and flower buds develop in spring. Leaves are deeply divided with a broad tip.

LATE SPRING



Cressleaf groundsel is highly visible across this farm field. The plant grows in open areas with wet soils, often in areas prone to seasonal flooding.

EARLY SUMMER



The flowers are entirely yellow with yellow petals and yellow centers. They are produced in groups at the end of branches. Seeds develop at different times, often while flowers are still present.

EARLY SUMMER



After the plant flowers, the petals give way to cottony tufts composed of many small seeds. Seeds are the primary means of reproduction and can be dispersed long distances by wind.

SUMMER - FALL



After going to seed or after a hard frost, cressleaf groundsel withers and collapses. It stays green during this process and rapidly decomposes, leaving seeds behind to germinate in fall.

GIANT HOGWEED

(*Heracleum mantegazzianum*)



BIENNIAL

PLANT DESCRIPTION

Giant hogweed is a large broadleaf biennial weed typically found in late spring to midsummer as an 8–10 foot tall upright, single-stemmed, branching plant with flat-topped, white flower heads. Giant hogweed can also be seen as a seedling in the spring. Larger than most other herbaceous plants, it can occasionally attain a height of 20 feet.

LEAF: Giant hogweed has very large, broad, jagged leaves that are generally wider than they are long. Leaves are hairless and grow in groups of three.

STEM: The main stem is very large, hollow, and is covered in hairs. Stems also have vertical ribs and purple spots and develop branches as they prepare to flower.

FLOWER: The white flower heads at the ends of branches are composed of many small flowers arranged in an upright, flat-topped or umbrella formation.

SEED: Seeds develop as flat, round, green disks covered in hairs that eventually turn brown.

REPRODUCTION: Seeds are the primary means of dispersal. Most seeds drop around the parent plant, but can also be spread by wind, water, and animals. A mature giant hogweed plant is capable of producing thousands of seeds that remain viable for up to five years.

WHY IT IS NOXIOUS: Use caution around giant hogweed; contact with sap can cause extreme skin blistering, especially when combined with sunlight exposure. Giant hogweed can displace desirable plants and create sight distance and safety concerns if allowed to grow near the road.

SEASONAL IDENTIFICATION

WHEN TO FIND: Giant hogweed is most noticeable in summer after flowering and seed set. This weed is larger than most other plants. It has very large leaves, stems, and white flat-topped, umbrella-shaped flower heads.

SPRING IDENTIFICATION = EASY TO MODERATE

Seedlings and young plants can be found growing low to the ground among other plants. The leaf is the best identification feature at this time. Stems of second year plants begin to develop in late spring.

SUMMER IDENTIFICATION = EASY

Stems develop hairs as the plant grows tall. Key features are the large stems, leaves, and flat-topped white flower heads. Flat, round, hairy green seeds develop in late summer and are often found on plants that are still in flower.

FALL IDENTIFICATION = EASY

Dead giant hogweed can be seen standing with stout, hollow stems and seed heads that are still intact. This weed skeleton is taller than most other weeds.

WINTER IDENTIFICATION = MODERATE

Giant hogweed's main stem can persist into winter. If found, look around for seedlings and rosettes that may overwinter.

SIMILAR-LOOKING SPECIES

WILD CARROT (*Daucus carota*) flower heads are also white, flat topped, and umbrella shaped, but they are much smaller and much more densely arranged. The stem is solid and covered in hairs.

POISON HEMLOCK (*Conium maculatum*) flower heads are white but are round or globe shaped and much smaller.

WILD PARSNIP (*Pastanica sativa*) flowers have a similar form but are yellow. After it dies, wild parsnip most closely resembles giant hogweed; however, the stems are smooth and have larger raised vertical ribs.

RIVM LEVEL OF CONCERN

| | |
|----------------------------------|-----------------------|
| <input type="radio"/> | OHIO DISTRIBUTION |
| <input type="radio"/> | ROADSIDE DISTRIBUTION |
| <input checked="" type="radio"/> | GROWTH |
| <input type="radio"/> | SEEDS |
| <input type="radio"/> | ABILITY TO DOMINATE |
| <input type="radio"/> | DIFFICULTY OF CONTROL |

LOW → HIGH

WHERE TO FIND:

Giant hogweed is not prevalent in Ohio but has been located in isolated stands in eastern Ohio and neighboring states. Giant hogweed prefers moist soil around waterways and is tolerant of shade but can also grow in full sun in dry soils around ditches.

CONTROL METHODS:

MECHANICAL: Hand pull using gloves. Use caution! Giant hogweed is toxic to humans and can burn the skin causing blisters. Mow repeatedly to reduce height or reduce seed production.

CHEMICAL: Make directed foliar applications in spring to summer with non-selective herbicide.

CULTURAL: Intensive grazing by sheep or goats can weaken and reduce giant hogweed colonies. Plant tall fescue in fall to provide competition.

RECOMMENDATION SUMMARY:

Giant hogweed is giant and toxic! Giant hogweed is rarely found in mowed areas. Always use caution and avoid contact with plant sap. For best control results, make directed foliar applications with non-selective herbicide up until flowering. Later season applications will still provide some control even after seeds begin to develop. Plant sap is toxic! Use caution when hand pulling to control or cutting to reduce seed or plant height. Giant hogweed is so large it displaces other vegetation leaving bare patches. When controlled, the treated area should be planted with tall fescue to avoid leaving bare patches and provide competition. Failure to control giant hogweed allows mature plants to produce thousands of seeds that remain viable for up to five years, resulting in localized spread of this large noxious weed.

SEASONAL IDENTIFICATION

GIANT HOGWEED (*Heracleum mantegazzianum*)

SPRING



Young plants are identified by the leaf only. Rosettes have large broad leaves with jagged or pointed lobes generally in groups of three. Seedlings usually only have one symmetrical leaf with a toothed edge that is wider than long.

SPRING - SUMMER



Thick, hollow stems are covered with hairs and have variable purple blotches that develop vertical ridges that become more prominent later in the season.

SUMMER



The white flower heads at the ends of branches are composed of many small white flowers that point upwards and are flat topped or umbrella shaped.

SUMMER



The central flower at the top of the main branch is usually first to develop seeds. Seeds are flat, round, green disks covered in hairs.

SUMMER



Colonies are easily recognized by their large, white flower heads, large broad, jagged leaves, and thick hollow stems covered in hairs and purple spots.

FALL - WINTER



Giant hogweed is typically dead by fall. Dead giant hogweed can be seen standing with stout, hollow stems and seed heads still intact. This weed skeleton is taller than most other Ohio herbaceous weeds.

GRAPEVINES

(*Vitis* spp.)



PLANT DESCRIPTION

Grapevine, or wild grape, is a broadleaf perennial vine typically seen from summer to fall with distinct leaves and clusters of small grapes. Its yellow leaves can be easily noticed in the fall. Mature grapevines can be found growing on trees. Young plants can also be found in turf but rarely grow large in mowed areas. Grapevine is commonly found growing on fences and in wooded areas.

LEAF: The leaves are somewhat heart shaped with three to five shallow pointed lobes and a coarse-toothed margin.

STEM: Young stems are smooth and green with red tints. At the ends of new growth are Y-shaped stem appendages called tendrils. Tendrils help the vine climb and attach to other plants and fences. As the vine ages, the stems become woody with dark, peeling bark.

FLOWER: Grapevine flowers are tiny and hard to notice. They are round and green with no visible petals, but they do produce slender white pollen heads. Flower clusters appear as unripe grape clusters.

FRUIT/SEED: After fruit set, unripe green grapes ripen to dark purple with a light waxy coating that can be easily rubbed off. One seed or multiple seeds develop within each grape and are often distributed by birds and other wildlife.

REPRODUCTION: Seeds are the primary means of reproduction. Seeds spread by being dropped around the parent plant, or are consumed and spread by animals and birds.

WHY IT IS NOXIOUS: Grapevine is considered noxious in groups of 100 or more small vines or larger vines that have been left uncontrolled. It can form dense colonies and outcompete desirable vegetation or grow to the tops of trees or on signs and fences in areas that are not mowed.

SEASONAL IDENTIFICATION

WHEN TO FIND: Grapevine's distinct leaf shape makes it noticeable in the growing seasons. It is especially noticeable when the leaves are changing color from green to yellow in the fall.

SPRING IDENTIFICATION = EASY

Young grapevine can be identified by leaves and curly stem tendrils. The leaves have a large-toothed margin and appear shiny.

SUMMER IDENTIFICATION = EASY

Grapevine can grow in large masses and grow to the tops of trees to the extent that it overtakes other vegetation. White flower clusters produce green grapes that eventually turn dark purple with a lighter waxy coating.

FALL IDENTIFICATION = EASY

In the fall, grapevine is one of the last plants to drop its leaves. As the season progresses, leaves change from green to yellow. After leaves drop, the tangled vines become easily visible.

WINTER IDENTIFICATION = EASY

The woody vines of older grapevine colonies easily stand out in the winter landscape. Stems are dark brown with vertically-peeling bark and can be several inches in diameter.

SIMILAR-LOOKING SPECIES

KUDZU (*Pueraria lobata*) is a broadleaf vine but its leaves grow in groups of three with a maximum of three lobes. The leaves, stems, and fruit are all covered with coarse brown hairs.

MOONSEED VINE (*Menispermum canadense*) leaves have a similar shape but have smooth margins. Its fruit is similar to grapevine but grows in clusters. This vine lacks tendrils.

VIRGINIA CREEPER (*Parthenocissus quinquefolia*) is a broadleaf vine with brown bark, but its leaves grow as five leaflets that extend radially from the center point. Leaves turn crimson red in the fall.

GRAPES (*Vitis* spp.) grown in vineyards on a trellis can look similar to grapevine growing on fences. The leaves are very similar but the fruit is usually larger. These plants are typically maintained.

RIVM LEVEL OF CONCERN

| | |
|--|-----------------------|
| | OHIO DISTRIBUTION |
| | ROADSIDE DISTRIBUTION |
| | GROWTH |
| | SEEDS |
| | ABILITY TO DOMINATE |
| | DIFFICULTY OF CONTROL |

LOW → HIGH

WHERE TO FIND:

Grapevine is common in Ohio and can be easily found growing on fences and near woodlines with adequate sun exposure. Grapevine requires a sunny, dry site, but can often grow to the top of trees to get sunlight when the base of the vine is in shady areas. Grapevine seedlings can also be found in turf that is infrequently mowed.

CONTROL METHODS:

MECHANICAL: Cut older vines at the base or near the ground. Mowing will control seedlings in turf.

CHEMICAL: Apply cut stem or basal bark herbicide application to older vines in fall or winter. Make directed foliar applications with non-selective or selective herbicide to low-growing grapevine colonies.

CULTURAL: Grapevine does not tolerate shade, so maintain taller desired vegetation.

RECOMMENDATION SUMMARY:

Grapevine is capable of climbing to the tops of trees and creating additional branch load, thereby increasing risk for tree failure. For best control results, cut older vines near the base and apply herbicide to the cut stem. For younger, or low-growing patches and vines on fences and guardrails, make directed foliar applications with selective herbicide any time after full leaf expansion in spring until fall coloration. Grapevine is not difficult to control. Mowing young seedlings in turf provides good control. Older vines that have reached the tops of trees can be controlled if cut near the base. Since grapevine is not tolerant of shade, no herbicide is needed if the vine base is growing in a shaded area. Failure to control grapevine will allow wildlife to further distribute fruit and seeds to be further distributed throughout Ohio.

SEASONAL IDENTIFICATION

GRAPEVINES (*Vitis* spp.)

SPRING



Young grapevine leaves appear shiny with green to red stems.

SPRING - SUMMER



The leaves are heart shaped with a coarse toothed margin and three to five shallow and pointed lobes.

SUMMER



Grapevine is often found as a large mass of vines and leaves. Y-shaped tendrils provide support and help the vine climb fences and other vegetation.

SUMMER



Flowers resemble unripe grapes. Flowers are round and green with barely visible petals. Grapes develop after flower petals drop.

SUMMER - FALL



When unripe, grapevine fruit are small and green. As the grapes ripen, they become dark purple and have a light waxy coating that is easily rubbed off. Each grape contains at least one seed.

FALL - WINTER



In fall, grapevine leaves turn yellow. Older grapevine become easily visible in the winter landscape with dark brown, peeling bark.

JAPANESE KNOTWEED

(*Fallopia japonica* var. *japonica*)



PLANT DESCRIPTION

Japanese knotweed is a bamboo-like perennial weed with a strong central stem and smaller leaf branches. It is most often noticed in spring to fall in dense, 4–10 foot tall colonies.

In early spring pink and green sprouts emerge. Sprouts look similar to asparagus but are much thicker. Japanese knotweed is very distinct and is easily spotted during most of the year in thick colonies.

LEAF: Leaves are oval to heart shaped with a tapered point and a smooth leaf margin. The leaves form a dense canopy that assists Japanese knotweed to outcompete most other Ohio plants.

STEM: Stems are green to purple and strongly zigzagged. The main stems are hollow, smooth, and chambered.

FLOWER: Later in summer, white flower spikes with many small, bell-shaped flowers emerge where leaves meet the stem. Flowers resemble white pipe cleaners at a distance.

SEED: Each flower on the spike produces a single seed. Seeds develop as whitish, papery capsules with three wings surrounding a single seed. Seeds turn rust colored or light brown and can persist into winter, which makes Japanese knotweed easy to identify in the dormant season.

REPRODUCTION: Seeds contribute to reproduction and can be easily spread by wind or water, but the root system is the primary means of reproduction. The spreading roots help Japanese knotweed form large colonies, thereby displacing all other vegetation. A mature Japanese knotweed plant is capable of producing hundreds of thousands of seeds, most of which drop below parent plants. Some are distributed by wind or water. Mowed cuttings create new colonies as cuttings will develop roots and grow new plants where they are dropped.

WHY IT IS NOXIOUS: Japanese knotweed is a rapidly-growing, aggressive plant that can dominate wet areas and ditches. It causes maintenance and safety concerns, but also poses an ecological threat as it displaces more desirable Ohio vegetation.

SEASONAL IDENTIFICATION

WHEN TO FIND: Japanese knotweed matures by early summer and flowers in late summer. It is easy to identify during all seasons, especially in large unmowed patches.

SPRING IDENTIFICATION = EASY TO MODERATE

Remnant patches of previous year's growth should still be visible in large colonies if they have not been mowed or laid over by heavy snow. New growth emerges as green and pink asparagus-like sprouts. Hollow stems develop and grow taller and leaves develop to full expansion.

SUMMER IDENTIFICATION = EASY

Mature plants have lush, oval to heart-shaped leaves, hollow, bamboo-like stems, and soft delicate white flowers that look similar to pipe cleaners at a distance.

FALL IDENTIFICATION = EASY

Seeds turn rust colored in fall. Some plants drop all seeds, while others remain on the stalks.

WINTER IDENTIFICATION = MODERATE

Purplish to dark brown bamboo-like canes persist and often hold large amounts of rust-colored seeds into winter. Large colonies are easily visible at a distance.

SIMILAR-LOOKING SPECIES

GIANT KNOTWEED (*Fallopia sachalinense*) looks very similar to Japanese knotweed and often grows in the same areas. The leaves are larger than Japanese knotweed and are more spade shaped.

BAMBOO (*Phyllostachys* spp.) is an aggressive ornamental garden plant that can resemble Japanese knotweed's hollow, segmented stems. Bamboo stems are green and woody. The leaves are slender and pointed.

RIVM LEVEL OF CONCERN

| | |
|--|-----------------------|
| | OHIO DISTRIBUTION |
| | ROADSIDE DISTRIBUTION |
| | GROWTH |
| | SEEDS |
| | ABILITY TO DOMINATE |
| | DIFFICULTY OF CONTROL |



WHERE TO FIND:

Japanese knotweed is common in Ohio, especially in the eastern half of the state. Japanese knotweed prefers wet sites near rivers and in ditches. It tolerates shade very well, but can also grow in full sun. This plant is easy to find in large patches, dominating all other vegetation.

CONTROL METHODS:

MECHANICAL: Mow from spring to late summer only if necessary to maintain visibility, weaken perennial patches, and reduce seed production. Expect rapid regrowth. Be careful not to transport cut plant parts off site as new colonies will form where cuttings are dropped and take root.

CHEMICAL: Make directed applications to Japanese knotweed with non-selective or selective residual herbicide after full leaf expansion in late spring to flower production in late summer.

CULTURAL: Improve drainage and increase sunlight to decrease desirable habitat.

RECOMMENDATION SUMMARY:

Japanese knotweed is a fast-growing, aggressive perennial that is difficult to control. Accomplishing complete control may take several seasons, so be persistent. For best control, make herbicide applications from late spring after leaves fully expand to late summer flowering. Allow at least four weeks for herbicide to work into the roots before cutting. Plan herbicide applications for consecutive years until control is achieved. Mow to maintain visibility or to weaken the root system's ability to store energy late in the season. Be careful not to transport cut stems to new locations after mowing. Cut plant parts of Japanese knotweed can grow into new plants and eventually large colonies. Improve drainage and increase sunlight to diminish habitat for Japanese knotweed and allow competition from a wider array of Ohio vegetation. Failure to control Japanese knotweed will result in the expansion of patches through spreading roots and development of seeds that can spread the plant to new areas. Japanese knotweed is a major concern for maintenance and visibility beyond the road edge.

SEASONAL IDENTIFICATION

JAPANESE KNOTWEED (*Fallopia japonica* var. *japonica*)

SPRING



Pink and green sprouts emerge and look similar to asparagus, but are much thicker. Stems are hollow.

LATE SPRING - LATE SUMMER



Bamboo-like main stems are smooth, hollow, and chambered. Leaf stems are reddish purple and strongly zigzagged. Oval to heart-shaped leaves have tapered points.

EARLY SUMMER



Large colonies form by spreading roots called rhizomes. Japanese knotweed shades out most other vegetation.

SUMMER



White flower spikes emerge where the leaf meets the stem. Flower spikes are seen in loose clusters with many small white flowers; each of which has five petals. By fall, one seed per flower has formed on the same spikes.

FALL



Japanese knotweed leaves briefly turn yellow before turning rust brown in fall. Colonies stand out when plants are rust colored. Seeds have formed at this time but are not easily seen until leaf drop.

FALL - WINTER



In winter, stems remain as standing canes. Many plants have rust-colored seeds but some have already dropped all seeds. Papery capsules with three wings surround each oval-shaped seed.

JOHNSONGRASS

(*Sorghum halapense*)



PLANT DESCRIPTION

Johnsongrass, or Johnson grass, is a 5–8 foot tall perennial grass typically seen in summer in dense colonies with a symmetrical, open, pyramid-shaped seed head. Johnsongrass looks like other grasses while young, but grows rapidly in summer and becomes taller than most grasses with a distinct leaf.

LEAF: The leaf blades are 2 inches wide with prominent white center midribs. The leaf wraps around the stem where it attaches, and if peeled off reveals a tattered translucent membrane at the base.

STEM: The stems are smooth and grow rapidly after flower formation during the boot-to-head stage.

FLOWER: The densely-arranged, tan flower heads emerge in summer. Once mature, the loosely-arranged, symmetrical, pyramidal flower heads help distinguish Johnsongrass from other large grasses.

SEED: The seeds are oval shaped, shiny, brown, and covered in coarse hairs. The seeds are produced on open, pyramid-shaped seed heads. A mature plant can produce thousands of seeds that remain viable for up to ten years.

REPRODUCTION: Seeds facilitate reproduction with most seeds falling around the parent plants, but the roots of Johnsongrass are the primary means of reproduction. Johnsongrass has rhizomes that spread underground, sprouting up new plants and creating dense colonies.

WHY IT IS NOXIOUS: Johnsongrass is a major concern for roadside maintenance due to its mature height. It invades agricultural crops and can be toxic to grazing animals.

SEASONAL IDENTIFICATION

WHEN TO FIND: The ideal time to find Johnsongrass is midsummer to late summer. Look for tall, dense colonies in flower or seed.

SPRING IDENTIFICATION = DIFFICULT

Johnsongrass is not prevalent or likely to be visible aboveground in spring, but will be present underground in root form.

SUMMER IDENTIFICATION = EASY

Johnsongrass grows in patches and can be identified by a white center midrib on the leaf. Flowers emerge in midsummer and the stem grows rapidly, reaching heights of 8 feet tall. Look for dense patches of tall grass and then look for loose, pyramid-shaped flower/seed heads.

FALL IDENTIFICATION = EASY

As Johnsongrass fades away, the leaf center vein turns pink-purple and the entire plant turns dark brown and eventually light tan.

WINTER IDENTIFICATION = DIFFICULT

Johnsongrass does not retain an above-ground form in winter but survives in root form.

SIMILAR-LOOKING SPECIES

SHATTERCANE (*Sorghum bicolor*) leaves look very similar but are wider than Johnsongrass when held side by side. The main difference is in the flower/seed head. Shattercane has a more dense, tufted flower/seed head similar to a dust broom and much larger, more rounded seeds.

CORN (*Zea mays*) leaves look similar but are actually broader than Johnsongrass. Corn flower head spreads open and has several branches that look like pipe cleaners.

RIVM LEVEL OF CONCERN

| | |
|--|-----------------------|
| | OHIO DISTRIBUTION |
| | ROADSIDE DISTRIBUTION |
| | GROWTH |
| | SEEDS |
| | ABILITY TO DOMINATE |
| | DIFFICULTY OF CONTROL |

LOW → HIGH

WHERE TO FIND:

Johnsongrass is not yet widespread in Ohio, but is becoming abundant in the southern half of the state. Johnsongrass can be found in well-drained areas with full sun. Johnsongrass is not controlled by mowing and is most noticeable in areas that are less frequently mowed. With a faster growth rate than other grass, Johnsongrass is easy to notice within weeks after mowing an area.

CONTROL METHODS:

MECHANICAL: Mow repeatedly from midsummer to fall to maintain visibility, weaken perennial patches, and reduce seed production. Expect rapid regrowth.

CHEMICAL: Make directed or broadcast applications to Johnsongrass in midsummer with selective residual herbicide. Make application when grass is at least 18 inches tall and before flower/seed heads develop.

CULTURAL: Plant tall fescue in early fall.

RECOMMENDATION SUMMARY:

Johnsongrass is a tall, aggressive, difficult-to-control perennial grass. Accomplishing complete control may take several seasons, so be persistent. For best control results make herbicide application in summer during the boot to head stage. Once established patches are under control, broadcast applications with a spray truck and boomless nozzles using grass selective herbicide (sulfosulfuron) to control seedlings that have not formed colonies. Johnsongrass has been reported to develop herbicide resistance, and results should be closely monitored for effectiveness. If a second application is required for control, use alternate herbicides with different modes of action. Mowing provides little to no control of Johnsongrass but can be used to keep plant height down. If Johnsongrass is mowed before herbicide applications, allow it to regrow to at least 18 inches before spraying. Plant tall fescue in the fall and allow to grow tall in late spring to compete with Johnsongrass for space and to reduce seed germination. Failure to control Johnsongrass could allow this very tall grass to dominate the entire right-of-way, creating maintenance, sight distance, and safety concerns.

SEASONAL IDENTIFICATION

JOHNSONGRASS (*Sorghum halapense*)

LATE SPRING



Johnsongrass seedlings with broad leaf blades emerge later than most Ohio grasses. White midrib is visible at this stage.

EARLY - MIDSUMMER



The leaf blades wrap around the stem, and if detached display white center midribs and a tattered, translucent membrane.

EARLY - MIDSUMMER



Johnsongrass grows approximately 2–4 feet tall before flower/seed head formation. This growth stage is known as boot-to-head. Chemical control is ideal at this stage.

LATE SUMMER



After seed head formation, Johnsongrass grows up to 8 feet tall. These dense colonies are formed by rhizomes.

LATE SUMMER - EARLY FALL



Note the open arrangement on the symmetrical, pyramid-shaped flower/seed head. Seed husks turn reddish purple as seeds develop.

LATE SUMMER - FALL



Patches of Johnsongrass can be seen in unmowed areas in fall but rarely into winter. Identification relies on open arrangement of seedhead. Seeds are oval shaped, shiny, and brown and are covered in coarse hairs.

KOCHIA

(*Kochia scoparia*)



PLANT DESCRIPTION

Kochia, or summer cypress, is a broadleaf summer annual weed that can be seen from summer to fall as a pyramidal-shaped bush that is 1–5 feet tall with many spreading branches. Kochia can also be seen as a seedling in late spring. Kochia is easily identified by its pyramidal form and dense canopy of narrow leaves.

LEAF: Kochia leaf blades attach directly to the stem, are small, slender, and are covered in hairs. Leaf veins run parallel to the leaf margins. Leaf hairs are inconspicuous when young. As the plant matures, the leaves become smaller and the hairs become denser and more visible.

STEM: The stems and branches display smooth vertical stripes that range from light to dark green, but can also be vibrant tints of red.

FLOWER: By late summer, small inconspicuous flowers bloom along the branches, filling in the spaces between the slender leaves. The five petaled flowers are very small and range in color from yellow to variations of red.

SEED: After flowering, tiny, irregular-shaped black seeds form within the flowers and are usually held until disturbed by animals, equipment, or hand pulling.

REPRODUCTION: Seeds are the primary means of reproduction with most seeds dropping below the parent plant. Mature kochia can produce thousands of seeds that may be viable in the soil for one to two years. Seeds germinate in late summer after most Ohio summer annuals.

WHY IT IS NOXIOUS: Kochia can overtake guardrails at the edge of the road creating visibility and maintenance concerns. Kochia also has demonstrated herbicide resistance.

SEASONAL IDENTIFICATION

WHEN TO FIND: Kochia is most noticeable in summer after branches develop a distinct pyramidal form with dense, narrow leaves. It is also easy to identify when the plant color changes in late summer.

SPRING IDENTIFICATION = MODERATE

Kochia seedlings prefer disturbed or dry sites. The small, slender leaves attach directly to the stem and are covered in hairs. Leaf veins are parallel to the leaf edge.

SUMMER IDENTIFICATION = EASY

Strong lateral branching creates a pyramidal form with striped stems ranging from green to red in color. The yellow flowers are produced along the branches. The leaf hairs become long and dense, which makes the branch feel soft.

FALL IDENTIFICATION = EASY

As kochia matures and completes its life cycle, it turns from green to bright red to tan. Not all plants turn red but all eventually turn tan after dying. Large colonies should be easy to locate until winter.

WINTER IDENTIFICATION = MODERATE

Dead kochia stems may stay standing until heavy snowfall but are not easy to identify unless in large colonies.

SIMILAR-LOOKING SPECIES

RUSSIAN THISTLE (*Salsola kali* var. *tenuifolia*) grows in a similar bushy form but is more round. The leaves are narrow and needle like with spine tips that are sharp to the touch.

MUGWORT (*Artemisia vulgaris*) looks similar from a distance in form and color. The leaves are highly divided with lobed margins. The leaves can be variable in appearance throughout the plant.

RIVM LEVEL OF CONCERN

| | |
|--|-----------------------|
| | OHIO DISTRIBUTION |
| | ROADSIDE DISTRIBUTION |
| | GROWTH |
| | SEEDS |
| | ABILITY TO DOMINATE |
| | DIFFICULTY OF CONTROL |



WHERE TO FIND:

Kochia is becoming more and more common in Ohio at the edge of the road and under rails. Single plants may be found but dense colonies are easy to spot. Kochia prefers full sun and well-drained, disturbed soil. Kochia is most often found in areas that have been sprayed in the past for bare ground.

CONTROL METHODS:

MECHANICAL: Mow to maintain visibility and to reduce seed production. Hand pull to remove individual plants. Grade road edge to control seedlings.

CHEMICAL: Broadcast pre-emergent herbicide to soils of infested areas in early summer before seeds germinate. Make broadcast applications to kochia with selective herbicides and added surfactant in summer before leaf hairs become dense. Kochia can be resistant to herbicides.

CULTURAL: Install paving when appropriate near roadway.

RECOMMENDATION SUMMARY: Kochia can be an aggressive summer annual weed that can take over guardrails and disturbed sites. For best control results, perform herbicide applications in summer before the leaf hairs become dense and prevent herbicide from reaching the small leaves. Always add surfactant when making foliar applications to increase the herbicide's ability to penetrate leaf hairs and reach the leaf surface. Kochia has shown an ability to develop resistance to many commonly used herbicides including ALS-inhibiting herbicides and glyphosate. Always monitor herbicide applications for effectiveness. If a second application is required for control, use alternate herbicides with different modes of action. If a large colony produces seed, prevent future germination by making pre-emergent herbicide applications to soil in early summer before seeds germinate. Mow or cut to maintain visibility and reduce seed production. Hand pull individual plants. Grading the road edge can also control young kochia plants growing at the edge of the road. Grading can be used to control existing population of seedlings but is not suggested as a preventative measure. Failure to control kochia will allow this aggressive weed to produce thousands of seeds, increasing the distribution along the road edge and creating maintenance and visibility concerns.

SEASONAL IDENTIFICATION

KOCHIA (*Kochia scoparia*)

EARLY SUMMER



Kochia's pyramidal form is apparent even in young plants. Leaves attach directly to the stem and are narrow, pointed, and covered in short hairs. Note water beads up on the leaf surface.

SUMMER



The leaf blades are about 2 inches wide with a prominent white stripe in the center. If the leaf is detached from the stem, a tattered, translucent membrane becomes visible.

LATE SUMMER



The branches are not noticeable on their own, but after the flowers develop, the branch structure becomes more visible.

LATE SUMMER



Small yellow flowers with five petals bloom along the stems, filling in the space between leaves. Leaves become very slender and covered in dense, long hairs.

LATE SUMMER - FALL



Kochia is easily identified when its flowers, branches, and stems turn red or pink. Not all plants or flowers turn red.

FALL - WINTER



Late in the fall season, kochia turns brittle and dries to a brown or tan color. At its full size, kochia can be seen overtaking guardrails. The seeds are dark in color, small, and irregularly shaped.

KUDZU

(*Pueraria montana var. lobata*)



PLANT DESCRIPTION

Kudzu, or “Vine That Ate The South,” is an aggressive, fast-growing broadleaf perennial climbing vine that can be seen in summer in massive colonies. Kudzu is capable of taking over large areas, which includes growing over signs, guardrails, to the tops of trees, and over structures.

LEAF: Leaves are dark green on top and light green or whitish on the underside. Young leaves are covered in hairs, older leaves are hairless. Leaves grow in groups of three with each leaf or leaflet having one to three lobes and a smooth leaf margin.

STEM: Kudzu has a large, twisting main stem at ground level that can become woody and thick, spreading outward or upward up to 100 feet. Younger stems are green and also covered in hairs.

FLOWER: Attractive clusters of purple flower spikes are often hidden from view under the dense leaves. Unopened flower buds are covered in soft brown hairs.

SEED: By early fall, green soybean-shaped seed pods are produced in clusters and are covered in hairs. Most seeds fall below the parent plant but are not known to readily germinate.

REPRODUCTION: The roots and vine shoots of kudzu are the primary means of reproduction. Kudzu roots are tuberous, storing enough energy to send out new shoots if the aboveground portion of the vine is injured.

WHY IT IS NOXIOUS: Kudzu is a fast-growing and highly-aggressive vine that can cause major maintenance concerns along the roadway. Kudzu has the ability to cover and overtake open areas, trees, guardrails, and signs.

SEASONAL IDENTIFICATION

WHEN TO FIND: Kudzu is easily found in the summer as a large mass of leaves and climbing vines. In the fall, it is most noticeable when its leaves change color from green to yellow.

SPRING IDENTIFICATION = EASY

Remnant patches of kudzu leaf-out late in spring. Leaves emerge from perennial root crowns or overwintered vines. Leaves grow in groups of three and are covered in hairs.

SUMMER IDENTIFICATION = EASY

Massive colonies are easily spotted carpeting open areas and surrounding vegetation. Leaves and stems are covered in coarse brown hairs. By late summer, purple flower spikes bloom.

FALL IDENTIFICATION = EASY

Hairy bean pods are found in hanging clusters. Individual pods resemble soybeans. Leaves turn dull yellow in fall.

WINTER IDENTIFICATION = EASY TO MODERATE

Kudzu will persist as a vine stem through winter. The vine stem is easily seen covering other vegetation.

SIMILAR-LOOKING SPECIES

GRAPEVINES (*Vitis* spp.) when left unmaintained can grow into comparable masses, but its single leaf has a toothed margin and is hairless. Fruits are bunches of small grapes and vines have peeling bark.

SOYBEAN (*Glycine max*) leaves grow with similar-looking three leaflets but without lobes on margins. Soybean grows as a short, vertical, single-stemmed plant. Fruit form is a pod with about three seeds.

MOONSEED VINE (*Menispermum canadense*) has a single leaf that looks similar to a kudzu leaflet but its fruit is a very small peach-like fruit that is green when young and blue to black when ripe.

RIVM LEVEL OF CONCERN

| | |
|----------------------------------|-----------------------|
| <input type="radio"/> | OHIO DISTRIBUTION |
| <input checked="" type="radio"/> | ROADSIDE DISTRIBUTION |
| <input checked="" type="radio"/> | GROWTH |
| <input type="radio"/> | SEEDS |
| <input checked="" type="radio"/> | ABILITY TO DOMINATE |
| <input checked="" type="radio"/> | DIFFICULTY OF CONTROL |

LOW → HIGH

WHERE TO FIND:

Kudzu is not prevalent in Ohio but has been seen in southern Ohio and neighboring states. Kudzu prefers full sun, dry fields, or sunny openings near wooded areas. Kudzu can climb over all other vegetation including trees and has the ability to form large dense mats that are easily noticed at a distance. Kudzu's rapid growth rate can allow it to grow over rails, signs, and other structures and encroach the roadway.

CONTROL METHODS:

MECHANICAL: Mow to provide clearance when necessary. Expect rapid regrowth after mowing.

CHEMICAL: Make directed applications to kudzu with selective residual herbicide in the spring to late summer while leaves are still green. Expect regrowth.

CULTURAL: Heavy grazing by goats and other similar livestock can reduce the health and vigor of kudzu colonies.

RECOMMENDATION SUMMARY:

Kudzu is an aggressive, fast-growing perennial vine that is difficult to control. Accomplishing complete control may take several seasons, so be persistent. For best control, make herbicide applications from spring to late summer while kudzu is actively growing. Use herbicide with residual activity at maximum labeled rates. Repeated low mowing can weaken kudzu, but it is time consuming. Kudzu should only be mowed to maintain visibility, not to provide control. Expect rapid regrowth after mowing. Intensive grazing can also weaken kudzu, but will most likely not provide complete control. Failure to control kudzu will allow this highly aggressive, fast-growing species to quickly overtake landscapes, vegetation, fixed objects, or open wooded areas.

SEASONAL IDENTIFICATION

KUDZU (*Pueraria montana* var. *lobata*)

SPRING



Leaves grow in groups of three and are dark green on top and light green or whitish on the underside. Young leaves are covered in hairs.

SPRING - FALL



Older leaves are usually hairless, but are distinctly shaped with one to three large, rounded or pointed lobes. Lateral leaflets usually have two lobes. The terminal leaflet is usually symmetrical and has three lobes. Stems are covered in dense hairs.

SUMMER



As kudzu ages, the stems become woody and smooth. Perennial twisting vines can strangle trees and overtake nearby vegetation, signs, guardrails, and open areas.

SUMMER - FALL



Purple flowers form attractive spike-shaped clusters.

FALL



Kudzu seed pods are hairy and resemble soybeans.

FALL - WINTER



Leaves turn dull yellow in fall. In the winter, persistent, sprawling perennial vines can be seen overtaking other vegetation.

MARESTAIL

(*Conyza canadensis*)



SUMMER
ANNUAL

OR



WINTER
ANNUAL

PLANT DESCRIPTION

Marestail, or horseweed, is a broadleaf summer or winter annual weed that can be seen in late spring to early summer as an upright, 3–5 foot tall, single-stemmed weed with an open, pyramidal flower head. Young plants can also be seen in early spring or in fall as low-growing seedlings or rosettes. Marestail is easiest to identify after growing tall and producing a terminal flower head that resembles a horse's tail.

LEAF: Young marestail rosette or seedling leaves are dark green, hairy, and have shallow, rounded leaf lobes. When marestail begins to grow vertically, the leaves become bright green, remain covered in hairs, but usually have no lobes. The leaves are produced directly on the main stem and are densely arranged.

STEM: The stem grows vertically during the vegetative stage and is also covered in hairs. As marestail matures and prepares to flower, branches develop at the top of the plant, tapering towards the top.

FLOWER: Marestail flowers are inconspicuous and very small. They look like miniature daisies with a round green base, short white petals, and a yellow center.

SEED: After pollination, white cottony seed tufts develop in round puffballs similar to dandelion seeds.

REPRODUCTION: Seeds are the primary means of reproduction and are dispersed long distances by wind. Mature marestail plants can produce hundreds of thousands of seeds that can remain viable in the soil for two to three years.

WHY IT IS NOXIOUS: Marestail is resistant to common herbicides. It is highly competitive at the road edge, can disperse seeds long distances, and is a major threat to agriculture.

SEASONAL IDENTIFICATION

WHEN TO FIND: The ideal time to find marestail is summer, since it is easily identified by leaves or flower and seed heads.

SPRING IDENTIFICATION = EASY TO MODERATE

Young marestail rosette or seedling leaves are dark green, hairy, and have shallow, rounded leaf lobes.

SUMMER IDENTIFICATION = EASY

Single stem plants lack branches and are covered in hairs. Leaves are slender and hair covered. Leaves attach directly to the stem. In midsummer, a spreading flower head develops at the top of the plant. Flowers are inconspicuous with white petals and yellow centers. Cottony seeds are produced from midsummer to late summer.

FALL IDENTIFICATION = EASY

Seeds that germinate in midsummer may have a chance to produce flower and seed before frost. Fall horseweed is usually much shorter than those that germinate in spring.

WINTER IDENTIFICATION = EASY TO MODERATE

Dead plant skeletons remain standing through winter. Rosettes may also be found but can die from extreme cold weather.

SIMILAR-LOOKING SPECIES

GOLDENROD (*Solidago* spp.) form and leaves look similar. The flowers are typically yellow and grow from many points along upper branches. Leaf hairs are very short and not as stiff.

DWARF MARESTAIL (*Conyza ramosissima*) flowers and seed heads look similar but are much smaller. It has many branching stems with no central axis. It takes the form of a short bush.

OXEYE DAISY (*Leucanthemum vulgare*) seedling or rosette form can resemble marestail seedling or rosette but it grows as a low mound rather than tall. Oxeye daisy leaves are hairless.

RIVM LEVEL OF CONCERN

| | |
|--|-----------------------|
| | OHIO DISTRIBUTION |
| | ROADSIDE DISTRIBUTION |
| | GROWTH |
| | SEEDS |
| | ABILITY TO DOMINATE |
| | DIFFICULTY OF CONTROL |

LOW → HIGH

WHERE TO FIND:

Marestail is common in Ohio at the edge of the road and under rails. Usually found in large groups or colonies, marestail prefers full sun and dry disturbed soil. Marestail is most often found in areas that have been sprayed in the past for bare ground.

CONTROL METHODS:

MECHANICAL: Mow in the summer only to maintain visibility or to reduce seed production. Hand pull individual plants. Grade road edge to control young plants.

CHEMICAL: Make broadcast applications to young plants from late summer to fall with selective herbicide and surfactant. Broadcast pre-emergent herbicide to soils of infested areas in spring before seeds germinate. Marestail has shown an ability to develop resistance to various herbicides.

CULTURAL: Install paving when appropriate near roadway.

RECOMMENDATION SUMMARY:

Marestail is an aggressive, herbicide-resistant, summer or winter annual weed that becomes more difficult to control as it matures. For best control results, make foliar herbicide applications in late spring to early summer. Marestail is more susceptible to chemical control when young and hairs are not as dense. When making foliar applications add surfactant to increase the herbicide's ability to penetrate leaf hairs and reach the leaf surface. Marestail has shown an ability to develop resistance to many commonly used herbicides including ALS-inhibiting herbicides and glyphosate. Always monitor herbicide applications for effectiveness, and if a second application is required for control use alternate herbicides with different modes of action. If a large colony produces seed, prevent future germination by making pre-emergent herbicide applications to soil in spring before seeds germinate. Mow or cut only to maintain visibility or to reduce seed production. Failure to control marestail will allow this aggressive, herbicide-resistant, heavy seed-producing weed to spread along roadways, under guardrails, and other disturbed areas. The wind-blown seeds can easily spread to neighboring private properties and farm fields and remain viable for two to three years.

SEASONAL IDENTIFICATION

MARESTAIL (*Conyza canadensis*)

SPRING - EARLY SUMMER



Rosettes or seedlings are covered in hairs and identified by narrow, pointed leaves with shallow lobes. By early summer, rosettes or seedlings begin to produce upright stems.

EARLY SUMMER



Leaves are narrow and pointed. The leaves are directly attached to the stem in a whorled arrangement. Leaves and stems are covered in white hairs.

SUMMER



Before marestail develops flowers, it grows as a single stem with many leaves. Note the bright green color. As it prepares to flower, branches develop the terminal flower heads.

SUMMER



Mature flowers are small with a rounded green base, tiny white petals, and a yellow center. The terminal flowers are found at the top of the plant in a pyramidal arrangement.

MIDSUMMER - LATE SUMMER



White cottony seed heads develop in round puffballs similar to dandelion seeds and are produced continuously after flowering. Seeds can germinate immediately and possibly complete the life cycle before winter.

FALL - WINTER



The stem and branches can persist standing upright throughout the winter. Seeds may still be present.

MILE-A-MINUTE WEED

(*Persicaria perfoliata*)



SUMMER
ANNUAL



PLANT DESCRIPTION

Mile-a-minute weed, also known as Devil's tearthumb, is an aggressive, fast-growing broadleaf summer annual vine. It can be seen in the summer as a climbing or spreading vine capable of taking over large areas. Mile-a-minute weed grows very fast and can quickly grow into thick mats covering the ground or climbing over other vegetation.

LEAF: The leaf is light green, small, and triangular with straight edges. The underside of the leaf and leaf stem are armed with downward-pointing sharp spines. Mile-a-minute weed vines have unique cup-like leaves encircling the stem.

STEM: The stem is very slender but distinctly square shaped and armed with sharp downward pointing spines.

FLOWER: The flowers are small with a whitish pink color and are produced in an upward pointing cluster from within the cup-like leaf, eventually developing berries.

FRUIT/SEED: Mile-a-minute weed fruit is formed in erect, tightly-arranged clusters of green berries that ripen to a waxy dark blue.

REPRODUCTION: The seeds of mile-a-minute weed function as the primary means of reproduction. Seed can be transported by water and wildlife. Seed production can vary based on site conditions and can stay viable for several years.

WHY IT IS NOXIOUS: Mile-a-minute weed poses a significant threat to wet habitats due to its ability to outcompete native vegetation. Due to rapid growth this aggressive weed can also cause significant maintenance concerns if left uncontrolled.

SEASONAL IDENTIFICATION

WHEN TO FIND: Look from late spring to fall near waterways for masses of vines with triangular leaves and blue berry clusters.

SPRING IDENTIFICATION = MODERATE

Young mile-a-minute weed has triangular leaves with straight edges. In spring, it also has distinctive, cup-like leaves that wrap the stem at nodes where branches occur. The thin stems and undersides of leaves are armed with downward pointing sharp spines.

SUMMER IDENTIFICATION = EASY

From summer to fall, mile-a-minute weed can flower. Its small whitish pink flowers form in spike clusters of 10–15 blossoms. Mile-a-minute weed grows very quickly and forms dense mats or may grow on top of other vegetation.

FALL IDENTIFICATION = EASY

From late summer until the first frost, mile-a-minute weed will have clusters of bright blue berries. This makes identification very easy. The clusters form above the cup-like leaves on the stem.

WINTER IDENTIFICATION = EASY TO MODERATE

In winter months, brown to grey, slender, narrow stems may remain. The stems form dense thickets and retain sharp spines.

SIMILAR-LOOKING SPECIES

ARROWLEAF TEARTHUMB (*Persicaria sagittata*) has a similar squared stem with many small spines. The leaves are narrow and shaped like an elongated heart.

HALBERDLEAF TEARTHUMB (*Persicaria arifolia*) has a similar squared stem with many small spines. The leaves are wide and long, and shaped like a spear head.

SAW GREENBRIER (*Smilax bonanox*) is also a climbing vine but it has triangle leaves that have wide, rounded corners and almost lobed edges. The stem has large, stout, flattened spines.

RIVM LEVEL OF CONCERN

| | |
|----------------------------------|-----------------------|
| <input type="radio"/> | OHIO DISTRIBUTION |
| <input type="radio"/> | ROADSIDE DISTRIBUTION |
| <input checked="" type="radio"/> | GROWTH |
| <input type="radio"/> | SEEDS |
| <input checked="" type="radio"/> | ABILITY TO DOMINATE |
| <input type="radio"/> | DIFFICULTY OF CONTROL |

LOW → HIGH

WHERE TO FIND:

Mile-a-minute weed is not prevalent in Ohio but has been observed along the Ohio River. Mile-a-minute weed requires adequate moisture to germinate, so look near waterways in full sun areas. Mile-a-minute weed can climb over all other vegetation, including trees, and has the ability to form large dense mats.

CONTROL METHODS:

MECHANICAL: Hand pull young plants before spines harden, or wear gloves to prevent getting pricked. Mow to reduce seed production if accessible.

CHEMICAL: Broadcast pre-emergent herbicide to soils of infested areas in spring before seeds germinate. Make directed foliar applications to young mile-a-minute weed with non-selective herbicides in spring to summer.

CULTURAL: Avoid creating disturbance to existing desirable plant community.

RECOMMENDATION SUMMARY:

Mile-a-minute weed is an aggressive, fast-growing summer annual vine that can overtake desirable vegetation and trees. Mile-a-minute weed grows rapidly throughout the growing season, so it is important to treat early. Chemical control is the best option for this weed. Foliar-applied herbicides may provide the best control but can cause off-target damage to plants that mile-a-minute weed has overtaken. If a large colony produces seed, prevent future germination by making pre-emergent herbicide applications to soil in spring before seeds germinate. Follow up with directed foliar herbicide applications to address any survivors. Avoid disturbance to surrounding desirable plant community in order to limit the spread of this weed. Mowing will have little effect on mile-a-minute weed but can reduce seed production. When hand pulling, gloves are recommended to avoid injury from the spines. Failure to control mile-a-minute weed will allow this fast-growing, aggressive vine to produce seeds that can be spread by wildlife and waterways, creating major ecological and maintenance concerns.

SEASONAL IDENTIFICATION

MILE-A-MINUTE WEED (*Persicaria perfoliata*)

SPRING



Mile-a-minute weed grows from seeds and forms young shoots. Vine shoots are slender and grow rapidly by either climbing or spreading.

SPRING - SUMMER



The leaf is distinctly triangle shaped with straight edges. Leaf undersides and slender stems are armed with spines.

SUMMER



Mile-a-minute weed grows rapidly and covers surrounding vegetation, thereby blocking surrounding vegetation from receiving available light.

SUMMER



Mile-a-minute weed flowers are small and bell shaped, produced from within the cup-like leaf in an erect cluster. The flowers turn from green to white to pink as they develop bluish purple berries.

SUMMER



Mile-a-minute weed fruit grows in erect clusters of small berries that range from green or pink to waxy blue. The cup-like leaf encircles the stem from which the fruit is produced.

FALL - WINTER



In winter, thin mile-a-minute weed vines can be seen draped over shrubs, trees, and log piles. The slender reddish stem is squared and retains the downward-pointing spines into spring.

MUSK THISTLE

(*Carduus nutans*)



PLANT DESCRIPTION

Musk thistle, or nodding thistle, is a biennial weed that can be seen in summer as an upright, multiple stemmed, 3–6 foot tall flowering plant with pink flowers and spine-tipped leaves. It can also be found as a low-growing seedling or rosette in spring. Round pink flowers are known to bend over or nod downward and are easily noticed in unmowed areas.

LEAF: Leaves are hairless, narrow, lobed, and coarsely toothed with sharp spines along the leaf margin. A key identification feature is the winged leaves and spines growing along the length of the stems.

STEM: Multiple stems arise from a single base of leaves. Stems are winged, covered in spines, and lack lateral branches.

FLOWER: Flowers are produced at the ends of stems. Flower buds are globe shaped with large, lance-shaped bracts. Flowers bloom in early summer, with pink flower petals. The way petals emerge from the flower base resembles the form of a shaving brush.

SEED: After pollination, cottony, white and fluffy seeds develop. Seeds and flowers are often present on the same plant at the same time.

REPRODUCTION: Seeds are the primary means of reproduction and are dispersed by wind. A mature musk thistle plant is capable of producing thousands of seeds that can remain viable for up to ten years.

WHY IT IS NOXIOUS: Musk thistle can create maintenance and visibility issues if allowed to grow near the road and can disperse seeds long distances.

SEASONAL IDENTIFICATION

WHEN TO FIND: Look for vivid pink-rose colored, globe-shaped flowers and spiny-winged stems from late spring to midsummer. Cottony seed heads can be seen from summer to fall.

SPRING IDENTIFICATION = DIFFICULT

Basal rosettes can be found as low-growing mounds of spiny leaves. At the rosette stage, distinguishing musk thistle from other thistles can be difficult.

SUMMER IDENTIFICATION = EASY TO MODERATE

Stems grow long and are covered in spiny wings. Green and pink flower buds are globe shaped with large lance-shaped bracts. Flowers are pink and resemble a shaving brush shape. Seeds are produced by midsummer as flowers continue blooming.

FALL IDENTIFICATION = EASY TO MODERATE

Fully mature plants are declining. Look for remnant, fluffy seed heads on fully-formed multiple stems with spiked wings along the stems.

WINTER IDENTIFICATION = DIFFICULT

Musk thistle does not persist into winter after going to seed and dying. However, rosettes that germinated in spring may be found and will survive over winter.

SIMILAR-LOOKING SPECIES

CANADA THISTLE (*Cirsium arvense*) leaves and form can be similar. The flowers are purple, small, and grow in groups of multiple flowers. Their stems are smooth with no hairs or spikes.

BULL THISTLE (*Cirsium vulgare*) leaves look similar but the lobes are more pointed or lance shaped. The flowers are constricted where petals emerge. The flower buds or base of emerged flowers are more oval shaped and have needle-like flower bracts. Stems and leaves are covered with dense white hairs.



RIVM LEVEL OF CONCERN

| | |
|--|-----------------------|
| | OHIO DISTRIBUTION |
| | ROADSIDE DISTRIBUTION |
| | GROWTH |
| | SEEDS |
| | ABILITY TO DOMINATE |
| | DIFFICULTY OF CONTROL |



WHERE TO FIND:

Musk thistle is common in western Ohio. It is typically found in well-drained fields, slopes, and unmanaged areas in full sun.

CONTROL METHODS:

MECHANICAL: Mow only to maintain visibility and to reduce seed production. Hand pull with gloves and use caution to avoid spines.

CHEMICAL: Make directed applications from spring to early summer with selective herbicide. For best results, make applications before plants grow tall and flowers bloom.

CULTURAL: Plant tall fescue in early fall.

RECOMMENDATION SUMMARY:

Musk thistle germinates in spring, lives for one full season, and overwinters as a rosette. In the second spring, the stems bolt and produce flowers and seeds before dying. Accomplishing control should not be difficult with many opportunities to prevent seed production. For best control results, make herbicide applications in late spring to early summer before plants grow tall and flowers bloom. Fall and early spring applications to rosettes and seedlings can also be effective. Use directed applications for large colonies and broadcast applications for sporadic musk thistle growing in turf. Mow at flower emergence to reduce seed production. Plant tall fescue in early fall and allow to grow tall in spring to compete for space and to shade out seedlings. Failure to control musk thistle will allow this tall-growing, heavy-seed-producing weed to spread into newly disturbed areas along the road and into adjacent private and agriculture properties.

SEASONAL IDENTIFICATION

MUSK THISTLE (*Carduus nutans*)

SPRING



Seedlings and rosettes can be found in spring. The winged leaves have a broad center midrib, light green edges, and multiple spines per lobe.

SPRING - SUMMER



Lobed and coarsely-toothed spiny leaves are hairless. Stems are covered in spiny, leaf-like wings. Spines are evenly dispersed along the leaves and stems and are very sharp to the touch.

SUMMER



Flower buds are green with a lavender center. They are globe shaped and symmetrical with large lance-shaped bracts. Attractive, pink flower petals emerge and look similar to a shaving brush.

SUMMER



Plants may be single stemmed or develop branches. Flowers and seeds are often found on the same plant at the same time.

LATE SUMMER - FALL



Note that the flower or seed heads occasionally nod or bend downward. Cottony seeds develop as the primary means of reproduction and are spread by wind.

FALL - WINTER



In early winter prior to snow, the plant retains much of its form, including seeds and seed heads.

OXEYE DAISY

(*Leucanthemum vulgare*)



PLANT DESCRIPTION

Oxeye daisy, or field daisy, is a broadleaf perennial weed that can be seen in early summer as a 1–3 foot tall, multiple-stemmed plant with big white flowers that have a yellow center. In spring, oxeye daisy can be seen in rosette or seedling form as small clumps of leaves. Oxeye daisy survives over winter in root form. Oxeye daisy looks like garden daisies, also known as Shasta daisies, but oxeye daisy is slightly shorter and has slightly smaller flowers.

LEAF: Oxeye daisy leaves are simple with a scalloped edge while young. As the plant matures, the leaves become more elongated and thinner. Rounded lobes develop into scraggly pointed lobes.

STEM: Multiple stems arise from the rosette in spring. Stems are smooth, solid, and green. As oxeye daisy matures and produces flowers, stems turn reddish.

FLOWER: Showy white flowers with yellow centers at the ends of stems emerge in early summer.

SEED: Seeds develop in the center of the flower and remain in place long after the petals drop. Seeds are small and oval shaped with lengthwise stripes. A mature plant can produce thousands of seeds that remain viable in the soil for up to 20 years.

REPRODUCTION: Seeds are the primary means of reproduction, with most seeds falling around the parent plants, but the roots of oxeye daisy are another means of reproduction. Oxeye daisy has rhizomes that spread underground, sending up new plants and creating mounded patches.

WHY IT IS NOXIOUS: Oxeye daisy is an agriculture crop invader and can be toxic to grazing animals late in the season as it turns brown. Oxeye daisy is difficult to control with mowing since it is perennial with a durable root system.

SEASONAL IDENTIFICATION

WHEN TO FIND: The ideal time to find oxeye daisy is in late spring to midsummer. Look for attractive white flowers with yellow centers.

SPRING IDENTIFICATION = MODERATE TO DIFFICULT

Oxeye daisy can be found as a seedling or clumped rosette in spring. Leaves have irregular, rounded lobes.

SUMMER IDENTIFICATION = EASY

Oxeye daisy growing in leafy clumps has produced many upright stems with flower buds at the ends. Flowers emerge in early summer with white petals and a yellow center.

FALL IDENTIFICATION = EASY TO MODERATE

As oxeye daisy fades away, the flower petals drop, and the yellow center turns to a brown seed head. Stems turn reddish purple before the entire plant turns brown.

WINTER IDENTIFICATION = DIFFICULT

Oxeye daisy does not retain any visible form in winter but survives in root form.

SIMILAR-LOOKING SPECIES

SHASTA DAISY (*Leucanthemum* spp.) is a garden daisy that looks very similar but is not often, if ever, found to be growing wild along Ohio's roadways. Shasta daisy often has larger and taller flowers.

MARESTAIL (*Conzya canadensis*) seedlings look similar with irregular lobed leaves but are covered in hairs.

RIVM LEVEL OF CONCERN

| | |
|--|-----------------------|
| | OHIO DISTRIBUTION |
| | ROADSIDE DISTRIBUTION |
| | GROWTH |
| | SEEDS |
| | ABILITY TO DOMINATE |
| | DIFFICULTY OF CONTROL |

LOW → HIGH

WHERE TO FIND:

Oxeye daisy is common and widespread in Ohio, but is not a maintenance concern for the right-of-way. Oxeye daisy prefers full sun and well-drained soil. It can be found in mowed turf, but also in dense patches in disturbed soil at the edge of the road. Oxeye daisy can also be found in areas that have been sprayed in the past for bare ground.

CONTROL METHODS:

MECHANICAL: Mow or cut in late spring to reduce seed production. Hand pull individual plants.

CHEMICAL: Make directed or broadcast herbicide applications with selective herbicide in spring before flowering.

CULTURAL: Plant tall fescue in fall; allow to grow tall in spring.

RECOMMENDATION SUMMARY:

Oxeye daisy is a perennial weed that germinates in spring and overwinters below ground in root form. Accomplishing complete control should not be difficult, but must be performed in spring. For best control results, make herbicide applications in spring before flowering. Applications to growing plants after flowering may still provide control to roots, but will need follow-up applications for new seedlings. Make broadcast applications to oxeye daisy growing in turf and directed applications to isolated patches. Properly timed mowing will only reduce seed production. Failure to control oxeye daisy allows existing plants to perennially persist, which results in greater production of seeds that can spread to disturbed areas along the road and into adjacent properties.

SEASONAL IDENTIFICATION

OXEYE DAISY (*Leucanthemum vulgare*)

SPRING



Oxeye daisy seedlings and perennial rosettes are characterized by rounded or scalloped leaf lobes.

SPRING - SUMMER



As oxeye daisy matures, the leaves become more elongated and thinner. Rounded lobes develop into pointed lobes.

SUMMER



Flowering colonies of oxeye daisy are easily spotted in early to midsummer.

SUMMER



Oxeye daisy can be found growing near guardrails and in other disturbed areas. The flowers are very similar to a garden daisy with white petals and a yellow center.

LATE SUMMER - FALL



After flower petals drop, the yellow seed head becomes notable. Stems turn reddish as oxeye daisy prepares to go dormant.

FALL - WINTER



Seed heads turn brown as stems wilt. Seeds are small and oval shaped with vertical stripes. In fall oxeye daisy dies aboveground but remains alive underground in root form.

PALMER AMARANTH

(*Amaranthus palmeri*)



PLANT DESCRIPTION

Palmer amaranth, or careless weed, is a 3–5 foot tall broadleaf summer annual weed typically seen in summer with large spike flower heads. In the spring it can be seen as a seedling with a poinsettia-like appearance with evenly spaced leaf arrangement. The leaves are connected to the stem of the plant on leaf stalks that are longer than the leaf.

LEAF: The leaf is spade or diamond shaped and has a smooth margin.

STEM: There are no hairs on Palmer amaranth's stems or leaves. The uppermost branches and flowering spikes are long and can grow to lengths of 3 feet.

FLOWER: Multiple branches and green flowering spikes are located on the upper portion of the plant. Flowering spikes resemble pipe cleaners; diameters can exceed the size of one's thumb. Palmer amaranth has both male and female plants; the flowers of the female plant have spine tips that are sharp when dry.

SEED: In fall the female flowers enclose the small, brown, roundish seeds. Seeds fall below the parent plant. Individual plants produce up to one million seeds that can remain viable in the soil for up to 20 years.

REPRODUCTION: Seeds function as the primary means of reproduction with most seeds dropping around the parent plant. They are often spread by mowing or agriculture equipment.

WHY IT IS NOXIOUS: Palmer amaranth is a major threat to corn and soybean fields. It can outcompete young corn plants for light. Palmer amaranth can be toxic to livestock.

SEASONAL IDENTIFICATION

WHEN TO FIND: Palmer amaranth is most easily noticed in the early summer as it is flowering. Flowering spikes, similar to large green pipe cleaners, are easily spotted from a distance in low-growing crops.

SPRING IDENTIFICATION = DIFFICULT

Palmer amaranth germinates late in the season, usually in early summer. When seedlings emerge, leaves are oppositely arranged and resemble a poinsettia with an evenly-spaced leaf arrangement.

SUMMER IDENTIFICATION = MODERATE

The plant is characterized by tall, long, flowering spikes. A single plant has multiple upright flowering spikes that may sometimes droop at their upper ends. Female flowers start to develop spine tips.

FALL IDENTIFICATION = EASY

As the female plant develops its seeds late in the season, the long spikes become more brittle and have a sharp touch. Only at maturity will the female plant have this sharp touch.

WINTER IDENTIFICATION = DIFFICULT

This plant may only persist as a plant skeleton or seed into winter.

SIMILAR-LOOKING SPECIES

COMMON WATERHEMP (*Amaranthus rudis*) has a similar form but leaves are long and linear. The flowering spikes are shorter and skinnier.

SMOOTH PIGWEED (*Amaranthus hybridus*) has similar leaves but has hairs on the leaf and stem surfaces. Flowering spikes are short, stout, and crowded at the top of the plant.

REDROOT PIGWEED (*Amaranthus retroflexus*) has similar leaves but has hairs on the leaf and stem surfaces. Flowers form into a single, upright terminal cluster.

RIVM LEVEL OF CONCERN

| | |
|-----------------------|-----------------------|
| <input type="radio"/> | OHIO DISTRIBUTION |
| <input type="radio"/> | ROADSIDE DISTRIBUTION |
| <input type="radio"/> | GROWTH |
| <input type="radio"/> | SEEDS |
| <input type="radio"/> | ABILITY TO DOMINATE |
| <input type="radio"/> | DIFFICULTY OF CONTROL |



WHERE TO FIND:

Palmer amaranth is not prevalent in Ohio, but has been found in central Ohio. It has only been seen in agriculture fields but is capable of spreading into the right-of-way. Palmer amaranth is typically found in soybean fields in dry soil. If found in the right-of-way, it would most likely be from seeds spread from equipment use in nearby farm fields.

CONTROL METHODS:

MECHANICAL: Mow only in late summer to reduce seed production. Hand pull individual plants.

CHEMICAL: Make directed applications to Palmer amaranth with selective herbicide in summer before flowering. Palmer amaranth has shown the ability to develop resistance to commonly used herbicides. Broadcast pre-emergent herbicide to soils before seeds germinate.

CULTURAL: Plant tall fescue in early fall and allow to grow tall in summer.

RECOMMENDATION SUMMARY:

Palmer amaranth is a summer annual weed that can be resistant to commonly used herbicides. For best control results, make applications from midsummer to late summer before flowering. Palmer amaranth has shown an ability to develop resistance to glyphosate, ALS-inhibiting herbicides, and other agriculture herbicides. Monitor herbicide applications for effectiveness due to Palmer amaranth's ability to develop herbicide resistance. If a second application is necessary due to poor herbicide results, use alternate herbicides with different modes of action. If a large colony produces seed at the road edge, prevent future germination by making pre-emergent herbicide applications to soil in spring before seeds germinate. Mow only to reduce seed production in late summer. Hand pull to control individual plants, but be cautious not to distribute seeds to new locations if pulling plants that are past flowering period. Plant tall fescue in fall and allow to grow tall in summer to compete with Palmer amaranth. Failure to control Palmer amaranth will allow individual plants to produce up to one million seeds that can remain dormant in the soil for up to 20 years.

SEASONAL IDENTIFICATION

PALMER AMARANTH (*Amaranthus palmeri*)

SUMMER



As an early seedling, Palmer amaranth has a long leaf stalk, leaves with smooth margins, and an evenly-spaced leaf arrangement.

MIDSUMMER - LATE SUMMER



When you fold the leaf stalk back, it is longer than the length of the leaf. The stem of the plant is smooth and hairless.

LATE SUMMER



Palmer amaranth is usually taller than soybeans. Long, green flower spikes become the defining characteristic in late summer. Flowers resemble pipe cleaners.

LATE SUMMER



The flowers grow densely on the multiple flowering spikes throughout the plant. The longest/largest spike typically grows from the top. Only female flowers produce seeds.

FALL



Female flowers turn brown in fall and are armed with sharp spines. Dark, round seeds remain in the flower until disturbed. Be cautious not to distribute seeds to new locations.

FALL - WINTER



Palmer amaranth turns entirely brown in fall and usually retains its form. Stems and flowers stay intact, but leaves will drop.

POISON HEMLOCK

(*Conium maculatum*)



PLANT DESCRIPTION

Poison hemlock is a biennial weed that can be seen from early spring to midsummer as a 3–8 foot tall, upright, single stemmed, branching plant with showy white flower heads. Poison hemlock can also be found in spring or fall as a low-growing seedling or rosette. Colonies are easily spotted in late spring to early summer with showy white flower heads.

LEAF: Leaves are dark green, glossy, and deeply divided with pointed lobes similar to a fern leaf.

STEM: Stems are slightly zigzag, hollow, smooth, and hairless with purple spots.

FLOWER: Upward pointing white flowers emerge in early summer in a loose umbrella formation of several clusters.

SEED: Seeds are yellowish green, small, and round with vertical ridges. The seeds fall near the parent plant in the fall.

REPRODUCTION: The seeds function as the primary means of reproduction germinating in both fall and spring. Most seeds are dropped around the parent plant and can also be spread by animals, birds, or by water.

WHY IT IS NOXIOUS: Use caution when in contact with this plant. Poison hemlock is highly toxic to humans if ingested. If sap contacts the skin, severe blistering can occur, especially when combined with sun exposure.

SEASONAL IDENTIFICATION

WHEN TO FIND: Late spring to midsummer is the easiest time of year to identify and locate poison hemlock in flower. In late summer, look for large colonies in flower or in seed production. Poison hemlock also persists into winter.

SPRING IDENTIFICATION = MODERATE

Seedlings and rosettes can be found covering the ground, often in colonies growing under dead mature plants. The fern-like leaves are large, broad, dark green, and glossy.

SUMMER IDENTIFICATION = EASY

Mature poison hemlock features include zigzag, and smooth hollow stems with purple blotches and white umbrella-shaped flower clusters at the ends of branches.

FALL IDENTIFICATION = EASY TO MODERATE

Mature poison hemlock plants have died off by this time leaving plant skeletons standing. Seedlings and rosettes can usually be found under dead mature plants by late fall. Seedlings and rosette patches are usually darker green than most other vegetation at this time.

WINTER IDENTIFICATION = MODERATE

Dead mature plants can persist into winter and can be identified by zigzag and hollow stems. Seedlings and rosettes stay green over winter but are dormant.

SIMILAR-LOOKING SPECIES

WILD CARROT (*Daucus carota*) young plants look most similar, but leaves are more deeply lobed and are not glossy. Hairy, solid stems are the main difference. Flower heads are white and flat topped.

GIANT HOGWEED (*Herculeum mantegazzianum*) has similar umbrella-like flower heads, but they are flat topped. The size of giant hogweed, especially the leaves, differentiate this plant from poison hemlock. Stems are hollow with purple splotches but are covered in hairs. All features of giant hogweed are generally much larger than those of poison hemlock.

RIVM LEVEL OF CONCERN

| | |
|--|-----------------------|
| | OHIO DISTRIBUTION |
| | ROADSIDE DISTRIBUTION |
| | GROWTH |
| | SEEDS |
| | ABILITY TO DOMINATE |
| | DIFFICULTY OF CONTROL |

LOW HIGH

WHERE TO FIND:

Poison hemlock is quite common in Ohio, usually found in large patches or colonies in unmowed areas along Ohio roadways. Look behind guardrails and on slopes along the road. Poison hemlock grows best on well-drained slopes with full sun, but can also tolerate wet soil and shaded areas along the edge of wooded environments.

CONTROL METHODS:

MECHANICAL: Mow or cut only from spring to early summer to maintain visibility or to reduce seed production. Hand pull with gloves. Use caution! Avoid sap contact as it can cause severe rashes.

CHEMICAL: Make directed applications from spring to early summer with selective herbicide. Make applications before flowers bloom. Fall applications to young plants can also provide control.

CULTURAL: Plant tall fescue in early fall.

RECOMMENDATION SUMMARY:

Poison hemlock is toxic, germinates in spring, lives for one full season, and overwinters as a rosette. In the second spring the stems bolt and produce flowers and seeds before dying. Accomplishing control should not be difficult with many opportunities to prevent seed production. For best control results make herbicide applications in spring to early summer. Fall applications to rosettes and seedlings can also be effective. Use directed applications because poison hemlock is usually found in dense patches. If it is sporadic in large areas, use broadcast applications with selective herbicide. Mow at flower emergence to reduce seed production. Plant sap is toxic! Use caution when hand pulling to control or cutting to reduce seed or plant height. Plant tall fescue in early fall and allow to grow tall in spring to compete for space and to shade out seedlings. Failure to control poison hemlock will allow this highly toxic, tall growing, and competitive weed to form dense patches, thereby crowding out more manageable vegetation.

SEASONAL IDENTIFICATION

POISON HEMLOCK (*Conium maculatum*)

FALL - SPRING



Seedlings and rosettes can be found in large patches in spring or fall. Note the thick tap root and that poison hemlock is hairless.

LATE SPRING - SUMMER



Stems are smooth and hollow with purple splotches. The divided fern-like leaf is glossy and more broad than wild carrot leaves.

EARLY SUMMER



Poison hemlock flowers develop as rounded clusters in an umbrella formation. Poison hemlock is commonly found on slopes and other unmowed areas in early summer.

SUMMER



After flowering, seeds rapidly develop, but not all at once. Seeds are yellowish green, small, and round with vertical ridges.

SUMMER



From a distance, colonies in seed appear yellow. As mature poison hemlock plants begin to fade away for the year, the entire plant turns yellow.

FALL & WINTER



As plants die, they turn rust colored and will drop seeds into the fall. Zigzag stems will persist overwinter. Check for seedlings in these areas to plan spring applications.

PURPLE LOOSESTRIFE

(*Lythrum salicaria*)



PERENNIAL

PLANT DESCRIPTION

Purple loosestrife is a broadleaf perennial weed that is typically found growing in wet areas along with cattails. This weed grows 4–6 feet tall by summer. The mature plant has distinct purple to pink spike flower heads. In the spring, it can be seen as a seedling with typically opposite leaf arrangements.

LEAF: The leaves attach directly to the stem, are narrow and lance shaped, and form a pointed or rounded tip. Leaves may or may not be covered in fine white hairs.

STEM: Purple loosestrife can be single stemmed or multi stemmed. The stem is distinctly square shaped and branches occur in the upper portion of the plant.

FLOWER: Flowering spikes can be over 1 foot long and are composed of small purple to pink flowers. Flowers are directly attached to the stalk and may be hairy at the base, with six delicate petals with yellow pollen heads in the center.

SEED: After flowering, tiny tear-drop-shaped seeds are abundantly produced and are usually held until disturbed.

REPRODUCTION: Seeds significantly contribute to reproduction, but purple loosestrife can also spread by its root system. The perennial roots will live for many years creating new shoots in the spring with multiple stems. Mature purple loosestrife plants may produce up to one million seeds that can stay viable for up to 20 years.

WHY IT IS NOXIOUS: Purple loosestrife is a major threat to wetlands and wet areas due to its large seed production and perennial nature. Dense colonies can cause drainage issues.

SEASONAL IDENTIFICATION

WHEN TO FIND: Purple loosestrife is most noticeable when it is flowering in summer. Look for purple flowering spikes and lance-shaped leaves.

SPRING IDENTIFICATION = MODERATE

When purple loosestrife emerges as a seedling, its leaves typically grow opposite on the stem. The leaves are lance shaped with a pointed tip or rounded tip. Leaves can have hairs on all surfaces.

SUMMER IDENTIFICATION = EASY

As the plant elongates, the stem is identifiable by its distinct square shape. The upper branches extend towards flowering spikes, which have many purple–pink flowers with six petals. Purple loosestrife often dominates large wet areas and ditches.

FALL IDENTIFICATION = EASY

As the flowers fade, they drop hundreds of thousands of seeds. The leaves and stems change to a reddish purple color in the fall.

WINTER IDENTIFICATION = MODERATE

The plant may persist through the winter as a thin, dead, skeleton. The seeds will lie dormant in the soil until the spring when they germinate.

SIMILAR-LOOKING SPECIES

BLUE VERVAIN (*Verbena hastata*) grows in a similar form. It has many small flowering spikes with very small blue to purple flowers, but the leaves have a toothed margin.

SWAMP MILKWEED (*Asclepias incarnata*) looks similar before flowering. Its leaves have a very short leaf stalk. Leaves are longer than purple loosestrife leaves. The flowers are pink with stamen twice as long as the petals. The flowers grow in round clusters at the top of the plant.

SWAMP LOOSESTRIFE (*Decodon verticillatus*) leaves look similar but have a very short leaf stalk. The purple flowers grow individually in leaf pairs.

RIVM LEVEL OF CONCERN

| | |
|--|-----------------------|
| | OHIO DISTRIBUTION |
| | ROADSIDE DISTRIBUTION |
| | GROWTH |
| | SEEDS |
| | ABILITY TO DOMINATE |
| | DIFFICULTY OF CONTROL |

LOW → HIGH

WHERE TO FIND:

Purple loosestrife is prevalent in Ohio's wetlands. It is typically found in wet areas, including areas with poor drainage, ditches, and near waterways that are infrequently mowed.

CONTROL METHODS:

MECHANICAL: Mow in summer to reduce height and maintain visibility, but expect regrowth.

CHEMICAL: Make directed or broadcast applications to purple loosestrife with non-selective or selective herbicides in the spring to fall. Use aquatically-approved herbicides when appropriate.

CULTURAL: Improve drainage in ditches.

RECOMMENDATION SUMMARY:

Purple loosestrife is an aggressive, perennial plant with a persistent seed bank that is capable of dominating wet areas. Since accomplishing complete control may take several seasons, persistence is important. For best control results make herbicide applications from spring to summer until the end of the flowering stage. Make applications to actively growing plants even after flowering to reduce seed production. Control may not be as effective at this time, but will help weaken the perennial root systems. Plan herbicide applications for consecutive years to ensure control is achieved. Increase drainage in wet ditches and similar places to reduce potential habitat for purple loosestrife. Mowing will have little effect on controlling a purple loosestrife population, but can reduce seed production if properly timed. Failure to control purple loosestrife will allow dense, perennial monoculture colonies to form. Individual plants can produce up to one million seeds that can remain viable for up to 20 years.

SEASONAL IDENTIFICATION

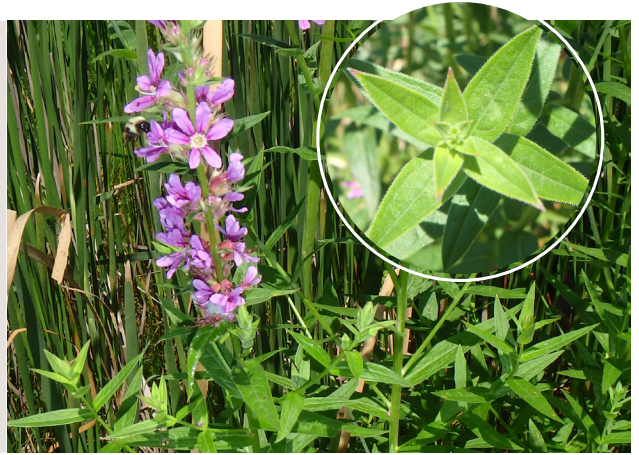
PURPLE LOOSESTRIFE (*Lythrum salicaria*)

SPRING



Seedlings grow with opposite leaf arrangements. The leaves are lance shaped with a rounded tip when young.

SPRING - SUMMER



Leaves directly attach to the distinctly square stems. The lance-shaped leaves become pointed, growing longer as the plant matures. Leaves may or may not have hairs.

SUMMER



Purple loosestrife flowers in summer and can be found growing in wet areas and ditches. Showy purple flower spikes at the ends of branches are easy to notice.

SUMMER



The flowers grow densely on the vertical flowering spikes. The flowers are small and have six pink to purple petals with yellow pollen heads. The base of flowers may have short soft hairs.

FALL



Leaves turn reddish purple as purple loosestrife prepares to go dormant. Note the spreading root system. In the following spring, new shoots will emerge from the perennial root system.

FALL - WINTER



The aboveground portion of purple loosestrife dies back in winter but may stay standing if undisturbed by snow plowing. Tiny tear-drop-shaped seeds hang onto the plant until disturbed. Most seeds fall around the parent plant.

RUSSIAN THISTLE

(*Salsola tragus*)



PLANT DESCRIPTION

Russian thistle, or tumbleweed, is a broadleaf summer annual weed that can be found from summer to fall as a 3–6 foot wide, round, bushy weed. Russian thistle can be seen in late spring as a seedling, or as a tumbleweed in late fall and winter. It is easily identified by its bushy, round form and small prickly leaves.

LEAF: The leaves are waxy and resemble pine needles. They are green, narrow, fleshy, and have a single sharp spine at the tip.

STEM: Russian thistle has many long branches that form its generally round shape. The stem is almost woody when the plant dries out after dying.

FLOWER: The flowers are small, green to white, and fleshy. They grow at the base of leaves along the stem and are hard to distinguish from other plant parts.

SEED: Seeds are the primary means of reproduction. Most seeds drop around the parent plant. Russian thistle frequently detaches from the root system, becoming a tumbleweed. As a tumbleweed, the seeds are dislodged from the flowers and fall to the ground as the plant tumbles across the landscape.

REPRODUCTION: Seeds are the primary means of reproduction. Mature Russian thistle can produce hundreds of thousands of seeds that may be viable in the soil for one to two years.

WHY IT IS NOXIOUS: The plant is not toxic; however, some people develop a skin rash from contact with leaf spines. Due to its prolific seed production and ability to spread the seeds over large distances, Russian thistle is capable of readily spreading onto adjacent lands.

SEASONAL IDENTIFICATION

WHEN TO FIND: Russian thistle is most noticeable during midsummer to fall after developing the round “tumbleweed” form.

SPRING IDENTIFICATION = EASY TO MODERATE

Young plants are fleshy and flexible. The leaves are very narrow, soft, flexible, and are most like pine needles at this stage. Seedlings may resemble grass sprouts or pine sprouts.

SUMMER IDENTIFICATION = EASY

Branches are long, highly divided, and can have red or purple stripes. Flowers are small, inconspicuous, and are formed singularly along the branches under the leaves. The new leaves are formed along branches and have papery margins with a sharp spine tip.

FALL IDENTIFICATION = EASY

As plants mature later in the year, the leaves, branches, and stem become stiff and woody, and new leaves are smaller than older leaves. Seeds also develop in the flowers.

WINTER IDENTIFICATION = EASY TO MODERATE

Russian thistle's stem will detach from the roots after it has dried and produced seeds. Russian thistle's form resembles a tumbleweed. Plant skeletons may be caught in other vegetation, fences, or other similar places.

SIMILAR-LOOKING SPECIES

KOCHIA (*Bassia scoparia*) can grow in a similar form but typically grows into a cone shape and its leaves are not armed with a spine tip. Kochia is soft to the touch.

RIVM LEVEL OF CONCERN

| | |
|----------------------------------|-----------------------|
| <input type="radio"/> | OHIO DISTRIBUTION |
| <input checked="" type="radio"/> | ROADSIDE DISTRIBUTION |
| <input checked="" type="radio"/> | GROWTH |
| <input checked="" type="radio"/> | SEEDS |
| <input type="radio"/> | ABILITY TO DOMINATE |
| <input checked="" type="radio"/> | DIFFICULTY OF CONTROL |

LOW \rightarrow HIGH

WHERE TO FIND:

Russian thistle is uncommon in Ohio. It has been seen in northwest Ohio near railroad tracks, but not along the road. Look in dry, disturbed sites along roadsides near railroad tracks.

CONTROL METHODS:

MECHANICAL: Individual plants can be controlled by pulling or cutting in the spring up until seeds develop.

CHEMICAL: Make directed applications to Russian thistle using non-selective herbicides with added surfactant in spring or summer when the plant is young and actively growing.

CULTURAL: Install pavement where appropriate near roadway.

RECOMMENDATION SUMMARY:

Russian thistle is a summer annual weed that develops into a stiff form that is very drought resistant late in the growing season. For best control, make herbicide applications in the spring shortly after seed germination or summer when the plant is young and actively growing. Adding surfactant will help improve herbicide surface coverage and penetration into small waxy leaves. Russian thistle survives times of drought by conserving water and using its deep taproot to capture subsurface water. Refrain from making herbicide applications in times of severe drought, as this plant will be less affected by herbicides. Pull individual plants any time of year, but be careful not to distribute seeds after flowering. Failure to control Russian thistle will allow individual plants to produce hundreds of thousands of seeds that have the potential to germinate on some of the driest sites in Ohio.

SEASONAL IDENTIFICATION

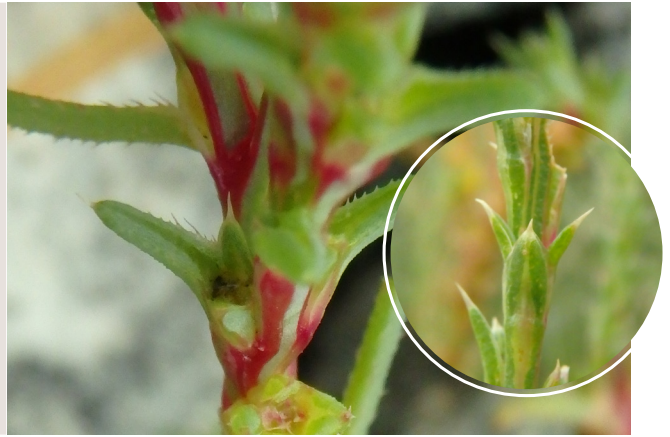
RUSSIAN THISTLE (*Salsola tragus*)

SPRING



Russian thistle can be found growing in dry areas. Look for a small, single-stemmed plant with sparse but prominent lateral branches and small, needle-like leaves.

SPRING & SUMMER



Russian thistle leaves are small, waxy, and narrow with a single spine at the tip. Note the younger leaves have hairs on the margin.

SUMMER



The flowers grow at the base of leaves on the stem. The stem can vary in color from green to a purple-striped appearance.

SUMMER



As Russian thistle matures, it develops a strong lateral branch structure that contributes to its round form.

LATE SUMMER - FALL



Tiny green seeds resemble shriveled flowers. Note that the entire plant is attached to the tap root at one single point.

FALL - WINTER



Russian thistle commonly breaks away from the root system as part of its normal life cycle. Aided by wind, seeds readily detach as the weed tumbles across the landscape.

SHATTER CANE

(*Sorghum bicolor*)



PLANT DESCRIPTION

Shatter cane, or sorghum, is a summer annual grass typically seen after midsummer growing 4–12 feet tall, with a prominent seed head that shatters apart at maturity. Shatter cane looks like corn, but is taller, has longer stems, and a much denser flower/seed head.

LEAF: The leaves are very broad for a grass (2–4 inches), with a bold white center stripe. The leaf wraps around the stem where it attaches, and if peeled off reveals a tattered see-through membrane at the base.

STEM: The stem is smooth and can be covered in a fine white powder.

FLOWER: The densely-arranged and compact tan flower heads emerge in summer around the time corn produces flowers.

SEED: Once pollinated, these flower heads become seed heads.

The large seeds are round, swollen, shiny, brown, and covered in coarse hairs on wavy stems. The seed head is heavy and easily shatters apart when handled.

REPRODUCTION: Seeds function as the primary means of reproduction. Most seeds fall below the parent plants but can be easily spread by equipment since seeds detach readily. The roots of shatter cane are fibrous and are unable to regenerate after winter.

WHY IT IS NOXIOUS: Shatter cane is a major threat to agriculture with a mature height of over 12 feet and the ability to produce a large number of seeds.

SEASONAL IDENTIFICATION

WHEN TO FIND: The ideal time to find shatter cane is in midsummer after flower/seed formation. Late summer or early fall is an ideal time to spot mature seed heads.

SPRING IDENTIFICATION = DIFFICULT

Shatter cane is not prevalent or likely to be visible at this time. If a known colony produced seeds last year, look for seedlings in the same location.

SUMMER IDENTIFICATION = EASY

Summer is the ideal time to identify shattercane. The leaves are broad for a grass and have a bold white stripe down the center. Look for dense tan flower heads that look like a dust broom and are usually taller than corn. Seed heads develop by late summer as a group of large, dark, round seeds that easily shatter apart.

FALL IDENTIFICATION = EASY

As shatter cane fades away, the leaf center vein turns pink. Dark seed heads are visible from a distance if they are not mowed. If seeds have been removed, look for wavy seed stems.

WINTER IDENTIFICATION = DIFFICULT

Shatter cane does not retain any noticeable form in winter.

SIMILAR-LOOKING SPECIES

JOHNSONGRASS (*Sorghum halapense*) leaves look very similar but are narrower than shatter cane. The main difference is in the flower/seed head. Johnsongrass has a symmetrical, pyramid-shaped flower/seed head with a loose, open arrangement and smaller seeds.

CORN (*Zea mays*) has a similar-looking leaf but is actually broader than shatter cane. Corn flower head spreads open and has several branches that resemble pipe cleaners.

COMMON REED (*Phragmites australis*) is comparable in size but has a much more full form. The leaves are shorter and smaller with no prominent mid-vein. The flowers and seeds are lighter in color and form smaller pointed seeds.

RIVM LEVEL OF CONCERN

| | |
|----------------------------------|-----------------------|
| <input type="radio"/> | OHIO DISTRIBUTION |
| <input type="radio"/> | ROADSIDE DISTRIBUTION |
| <input checked="" type="radio"/> | GROWTH |
| <input type="radio"/> | SEEDS |
| <input type="radio"/> | ABILITY TO DOMINATE |
| <input type="radio"/> | DIFFICULTY OF CONTROL |



WHERE TO FIND:

Shatter cane is not common in Ohio but can be randomly found in and around corn fields or fields in several locations around the state. Shatter cane favors full sun and well-drained soil.

CONTROL METHODS:

MECHANICAL: Seedlings can be easily controlled by tilling. Mow at the boot-to-head stage.

CHEMICAL: Make directed application to shatter cane before late summer with non-selective herbicide. The ideal time for application is in the boot-to-head stage of development. After stem elongation, foliar applications are not as effective.

CULTURAL: If colonies produce seed or displace desirable vegetation, plant grass in the fall so that it is established by spring.

RECOMMENDATION SUMMARY:

Shatter cane is a large annual grass that produces large seeds by fall. It is not difficult to control with herbicides or mowing and should not be allowed to produce seed. For best control, make directed applications before late summer with non-selective herbicide. Shatter cane has been reported as glyphosate-resistant. If using glyphosate, results should be closely monitored. Always monitor herbicide applications for effectiveness. If a second application is required for control, use alternate herbicides with different modes of action. Mow at the boot-to-head stage to provide control and prevent seed production. Failure to control shatter cane will result in a very tall grass that can cause sight distance issues and invade agriculture fields.

SEASONAL IDENTIFICATION

SHATTER CANE (*Sorghum bicolor*)

SUMMER



Shatter cane colonies can be easily spotted in corn with its more compact, tufted seed/flower heads. Shatter cane is usually taller than corn.

SUMMER



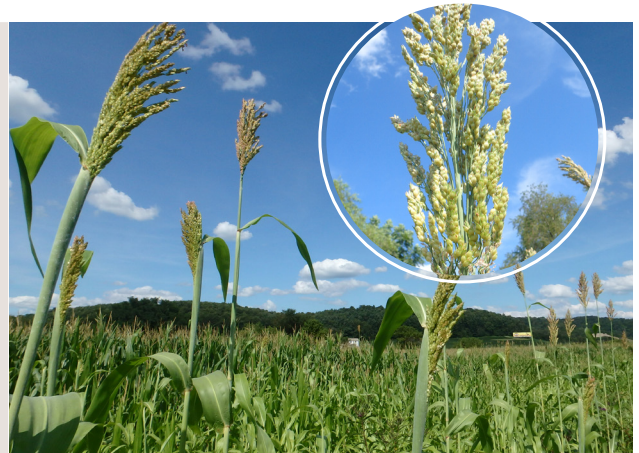
Shatter cane is tall and slender with broad leaf blades that have a prominent white midrib and wrap around the smooth, stout stem where attached.

SUMMER



Shatter cane roots are fibrous and not perennial like its close relative, Johnsongrass.

SUMMER



Shatter cane is shown in the boot-to-head stage when flower heads are developing and stem elongation occurs. Shatter cane can mature to over 10 feet tall.

LATE SUMMER - EARLY FALL



Later in the season, tufted seed heads spread open from the weight of the large round seeds, which are brown, shiny, and covered in coarse hairs.

FALL



Before dying off in the fall, leaves develop purple splotches. Shatter cane turns yellow-brown around the same time as corn.

WILD CARROT

(*Daucus carota*)



PLANT DESCRIPTION

Wild carrot, or Queen Anne's lace, is a broadleaf biennial weed that can be seen from spring to fall as a 2–5 foot tall, upright, multiple-stem plant with flat-topped, white flower heads. Wild carrot can also be seen during spring or fall as a low-growing seedling or rosette. Wild carrot's flowers can be easily spotted growing abundantly along roadways for most of the season.

LEAF: The leaves are deeply divided with many fine lobes resembling carrot leaves.

STEM: Multiple stems are solid, covered in white hairs, and lack branches.

FLOWER: The white flower heads bloom at the end of stems and are composed of many small flowers tightly arranged in an upright, flat-topped umbrella formation. As seeds develop, the seed head closes upwards into a bird's nest appearance.

SEED: The seeds are small, round, and greenish yellow with red stripes and covered in white barbs.

REPRODUCTION: The seeds function as the primary means of reproduction. Most seeds are dropped around the parent plant but can also spread by attaching to animals, clothing, or equipment. A mature wild carrot plant is capable of producing thousands of seeds that remain viable in the soil for one to two years. Wild carrot has a large fleshy tap root, which has a distinct carrot smell when cut or crushed.

WHY IT IS NOXIOUS: Wild carrot is abundant in Ohio and is known to cause maintenance concerns along roadways and invade agriculture fields.

SEASONAL IDENTIFICATION

WHEN TO FIND: Wild carrot is easily noticed in summer with abundant white flowers but is also easy to locate in fall or winter as a plant skeleton.

SPRING IDENTIFICATION = EASY TO MODERATE

Seedlings and rosettes can be found growing low among other plants and grass. The deeply divided, finely lobed compound leaves are the key to identification. Stems develop by late spring.

SUMMER IDENTIFICATION = EASY

Wild carrot populations mature at different times throughout the season, but by midsummer, stems have grown long and flat-topped white flowers are abundant in mowed fields. Seeds on most plants will develop by late summer.

FALL IDENTIFICATION = EASY

Mature wild carrot should mostly die off by fall. In warm fall seasons, look below dead wild carrot plants for germinated seedlings.

WINTER IDENTIFICATION = EASY

In unmowed areas, dead plant skeletons with multiple stems and cupped seedheads persist through winter into the following spring.

SIMILAR-LOOKING SPECIES

POISON HEMLOCK (*Conium maculatum*) flowers are white, but not as densely arranged or as flat topped. Poison hemlock leaves are similar but are darker green, glossy, and fern like. Stems are hairless, hollow, and have purple spots.

YARROW (*Achillea millefolium*) leaves are similar but more delicate and feathery. Yarrow has similar flat-topped white flowers but is not as symmetrical.

COMMON RAGWEED (*Ambrosia artemisiifolia*) looks similar in the seedling stage only. Leaf lobes are more rounded.

RIVM LEVEL OF CONCERN

| | |
|---|-----------------------|
| ● | OHIO DISTRIBUTION |
| ● | ROADSIDE DISTRIBUTION |
| ◐ | GROWTH |
| ◐ | SEEDS |
| ◐ | ABILITY TO DOMINATE |
| ○ | DIFFICULTY OF CONTROL |

○ ◐ ◑ ●

LOW → HIGH

WHERE TO FIND:

Wild carrot is common and widespread in Ohio. Found growing from the edge of the road to the fence, wild carrot is most common in sunny, well-drained fields and slopes.

CONTROL METHODS:

MECHANICAL: Mow from spring to early summer only to maintain visibility and reduce seed production. Hand pull individual plants.

CHEMICAL: Make directed or broadcast applications from spring to early summer with selective herbicide. Make applications before flowers bloom.

CULTURAL: Plant tall fescue in the fall and allow to grow tall in spring.

RECOMMENDATION SUMMARY:

Wild carrot germinates in spring, lives for one full season, and overwinters as a rosette. In the second spring, the stems bolt and produce flowers and seeds before dying. Accomplishing control should not be difficult with many opportunities to prevent seed production. For best control results, make herbicide applications in spring to early summer. Fall applications to rosettes and seedlings can also be effective. Use directed applications for large colonies and broadcast applications for sporadic wild carrot growing in turf. Mow at flower emergence to reduce seed production. Plant tall fescue in early fall and allow to grow tall in spring to compete for space and to shade out seedlings. Failure to control wild carrot will allow this tall-growing weed to proliferate along the roadways, causing maintenance and site distance issues as well as potentially spreading into adjacent properties.

SEASONAL IDENTIFICATION

WILD CARROT (*Daucus carota*)

SPRING & FALL



Wild carrot can be found as a seedling or rosette in spring or fall. Leaves look like garden grown carrots, and the white tap root smells like edible garden carrots when cut or crushed.

LATE SPRING - SUMMER



The stem is solid with vertical ribs and covered in white hairs. As the plant matures, the leaf elongates and becomes more deeply divided.

SUMMER



Wild carrot is abundant in actively mowed areas in Ohio. It can be found all year round but is easiest to see in the growing season when flowering.

SUMMER



Flat-topped white flower heads continuously produced over the growing season allow wild carrot to hold seeds and flowers at the same time, making their reproductive season longer than most Ohio plants.

LATE SUMMER - FALL



The seed head closes upwards to resemble a bird's nest. The seeds are round and covered in white barbs to help the seed spread by attaching to animals, clothes, or equipment.

FALL - WINTER



Wild carrot persists into winter with seed heads and a multi-stem form. It is common to see dead wild carrot stand up through winter into the following spring. If you see standing dead wild carrot, check for seedlings below.

WILD MUSTARD

(*Sinapis arvensis*)



OR



PLANT DESCRIPTION

Wild mustard, or charlock, is a broadleaf summer or winter annual weed that can be seen from spring to fall as an upright 2–4 foot tall plant with bunches of yellow flowers at the end of the upper branches. Wild mustard can also be found as a seedling from spring to late summer. Since wild mustard seeds can germinate twice in one growing season, mature plants with flowers can be seen from spring to fall.

LEAF: The leaves of wild mustard vary in shape and number of lobes. Lobeless leaves are egg shaped. Leaves have one or two sets of lobes at the base. Leaves are more dense in the lower portion of the plant, but as wild mustard matures the canopy becomes sparse.

STEM: Stems are dark green and glossy, but are sparsely covered in short white hairs. As wild mustard prepares to flower, branching occurs towards the top of the plant.

FLOWER: Small yellow flowers with four petals bloom along the branches, which eventually produce seed pods.

SEED: Wild mustard's seeds form in pods that look like miniature green bean pods.

REPRODUCTION: Seeds function as the primary means of reproduction. Most seeds drop below the parent plant. A mature wild mustard plant is capable of producing thousands of seeds that can remain viable in the soil for up to 20 years.

WHY IT IS NOXIOUS: Wild mustard is a significant agriculture weed with a root system that competes with crops for resources. Seeds are toxic to humans and livestock if consumed.

SEASONAL IDENTIFICATION

WHEN TO FIND: Wild mustard can be seen all season long when it is flowering. Flowering has been observed in central Ohio from late spring to midfall.

SPRING IDENTIFICATION = DIFFICULT

As a young plant or seedling, wild mustard is found growing low to the ground and can only be identified by the leaves. Egg-shaped or oval leaves tend to have one or two lobes at the base of the leaf near the stem, and stiff hairs on the underside.

SUMMER IDENTIFICATION = MODERATE TO DIFFICULT

Look for yellow flowers with four petals, 1–2 inches wide, and green seed pods. Wild mustard does not exceed 4 feet in height. There are many look-alikes.

FALL IDENTIFICATION = DIFFICULT

The plant can be identified by its seed pods. The stalk of the pod is short and extends outward and upward from the stem. Some wild mustard plants turn bright red in fall.

WINTER IDENTIFICATION = DIFFICULT

Wild mustard may persist into winter during warm years, but it usually withers and decomposes before spring.

SIMILAR-LOOKING SPECIES

BROWN MUSTARD (*Brassica juncea*) is a similar-looking mustard. It often has a waxy coating on the stem. The stalk of seed pod is very small (10–15mm long).

BLACK MUSTARD (*Brassica nigra*) is a similar-looking mustard. The leaves, flowers, and stems look very similar, but black mustard is usually over 4 feet tall.

YELLOW ROCKET (*Barbarea vulgaris*) flowers are similar to wild mustard and can be widespread in spring. These flowers appear early in the growing season, long before wild mustard flowers. Leaves have deep, multiple lobes.

FIELD MUSTARD (*Brassica rapa*) is a similar-looking mustard. It contains leaves that wrap around the stem. Leaves have short, stiff hairs on their margins and veins.

RIVM LEVEL OF CONCERN

| | |
|--|-----------------------|
| | OHIO DISTRIBUTION |
| | ROADSIDE DISTRIBUTION |
| | GROWTH |
| | SEEDS |
| | ABILITY TO DOMINATE |
| | DIFFICULTY OF CONTROL |

LOW → HIGH

WHERE TO FIND:

Wild mustard can be found in farm fields across central Ohio. Wild mustard can be found invading the right-of-way from farm fields and may be found in mowed turf or ditches. Wild mustard prefers well-drained soil and full sun.

CONTROL METHODS:

MECHANICAL: Mow in spring and late summer to reduce seed production. Hand pull to control individual plants.

CHEMICAL: Make directed applications to young wild mustard plants with selective herbicides in spring or fall.

CULTURAL: Plant tall fescue in early fall allowing it to grow tall in spring.

RECOMMENDATION SUMMARY:

Wild mustard can be a summer or winter annual. As a summer annual, the seeds germinate in the spring and flower in the summer. When acting as a winter annual, wild mustard seeds germinate in late summer or fall and produce seeds before winter. When wild mustard germinates in spring, the colonies are usually larger and produce more seeds than the germinated seeds in fall. For best control results, make directed herbicide applications in spring before flowers bloom. Only make fall applications if winter annual colonies present themselves. Mowing will not provide control of a wild mustard population but can reduce seed production. Plant tall fescue in early fall and allow to grow tall in spring to provide competition and reduce spring seed germination. Failure to control wild mustard may allow further spread of this weed from roadways to neighboring agriculture lands.

SEASONAL IDENTIFICATION

WILD MUSTARD (*Sinapis arvensis*)

SPRING - LATE SUMMER



Young wild mustard is short growing with leaves growing low to the ground. The leaves are generally oval shaped with one to two lobes near the base of the leaf.

SPRING



Leaves have a toothed margin and vary in shape and size. Short stiff hairs are found on the underside of leaves on stems. Purple coloring can be found where a branch meets the stem.

SUMMER - FALL



When in flower, large colonies of wild mustard are easy to spot at a distance. Wild mustard can germinate in spring and flower by summer or germinate in summer and flower by fall.

SPRING - SUMMER



The yellow flowers are 1–2 inches wide with four petals. The flower grows in a cluster of multiple flowers at the end of the upper branches.

SUMMER - FALL



As wild mustard matures and seeds have developed, the plant lacks flowers and leaves in the upper branches. Note the visible seed outline near the tip of the seed pod.

LATE SUMMER/FALL - WINTER



After maturing and producing seeds, wild mustard may turn bright red before it dies. Red color change is more frequent in plants that mature by summer. Plants that germinate in fall may be killed by frost before flowering and producing seeds.

WILD PARSNIP

(*Pastinaca sativa*)



PLANT DESCRIPTION

Wild parsnip, or yellow parsnip, is a broadleaf biennial weed that can be seen from late spring to early summer as an upright, single-stemmed, 3–5 foot tall branching plant with flat-topped yellow flowers. Wild parsnip can also be found as a seedling or rosette in spring and fall. Wild parsnip is easily noticed when flowering, especially in colonies along the road edge.

LEAF: The leaves of young plants are oval shaped with tattered edges and look like parsley leaves. Leaves usually grow in groups of 5–11. As wild parsnip matures, branches develop and leaves grow larger and become more pointed with deeper lobes.

STEM: Stems are hairless with prominent vertical ribs.

FLOWER: Bright yellow flower heads bloom at the end of the branches and are arranged in an upright, flat-topped formation.

SEED: Seeds are flat, green disks that eventually turn brown. The large fleshy tap root is another key identification feature that has a distinct parsnip or carrot smell when cut or crushed.

REPRODUCTION: Seeds function as the primary means of reproduction. Most seeds drop around the parent plant but can be dispersed by wind, water, and animals. A mature wild parsnip plant is capable of producing thousands of seeds that remain viable in the soil for up to three years.

WHY IT IS NOXIOUS: Use caution when handling wild parsnip leaves and stems, as contact with sap may cause a skin rash, especially when combined with sunlight exposure.

SEASONAL IDENTIFICATION

WHEN TO FIND: Wild parsnip is often seen in late spring to early summer as one of the only plants with yellow, upright, flat-topped flowers.

SPRING IDENTIFICATION = EASY TO MODERATE

Seedlings and rosettes can be found growing low among other plants and grass. Long stems with raised vertical ribs develop by late spring.

SUMMER IDENTIFICATION = EASY

Wild parsnip flowers in early summer and produces seed by midsummer. Leaves have become larger and more pointed with deeper lobes. The entire plant turns yellow and dies off by the end of the summer.

FALL IDENTIFICATION = MODERATE

Dead plants may still be standing as copper-brown stems. Look for remnant seed head and vertical ribs on stems. Young plants may be present in seedling or rosette form identified by leaf.

WINTER IDENTIFICATION = MODERATE TO DIFFICULT

Dormant seedlings and rosettes can be found in low-growing form.

SIMILAR-LOOKING SPECIES

GIANT HOGWEED (*Hercleum mantegazzianum*) leaves and form look similar from a distance. The flowers are upright and flat topped but they are white. The stems are covered in hairs. Giant hogweed is also much larger than wild parsnip.

WILD CARROT (*Daucus carota*) flowers grow in a similar umbrella shape. The flowers are upright and flat topped, but they are white. Leaves are fern like. Stems do not branch and are covered in hairs.

RIVM LEVEL OF CONCERN

| | |
|--|-----------------------|
| | OHIO DISTRIBUTION |
| | ROADSIDE DISTRIBUTION |
| | GROWTH |
| | SEEDS |
| | ABILITY TO DOMINATE |
| | DIFFICULTY OF CONTROL |



WHERE TO FIND:

Wild parsnip is common in Ohio and can be easily found along the edge of the road in unmowed areas. It usually grows in patches. Wild parsnip favors well-drained soil and full sun, but tolerates shade and moderate soil moisture as well.

CONTROL METHODS:

MECHANICAL: Mow only from spring to early summer to maintain visibility and reduce seed production. Hand pull with gloves and use caution to avoid plant sap that can cause rashes.

CHEMICAL: Make directed or broadcast applications from spring to early summer with selective herbicide. Make applications before flowers bloom.

CULTURAL: Plant tall fescue in the fall and allow to grow tall in spring.

RECOMMENDATION SUMMARY:

Wild parsnip germinates in spring, lives for one full season, and overwinters as a rosette. In the second spring, the stems bolt, produce flowers, and then seeds before dying. Accomplishing control should not be difficult with many opportunities to prevent seed production. For best control results make herbicide applications in spring to early summer. Fall applications to rosettes and seedlings can also be effective. Use directed applications for large colonies and broadcast applications for sporadic wild parsnip growing in turf. Mow at flower emergence to reduce seed production. Plant tall fescue in early fall and allow to grow tall in spring to compete for space and to shade out seedlings. Failure to control wild parsnip will allow this tall-growing, moderately-competitive weed to form dense patches, thereby crowding out more manageable vegetation.

SEASONAL IDENTIFICATION

WILD PARSNIP (*Pastinaca sativa*)

SPRING & FALL



Wild parsnip can be found as a seedling or rosette in spring or fall. Leaves look like parsley when they are young. The white tap root smells like edible garden parsnips when cut or crushed.

LATE SPRING - SUMMER



Leaves develop variable lobes as the plant grows tall and stems elongate. Stems are hollow and smooth with prominent vertical ribs.

EARLY - MIDSUMMER



Terminal yellow flower heads develop at the end of branches. The flowers point upwards, are flat topped, and loosely arranged.

SUMMER



Seeds develop starting with the central flower head. Seeds develop as yellow-green flat, round, hairless disks.

SUMMER



Wild parsnip colonies in flower or in seed are quite easily spotted along roadways. Yellow flowers are distinct, and after seed set, the entire plant turns greenish yellow.

LATE SUMMER - EARLY FALL



Wild parsnip turns a rusty brown color with remnant seeds in late summer. Dead mature plants are not likely to stand over winter, but seedlings and rosettes can be found growing in turf during the dormant season.





**INVASIVE PLANT
IDENTIFICATION AND CONTROL**

AUTUMN OLIVE

(*Elaeagnus umbellata*)



PERENNIAL



PLANT DESCRIPTION

Autumn olive is a perennial woody shrub that usually has multiple stems spreading to a height and width of up to 30 feet. Autumn olive's sweet fragrance fills the air during spring flowering. Once leaves develop, the silvery underside of the leaf helps this shrub stand out at a distance.

LEAF: leaves are oval shaped with a pointed end and smooth leaf margins. The top of the leaf is dull green, but the underside is distinctly shiny and silver colored.

STEM: Stems are dark brown to grey and with age become furrowed and coarse. Young stems commonly are covered with woody outgrowths that are sharp like thorns.

FLOWER: Flowers emerge in summer, are dull white to pale yellow, and are very fragrant. It is very common for the fragrance to be noticed from the roadway in the spring.

FRUIT/SEED REPRODUCTION: Red berries with white or light brown speckles cover autumn olive in the late summer to fall. Berries contain one seed per berry and are usually distributed by birds or drop around the parent plant.

WHY IT IS A PROBLEM: Autumn olive overtakes wood lines that are often close to the roadway. This perennial woody shrub is not controlled by mowing and if left uncontrolled may create obstructions near the roadway.



WHERE TO FIND

Common to eastern and southern Ohio along woodlines and in pastures, autumn olive prefers dry soil and has a high tolerance to shade.

CONTROL METHODS

MECHANICAL: Mow to remove as obstruction near roadway, but partner mechanical removal with an herbicide application.

CHEMICAL: Make ground applications following removal in spring or make foliar applications in late summer or fall before removal.

CULTURAL: Plant desirable vegetation such as tall fescue to provide competition and reduce future seed germination.

RECOMMENDATION SUMMARY: Prevent autumn olive from overtaking wood lines and creating obstructions. Control this problematic woody perennial with herbicides before it reaches maturity and requires mechanical removal.

BUSH HONEYSUCKLE

(*Lonicera maackii*, *Lonicera tatarica*, and *Lonicera morrowii*)



PERENNIAL



PLANT DESCRIPTION

Bush honeysuckle is a rapidly-growing, rapidly-spreading invasive shrub. This woody perennial has multiple spreading stems, maturing at around 15 feet height and width. Bush honeysuckle leafs out early and drops leaves late, giving it an advantage over native vegetation.

LEAF: Leaves are oppositely arranged, oval shaped, broadest in the middle, tapering to a tear-drop tip. Leaf margins are smooth.

STEM: Bush honeysuckle stems are light brown with vertical furrowed or peeling bark. Wood is brittle and easily broken.

FLOWER: Flowers are white to pink with yellow pollen heads that extend from the middle of the flower beyond the petals.

FRUIT/SEED REPRODUCTION: Bush honeysuckle is a prolific fruit and seed producer easily noticed in late summer to fall. Bright red berries usually grow in groups of four on the stem at the base of the leaves. Berries contain one seed per berry and are usually distributed by birds or drop around the parent plant or into waterways.

WHY IT IS A PROBLEM: Bush honeysuckle spreads rapidly, overtaking wood lines that are often close to the roadway. Bush honeysuckle outcompetes native plants with its extended growing season by leafing out early and dropping late.



WHERE TO FIND

Common to central and southwestern Ohio along woodlines and overtaking wooded areas. Bush honeysuckle prefers dry soil, but is also common along waterways.

CONTROL METHODS

MECHANICAL: Mow to remove as obstruction near roadway, but partner mechanical removal with an herbicide application.

CHEMICAL: Make ground applications following removal in spring or make foliar applications in late summer or fall before removal.

CULTURAL: Plant desirable vegetation such as tall fescue to provide competition and reduce future seed germination.

RECOMMENDATION SUMMARY: Prevent bush honeysuckle from overtaking wood lines and creating obstructions. Control this problematic woody perennial with herbicides before it reaches maturity and requires mechanical removal. Since bush honeysuckle stays green late into the season, take advantage of that while using herbicides. Making applications during this time will reduce collateral damage to desirable vegetation.

COMMON REED GRASS

(*Phragmites australis*)



PERENNIAL

PLANT DESCRIPTION

Common reed grass or phragmites is a tall perennial grass with a prominent seed head and tillering leaves that grow in upward angles. Mature phragmites can grow to over 10 feet in height. Phragmites is usually found growing in large, dense colonies, crowding out all other plants.

LEAF: Tillering leaves grow along the stem and point away from the stem at slightly upward angles. Leaves are slender and pointed.

STEM: Each plant has a single stem, but usually grows in dense patches. Stems are smooth and hollow.

FLOWER: The flower and seed head is brown to reddish brown. These are most noticeable in late summer to fall.

FRUIT/SEED REPRODUCTION: Phragmites reproduces primarily through underground root rhizomes, but can also spread by seed.

WHY IT IS A PROBLEM: Phragmites colonies can obscure fixed objects like culverts and drainage outflows. It can overtake ditches and wetland areas, creating habitat diversity concerns.



WHERE TO FIND

Common across Ohio in wet areas around culverts and in areas that have poor drainage or standing water.

CONTROL METHODS

MECHANICAL: Removal with heavy equipment is difficult in wetland areas. Mow when ground is frozen to remove skeletons so new growth can be sprayed more easily in summer. Manual string trimming is the best option for cutting during warm months.

CHEMICAL: Spray glyphosate or imazapyr in summer after flowering before seedheads form.

CULTURAL: Improve drainage and reduce standing water.

RECOMMENDATION SUMMARY: Prevent phragmites colonies from creating management concerns by improving drainage in wet areas and making herbicide applications in late summer just after seedhead development. Phragmites may be difficult to control with herbicides, so repeat applications may be necessary over several years.

NARROW LEAF CATTAIL and HYBRID CATTAIL

(*Typha angustifolia* and *Typha X glauca*)



PERENNIAL

PLANT DESCRIPTION

Cattail is a grass that grows in dense colonies and prefers wet areas. A mature cattail plant can be over 6 feet tall. Cattails are single stem plants with slender upwards pointing leaves and brown or cottony seed heads. Usually found growing in large, dense colonies.

LEAF: Upwards pointing, slender and smooth with no visible veins. Leaves wrap around stem at base.

STEM: Each plant has a single stem that is smooth and hollow. The tender stem when broken near the base smells like cucumber.

FLOWER: The flower is a dull brown spike growing at the top of the single stem.

FRUIT/SEED REPRODUCTION: Brown seed heads are easily noticed at the top of the plants. Seeds are arranged around the stem in a tight, velvety cylinder. They eventually break open and turn to cottony tufts.

WHY IT IS A PROBLEM: Cattail colonies can obscure fixed objects like culverts and drainage outflows. Cattails can overtake ditches and wetland areas, creating habitat diversity concerns.



WHERE TO FIND

Common across Ohio in wet areas around culverts and in areas that have poor drainage or standing water.

CONTROL METHODS

MECHANICAL: Removal with heavy equipment is difficult in wetland areas. Manual trimming is the best option for sight distance.

CHEMICAL: Spray glyphosate or imazapyr in summer after flowering before seedheads form.

CULTURAL: Improve drainage and reduce standing water.

RECOMMENDATION SUMMARY: Prevent cattail colonies from creating management concerns by improving drainage in wet areas and making herbicide applications in late summer just after flowering.

TREE-OF-HEAVEN

(*Ailanthus altissima*)



PERENNIAL

PLANT DESCRIPTION

Tree-of-heaven is a rapidly growing, rapidly spreading invasive tree species. It usually grows as a single-stemmed tree, but can also be found growing in large, dense colonies. Tree-of-heaven easily reproduces by seed and root sprouting. Mature trees can reach heights of 60–75 feet.

LEAF: Large, pinnately-compound leaves are alternately arranged on branches. Leaflets are oval shaped with a pointed tip and a smooth margin. Each compound leaf contains 11–25 leaflets.

STEM: Stems are smooth and gray with tan furrows. Stems are stout with inconspicuous naked buds. Wood is fragile and easily broken. Broken stems have a strong odor reminiscent of bad peanut butter.

FLOWER: Showy green to cream-colored flowers are born at the ends of branches in erect clusters.

FRUIT/SEED REPRODUCTION: Seeds with papery wings are produced at the ends of branches and later in the season become showy red before dropping and being dispersed by wind. Tree-of-heaven trees can produce seeds after only three years and a single tree can produce thousands of seeds.

WHY IT IS A PROBLEM: Tree-of-heaven can create obstructions for signs, roadways, and bridges. Tree-of-heaven not only rapidly regrows after mechanical removal, but it also produces root sprouts and leads to a higher per acre density if cutting without using herbicides. It also is an abundant seed producer that can spread far distances and germinate in poor soils.



WHERE TO FIND:

Tree-of-heaven prefers dry soil and full sun. It can easily take over disturbed areas with poor soil. It is typically found on slopes after clearing or grading.

CONTROL METHODS:

MECHANICAL: Mechanical removal is difficult or dangerous on steep slopes or in disturbed areas. Do not remove without herbicide use unless immediate clearance is needed.

CHEMICAL: Make basal bark applications during the dormant season or cut stump treatment to tree-of-heaven stems under 6 inches in diameter using an oil-based product containing *triclopyr* mixed in oil. Foliar applications can be made to younger trees under 20 feet in height.

CULTURAL: Plant desirable vegetation on slopes to provide competition and reduce tree-of-heaven seed germination.

RECOMMENDATION SUMMARY:

Tree-of-heaven should be controlled while young before it can produce seeds and before it reaches a size that would require mechanical removal. Manual removal promotes root sprouting and leads to a higher density per acre after cutting.



APPLICATOR GUIDANCE



GENERAL RIVM GUIDELINES AND LEVEL OF CONCERN

The Ohio Prohibited Noxious Weed Level of Concern table is an overview of all 21 prohibited noxious weeds and their categorized level of concern. The categories for evaluation relate right-of-way vegetation management issues and the concerns that each weed presents. See the How to Use This Guide section for complete information on the categories.

GENERAL RIVM GUIDELINES

- Scout roadsides during biweekly roadside inspections and post management activities for prohibited noxious weeds. Be cognizant of life cycles and flower timing.
- Document noxious weed sightings and size of infestations.
- Verify identification of plants before planning an application.
- Determine proper timing of treatments to achieve adequate control.
- Measure the length and width of the area you intend to control to calculate acreage.
- Determine proper herbicide and mix additives for desired vegetation control.
- Always calibrate spray equipment before making herbicide applications.
- Check water quality as necessary per label requirements and use adjuvants when recommended in product labels.
- Refer to the herbicide label for personal protective equipment (PPE) requirements, use rates, mix instructions, tank mix partners, and restrictions.
- Promote desirable vegetation that will outcompete and suppress the spread of prohibited noxious weeds.
- After controlling prohibited noxious weeds through spraying or mowing, clean equipment, clothing, footwear, and tools to reduce spread of seeds or plant fragments.
- Dispose of seeds, plant parts, and other materials from an infested site in an infested area to avoid spreading to new sites.
- Always wash hands after handling equipment possibly contaminated with poisonous plants and herbicides.
- Monitor herbicide applications, mechanical, and cultural control efforts for effectiveness.
- Rotate herbicides every year or as needed to manage herbicide resistance in target weeds.
- Keep records of applications, including: date, time, weather, area treated, herbicide, target weed, and control results.
- Do not store mixed herbicides for extended periods as efficacy will be greatly reduced.
- Always triple rinse when changing herbicides or preparing to store spray equipment.

REMEMBER:



OHIO PROHIBITED NOXIOUS WEED LEVEL OF CONCERN

| KEY LOW → HIGH | OHIO DISTRIBUTION | ROADSIDE DISTRIBUTION | GROWTH | SEEDS | ABILITY TO DOMINATE | DIFFICULTY OF CONTROL |
|-----------------------|-------------------|-----------------------|--------|-------|---------------------|-----------------------|
| APPLE OF PERU | ○ | ◐ | ◑ | ● | ◐ | ◐ |
| CANADA THISTLE | ● | ● | ◑ | ● | ◑ | ◑ |
| CRESSLEAF GROUNDSEL | ◐ | ◑ | ○ | ◑ | ◑ | ○ |
| GIANT HOGWEED | ○ | ◑ | ● | ◑ | ◑ | ◑ |
| GRAPEVINES | ◑ | ◑ | ◑ | ○ | ◑ | ◐ |
| JAPANESE KNOTWEED | ◑ | ● | ● | ◑ | ● | ● |
| JOHNSONGRASS | ◑ | ● | ● | ◑ | ● | ● |
| KOCHIA | ◑ | ◑ | ◑ | ○ | ◑ | ● |
| KUDZU | ○ | ◑ | ● | ○ | ● | ● |
| MARESTAIL | ◑ | ◑ | ◑ | ◑ | ◑ | ● |
| MILE-A-MINUTE WEED | ○ | ◑ | ● | ◑ | ● | ◐ |
| MUSK THISTLE | ◐ | ◑ | ◑ | ◑ | ◑ | ◐ |
| OXEYE DAISY | ◑ | ● | ◐ | ◑ | ◐ | ◐ |
| PALMER AMARANTH | ○ | ◑ | ◑ | ◑ | ◐ | ◑ |
| POISON HEMLOCK | ◑ | ◑ | ◑ | ◑ | ◑ | ◐ |
| PURPLE LOOSESTRIFE | ◑ | ◑ | ◑ | ● | ◑ | ◑ |
| RUSSIAN THISTLE | ○ | ◑ | ◑ | ◑ | ○ | ◐ |
| SHATTER CANE | ○ | ◑ | ● | ○ | ◑ | ◐ |
| WILD CARROT | ● | ● | ◑ | ◑ | ◑ | ○ |
| WILD MUSTARD | ◐ | ◑ | ◐ | ◑ | ◐ | ○ |
| WILD PARSNIP | ◑ | ◑ | ◑ | ○ | ◑ | ◐ |

PLANT LIFE CYCLES AND CHEMICAL CONTROL TIMING

Use the tables below as general guidelines for identifying and treating prohibited noxious weeds and invasive plants with herbicides by their life cycle. Refer to the individual plant pages for more information about all of the control options and proper timing of treatments. The first table lists plants by life cycle. Following each plant name are numbers that indicate the types of herbicides that could be used to control that plant. Some plants are best controlled with a combination of herbicides. The table at the bottom can be used to quickly look up a life cycle and identify the general timing of herbicide applications to control a plant with that life cycle.

REMEMBER:









PLANT LIFE CYCLES

|  SUMMER ANNUAL |  WINTER ANNUAL |  SUMMER/WINTER ANNUAL* |  x2 BIENNIAL |  PERENNIAL |
|--|--|--|--|--|
| APPLE OF PERU (2) KOCHIA (2, 4, 5) MILE-A-MINUTE WEED (1, 5) PALMER AMARANTH (2, 5) RUSSIAN THISTLE (1, 4) SHATTER CANE (1) | CRESSLEAF GROUNDSEL (2, 5) | MARESTAIL (2, 4, 5) WILD MUSTARD (2) | GIANT HOGWEED (1) MUSK THISTLE (2) POISON HEMLOCK (2) WILD CARROT (2) WILD PARSNIP (2) | AUTUMN OLIVE (2, 3) CANADA THISTLE (2, 3) GRAPEVINE (1, 2) BUSH HONEYSUCKLE (1, 2, 3) JAPANESE KNOTWEED (1, 2) JOHNSONGRASS (2, 3) KUDZU (1, 2, 3) NARROW LEAF CATTAIL AND HYBRID CATTAIL (1) OXEYE DAISY (2) PHRAGMITES (1) PURPLE LOOSESTRIFE (1, 2) TREE-OF-HEAVEN (2) |

(1) Non-Selective, (2) Selective, (3) Residual, (4) Surfactant, (5) Pre-emergent

*Summer/Winter Annual: these plants may be found as either summer or winter annuals. If conditions are favorable, seeds may germinate twice in the same year adopting the seed germination timing of the other annual.

CHEMICAL CONTROL TIMING

| | MARCH 20 | | JUNE 20 | | SEPTEMBER 22 | | DECEMBER 20 | |
|---|-----------------------------|----------|-------------------|-------------------|----------------|------------------|------------------|--|
| | PRIMARY TIMING | | PRIMARY TIMING | | PRIMARY TIMING | | SECONDARY TIMING | |
| LIFE CYCLE TYPE | SPRING | | SUMMER | | FALL | | WINTER | |
|  SUMMER ANNUAL | GERMINATION | | SEEDLING | VEGETATIVE GROWTH | FLOWERING | SEED/DIEBACK | | |
|  WINTER ANNUAL | VEGETATIVE GROWTH/FLOWERING | | SEED/DIEBACK | | GERMINATION | SEEDLING/ROSETTE | | |
|  x2 BIENNIAL YEAR ONE | GERMINATION | | SEEDLING | ROSETTE | | | | |
|  x2 BIENNIAL YEAR TWO | VEGETATIVE GROWTH | | FLOWERING | | SEED/DIEBACK | | | |
|  PERENNIAL YEAR ONE | GERMINATION | SEEDLING | VEGETATIVE GROWTH | | FLOWERING | SEED/DIEBACK | DORMANT ROOT | |
|  PERENNIAL YEAR TWO + | VEGETATIVE GROWTH | | FLOWERING | | SEED/DIEBACK | | DORMANT ROOT | |

COMMON RIVM HERBICIDES

The Common RIVM Herbicides table categorizes common herbicides that are labeled for use in a RIVM program. The herbicide type column groups together herbicides that have similar outcomes or uses. For each type of herbicide, a chemical name or active ingredient is listed along with several products that contain the chemical name. For most active ingredients, several products are available for purchase. This table is not a comprehensive list or endorsement of products or active ingredients. Always refer to individual herbicide product labels before handling, mixing, or applying herbicides. Always check labels for safety and environmental restrictions. When making an aquatic application, do not use a surfactant unless labeled for aquatic use. Restricted use herbicides are indicated in **RED** and herbicides labeled for aquatic use are in **BLUE**. Prior to using any restricted herbicides, contact the District Environmental Coordinator. **REMEMBER:**



COMMON RIVM HERBICIDES

| HERBICIDE TYPES | CHEMICAL NAME | COMMON PRODUCTS WITH CHEMICAL NAME AS PRIMARY ACTIVE INGREDIENT |
|-------------------------------|---|---|
| BASAL BARK OR STUMP TREATMENT | Aminopyralid | Capstone®, Milestone®, Opensight® |
| | Glyphosate | Abundit® Extra, AquaMaster®, Razor®, Ranger PRO®, Rodeo® |
| | Imazapyr | Arsenal®, Nufarm Polaris® |
| | Picloram | Pathway®, Tordon® RTU |
| | Triclopyr | Garlon® 3A, Garlon® 4, Garlon® XRT, Pathfinder II®, Triclopyr 4, Vastlan™ |
| BROADLEAF SELECTIVE HERBICIDE | 2,4-D | 2,4-D Amine, Chapparel™, DMA® 4 IVM Herbicide, Weedestroy® AM-40 |
| | Aminocyclopyrachlor | Method® SG, Perspective®, Streamline® |
| | Aminopyralid | Capstone®, Milestone®, Opensight® |
| | Chlorsulfuron | Chlorsulfuron 75, Telar® |
| | Clopyralid | Clean Slate™, Clopyralid 3, Transline® |
| | Dicamba | Dicamba + 2,4-D DMA, Vanquish® |
| | Fluroxypyr | Cleanwave®, Fluroxypyr, Vista® XRT |
| | Fosamine | Krenite® S |
| | Hexazinone | Velpar® |
| | Metsulfuron | Escort® XP, MSM 60, Patriot® |
| | Picloram (restricted use) | Tordon® K, Trooper™ 22K |
| | Rimsulfuron | Laramie 25DF, Matrix®, Resolve® SG |
| Sulfometuron | Oust® XP, Spyder™ | |
| Triclopyr | Crossbow®, Garlon® 3A, Relegate™, Tahoe® 3A, Vastlan™ | |
| CHEMICAL SIDE TRIM | Aminopyralid | Capstone®, Milestone®, Opensight® |
| | Fosamine | Krenite® S |
| | Triclopyr | Crossbow®, Garlon® 3A, Relegate™, Tahoe® 3A, Vastlan™ |
| GRASS SELECTIVE HERBICIDE | Clethodim | Envoy Plus® |
| | Imazapic | Panoramic 2SL, Plateau® |
| | Sethoxydim | Sethoxydim SPC |
| | Sulfosulfuron | Certainty®, Outrider® |
| PLANT GROWTH REGULATOR (PGR) | Glyphosate (rate specific) | Abundit® Extra, AquaMaster®, Ranger PRO®, Razor®, Rodeo® |
| | Imazapic | Panoramic 2SL, Plateau® |
| | Mefluidide | Embark® 2S IVM |
| POST-EMERGENT NON-SELECTIVE | Glufosinate | Finale® |
| | Glyphosate | Abundit® Extra, AquaMaster®, Aquaneat®, Ranger PRO®, Razor®, Rodeo® |
| | Imazapyr | Arsenal®, Ecomazapyr 2 SL, Habitat®, Imazapyr 4SL, |
| | Pelargonic acid | Scythe® |
| | Tebuthiuron | Spike® 80 |
| PRE-EMERGENT NON-SELECTIVE | Bromacil | Bromacil 40/40, Bromacil 80, Hyvar®, |
| | Diuron | Diuron 80 DF, Diuron 4L, Mojave 70 EG, Parrot™ DF, Sahara® |
| | Flumioxazin | Lock Down™, Payload®, Piper™ |
| | Indaziflam | EsplAnade® 200 SC |
| | Oryzalin | Oryzalin 4, Surfian® |
| | Pendimethalin | AquaCap™, Pendulum®, Pendulum® 2G |

CALIBRATION GUIDANCE FOR DIRECTED HERBICIDE APPLICATIONS

Calibration and understanding of equipment flow rates promote proper application rates, herbicide efficiency, and herbicide effectiveness. The following table and worksheet are intended to help calibrate directed herbicide applications using a spray gun or backpack sprayer. The flow rate (in gallons per minute, GPM) must be known to determine the time it takes to treat either 1 acre or 1,000 square feet. The recommended application rate of the herbicide solution in gallons per acre (GPA) can be found on the herbicide product label.

The table shows typical flow rates and calculated spray times. The worksheet below can be used to determine spray times for specific calculated flow rates. The time to fill a 1-gallon container in seconds (A) can be used to calculate the flow rate in GPM (B), which can then be used to calculate spray times for 1 acre (C) and 1,000 square feet (D).

Once the worksheet is complete and the time required to spray an area is determined, the next step is to practice with water and dye. The applicator should practice until the 1,000-square-foot area can be covered in the amount of time calculated in the worksheet below (line 5). The photographs below demonstrate how to set up a 1,000-square-foot practice area.

REMEMBER:  **THE LABEL
IS THE LAW**



SAMPLE CALIBRATION TIMES

| SECONDS TO FILL 1 GALLON (A) | FLOW RATE IN GALLONS PER MINUTE (GPM) (B) | SPRAY TIME | |
|------------------------------------|---|-----------------------------------|--|
| | | MINUTES TO SPRAY 1 ACRE (C) | SECONDS TO SPRAY 1,000 SQUARE FEET (D) |
| 60 seconds | 1 GPM | 100 minutes | 138 seconds |
| 30 seconds | 2 GPM | 50 minutes | 69 seconds |
| 20 seconds | 3 GPM | 33 minutes | 46 seconds |
| 15 seconds | 4 GPM | 25 minutes | 34 seconds |
| 12 seconds | 5 GPM | 20 minutes | 28 seconds |

CALIBRATION FOR SPRAY GUN OR BACKPACK SPRAYER

EXAMPLE WORKSHEET

CALCULATE FLOW RATE IN GALLONS PER MINUTE:

- Determine the seconds it takes to fill a 1-gallon bucket with spray gun or backpack nozzle = (A) 30 seconds
- $60 \text{ (seconds per minute)} \div \text{(A) } 30 \text{ seconds to fill a 1-gallon bucket with spray gun or backpack nozzle} = \text{(B) } 2 \text{ (GPM) flow rate}$

CALCULATE MINUTES TO SPRAY 1 ACRE:

- Check the herbicide label for the recommended GPA 100 (GPA) application rate $\div \text{(B) } 2 \text{ (GPM) flow rate} = \text{(C) } 50 \text{ minutes to spray 1 acre}$

CALCULATE SECONDS TO SPRAY 1,000 SQUARE FEET:

- $0.02296 \text{ (acre per 1,000 square feet)} \times \text{(C) } 50 \text{ minutes to spray 1 acre} = \text{1.15 minutes to spray 1,000 square feet}$
- $60 \text{ (seconds per minute)} \times \text{1.15 minutes to spray 1,000 square feet} = \text{(D) } 69 \text{ seconds to spray 1,000 square feet}$

CALIBRATION GUIDANCE FOR BROADCAST HERBICIDE APPLICATIONS

Calibration and understanding of equipment flow rates promote proper application rates, herbicide efficiency, and herbicide effectiveness. The following tables are intended to help calibrate equipment for broadcast applications with boomless nozzles. Proper application requires the operator to determine the flow rate or gallons per minute (GPM) of the spray nozzles.

Using a spray truck equipped with an application control panel is recommended. With a control panel set up, the application rate or gallons per acre (GPA) is controlled, and the flow rate or GPM will fluctuate based on the ground speed. With this system, the operator must set the nozzle spray width and verify or set the application rate based on gallons per acre. The recommended GPA of the herbicide solution can be found on the herbicide product label. When using a spray truck without a control panel, the GPM is not controlled by instruments and must be controlled by the speed of the driver. In this case, additional calibration will be required.

The nozzle manufacturer's specifications provide a calibration table to determine GPM based on nozzle spray width, pounds per square inch (PSI), GPA, and ground speed. This calibration table should be used to verify all settings.

Once the spray truck's settings are known, the applicator should check the nozzle spray pattern to verify the nozzle is spraying the intended width. The applicator should put water in the tank and practice on dry pavement (pictured below left). The applicator should measure the pattern sprayed on the ground to verify nozzles are functioning properly. When applied correctly, the water pattern will dry evenly. Always make these adjustments with water before going out on the right-of-way to make applications with herbicide.

REMEMBER:



The first table below can be used to determine how much time it will take to spray 1 acre based on chosen nozzle spray width and ground speed. Use the second table to determine the distance in linear feet and lane miles to spray 1 acre based on nozzle spray width.

TIME REQUIRED TO SPRAY ONE ACRE BASED ON GROUND SPEED AND NOZZLE SPRAY WIDTH

| GROUND SPEED (MPH) | 6-FOOT NOZZLE SPRAY WIDTH (MINUTES: SECONDS) | 10-FOOT NOZZLE SPRAY WIDTH (MINUTES: SECONDS) | 20-FOOT NOZZLE SPRAY WIDTH (MINUTES: SECONDS) | 30-FOOT NOZZLE SPRAY WIDTH (MINUTES: SECONDS) | 40-FOOT NOZZLE SPRAY WIDTH (MINUTES: SECONDS) |
|--------------------|--|---|---|---|---|
| 4 | 20:38 | 12:23 | 6:11 | 4:08 | 3:06 |
| 5 | 16:30 | 9:54 | 4:57 | 3:18 | 2:29 |
| 6 | 13:45 | 8:15 | 4:07 | 2:45 | 2:04 |
| 7 | 11:47 | 7:04 | 3:32 | 2:21 | 1:46 |
| 8 | 10:19 | 6:11 | 3:06 | 2:04 | 1:33 |
| 9 | 9:10 | 5:30 | 2:45 | 1:50 | 1:23 |
| 10 | 8:15 | 4:57 | 2:29 | 1:39 | 1:14 |

LANE-MILE DISTANCE OF ONE ACRE BASED ON NOZZLE SPRAY WIDTH

| NOZZLE SPRAY WIDTH (FEET) | LINEAR FEET PER 1 ACRE (FEET) | LANE MILES PER 1 ACRE (MILE) |
|---------------------------|-------------------------------|------------------------------|
| 6 | 7,260 | 1.4 |
| 10 | 4,356 | 0.8 |
| 20 | 2,178 | 0.4 |
| 30 | 1,452 | 0.3 |
| 40 | 1,089 | 0.2 |

PRODUCTION BASED ON TANK SIZE

Use the following worksheet to determine the area and lane miles that can be treated with one full spray tank. The appropriate amount of herbicide to add to the tank based on acreage can also be calculated. To calculate acreage that can be covered, the important variables are total volume mixed, gallons per acre (GPA) application rate of the equipment, and the width of the spray pattern. Reset the spray truck control panel to the appropriate settings. The recommended GPA of the herbicide solution can be found on the herbicide product label.

If using a truck with multiple nozzles, complete this worksheet for each nozzle spray width. Do not mix more herbicide solution than can be used in one day as herbicides can lose efficacy within hours after mixing. Check the nozzle manufacturer's specifications calibration table to determine flow rate in gallons per minute (GPM) based on nozzle spray width, pounds per square inch (PSI), GPA, and ground speed.

EXAMPLE WORKSHEET

REMEMBER:



CALCULATE ACRES THAT CAN BE TREATED WITH ONE FULL TANK:

1. Reset spray truck control panel to the appropriate GPA application rate (A) 39 (GPA) application rate
2. 1 Full Tank = (B) 1,000 gallons ÷ (A) 39 (GPA) application rate = (C) 25.64 acres that can be treated with one full tank

CALCULATE AMOUNT OF HERBICIDE NEEDED FOR ONE FULL TANK OF HERBICIDE SOLUTION:

3. READ THE LABEL to determine appropriate herbicide rate per acre = (D) 7 (ounces or gallons)
4. (C) 25.64 acres that can be treated with one full tank x (D) 7 (ounces or gallons) per acre labeled herbicide rate = (E) 179.48 (ounces or gallons) herbicide to add for one full tank of herbicide solution

CALCULATE LINEAR MILES PER 1 ACRE TO BE TREATED:

5. 43,560 (square feet per acre) ÷ (F) 22 (feet) nozzle spray width = 1,980 linear feet ÷ 5,280 (feet per mile) = (G) 0.38 linear miles per acre

CALCULATE MILES THAT CAN BE SPRAYED WITH ONE FULL TANK:

6. (G) 0.38 linear miles per acre x (C) 25.64 acres that can be treated with one full tank = (H) 9.74 total miles that can be treated with one full tank at the chosen nozzle spray width

PRODUCTION BASED ON WORK HOURS

Use the following worksheet to determine how many gallons to mix based on available spray hours. To complete this worksheet, the applicator will need to know the nozzle spray width (feet), ground speed (mph), desired work day length (hours), and the gallons per acre (GPA) application rate of the equipment. Reset the spray truck control panel to the appropriate settings. The recommended GPA of the herbicide solution can be found on the herbicide product label.

This worksheet is designed for one nozzle; if multiple nozzles are used, the worksheet will need to be completed for each nozzle. Check the nozzle manufacturer's specifications calibration table to determine flow rate in gallons per minute (GPM) based on nozzle spray width, pounds per square inch (PSI), GPA, and ground speed.

EXAMPLE WORKSHEET

REMEMBER:



CALCULATE TIME NEEDED TO TREAT ONE ACRE:

- 43,560 (square feet per acre) \div 6 (feet) nozzle spray width = (A) 7,260 linear feet in 1 acre
- 0.000189 (mile per foot) \times (A) 7,260 linear feet in 1 acre = (B) 1.37 lane miles in 1 acre
- (B) 1.37 lane miles in 1 acre \div 8 (mph) ground speed = (C) 0.17 hours to spray 1 acre

CALCULATE ACRES TREATED PER DAY:

- 6 (hours) desired work day length \div (C) 0.17 hours to spray 1 acre = (D) 35.29 acres sprayed per day

CALCULATE AMOUNT OF HERBICIDE SOLUTION NEEDED:

- (D) 35.29 acres sprayed per day \times 36 (GPA) application rate = 1,270.44 (gallons) amount of herbicide solution to mix for available spray hours

GUIDANCE FOR PREPARING AN HERBICIDE MIXTURE

The guidance in this section is intended for a licensed applicator. The entire APPLICATOR GUIDANCE section should be reviewed before mixing herbicides. Use the following worksheets to help determine the volume or percent of herbicide to use in a spray solution.

- Identify target vegetation as grass, broadleaf, or woody.
- Determine if the goal is to achieve total vegetation control (bare ground) or selective control to preserve some existing vegetation.
- Review COMMON RIVM HERBICIDES page and herbicide labels to determine which herbicide is appropriate for target vegetation and goal; select herbicide.
- Measure the target area's length and width.
- Check herbicide label for per acre rates. Never exceed the maximum allowable rate per acre per year.
- If herbicide label rate is provided in ounces or gallons per acre, use the Herbicide Per Acre Rate Worksheet. If herbicide label rate is provided in percent per acre, use the Herbicide Percent Solution Worksheet.
- Read the herbicide label to determine if tank mix partner herbicide or adjuvants are needed. Also, check the label to determine in what order water and herbicide or adjuvant should be mixed.
- See the VOLUME CONVERSIONS AND MIX RATES page to maintain common volume units throughout the worksheet.
- When using herbicide in liquid or solid form use the proper measuring containers and follow the product label instructions.
- The application rate in gallons per acre (GPA) of the herbicide solution can be found on the herbicide product label. Set the spray truck control panel to the appropriate (GPA) setting prior to each spray job.
- Check the nozzle manufacturer's specifications calibration table to determine flow rate in gallons per minute (GPM) based on nozzle spray width, pounds per square inch (PSI), GPA, and ground speed.
- Always refer to product labels and safety data sheets (SDS) to determine proper personal protective equipment (PPE).
- Check the local weather forecast to determine if rain and wind conditions are suitable for application prior to mixing herbicide solution.

HERBICIDE PER ACRE RATE

(For labeled herbicide rates provided in ounces or gallons)

EXAMPLE WORKSHEET

CALCULATE ACRES TO BE TREATED:

1. 22 (feet) area width × 10,000 (feet) area length = (A) 220,000 (square feet) spray area
2. (A) 220,000 (square feet) spray area ÷ 43,560 (square feet per acre) = (B) 5.05 acres to be treated

CALCULATE HERBICIDE VOLUME TO BE USED:

3. READ THE LABEL to determine appropriate herbicide rate per acre: (C) 7 (ounces) or gallons per acre
4. (C) 7 (ounces) or gallons per acre × (B) 5.05 acres to be treated = (D) 35.35 (ounces) or gallons herbicide volume to be used

CALCULATE HERBICIDE SOLUTION NEEDED:

5. If using a spray truck reset control panel to the appropriate (GPA) application rate for broadcast applications (E) 39 (GPA) application rate
6. (E) 39 (GPA) application rate × (B) 5.05 acres to be treated = (F) 196.95 (gallons) mixed herbicide solution needed
7. Convert to ounces if needed (F) 196.95 × 128 (ounces per 1 gallon) = 25,209.60 ounces
8. If herbicide label recommends using adjuvants, check adjuvant label for rate [32 ounces of adjuvant per 100 gallons of herbicide solution × (F) 196.95 gallons mixed herbicide solution needed = 6,302.40 ÷ 100 = (G) 63.02 ounces of adjuvant to use]

CALCULATE GALLONS OF WATER NEEDED:

9. If needed convert herbicide volume and adjuvant volume from ounces to gallons [(D) 35.35 ounces ÷ 128 (ounces per 1 gallon) = (H) 0.28 gallons herbicide volume to be used and (G) 63.02 ounces ÷ 128 (ounces per 1 gallon) = (I) 0.49 gallons adjuvant volume to be used]
10. Add (H) 0.28 gallons herbicide volume to be used + (I) 0.49 gallons adjuvant volume to be used = (J) 0.77 gallons of additives
11. Subtract (J) 0.77 (gallons) additives from (F) 196.95 (gallons) mixed herbicide solution to be use = 196.18 gallons of water to be used

REMEMBER:



HERBICIDE PERCENT SOLUTION

(For labeled herbicide rates provided in percent)

EXAMPLE WORKSHEET

REMEMBER:



CALCULATE ACRES TO BE TREATED:

1. 6 (feet) area width × 100,000 (feet) area length = (A) 600,000 (square feet) spray area
2. (A) 600,000 (square feet) spray area ÷ 43,560 (square feet per acre) = (B) 13.77 acres to be treated

CALCULATE HERBICIDE SOLUTION TO BE USED:

3. If using a spray truck reset control panel to the appropriate (GPA) application rate for broadcast applications (C) 36 (GPA) application rate
4. (C) 36 (GPA) application rate × (B) 13.77 acres to be treated = (D) 495.72 (gallons) mixed herbicide solution to be used

CALCULATE HERBICIDE VOLUME TO BE USED:

5. READ THE LABEL to determine appropriate herbicide rate by percent solution: (E) 2 (%) herbicide rate
6. (D) 495.72 (gallons) mixed herbicide solution needed × (E) 2 (%) herbicide rate = (F) 9.91 (gallons) herbicide needed
7. If herbicide recommends using adjuvants, check adjuvant label for rate [32 ounces of adjuvant per 100 gallons of herbicide solution × (D) 495.72 (gallons) mixed herbicide solution needed = 15,863.04 ÷ 100 = (G) 158.63 ounces of adjuvant to use]

CALCULATE GALLONS OF WATER NEEDED:

8. If needed convert adjuvant volume from ounces to gallons [(G) 158.63 (ounces) adjuvant volume ÷ 128 = (H) 1.24 gallons adjuvant volume to be used
9. Add (F) 9.91 (gallons) herbicide needed + (H) 1.24 (gallons) adjuvant volume to be used = (I) 11.15 gallons of additives
10. Subtract (I) 11.15 (gallons) additives from (D) 495.72 (gallons) mixed herbicide solution to be used = 484.57 gallons of water to be used

DAILY PESTICIDE REPORT (M&R-629)

(This ODOT required form must be completed on a daily basis when making herbicide applications.)

EXAMPLE WORKSHEET

SHEET ___ OF ___ DATE: _____

| LOCATION | | | | | | | | | | WORK | | | | | | | | | | | | |
|--|------------------|------------------|------------|----------------|------------|-----------------|------------------------------|------------|-----------|--------------------------|----------------|-------|---|--|--|--|--|--|--|--|--|--|
| KEY | COUNTY | ROUTE | ROUTE TYPE | LANE DIRECTION | SPOTOR SLM | FACILITY OR SLM | MAINTENANCE ACTIVITY CODE | START TIME | STOP TIME | DESCRIPTION (SEE PAGE 2) | ACCOMPLISHMENT | UNIT | | | | | | | | | | |
| 1 | PIC | 23 | IR | Ascending | 1.1 - 3.1 | | M691-002 Herbicidal Spraying | 8am | 10am | Guardrail/signpost | 2 | Miles | | | | | | | | | | |
| 2 | | | | | | | | | | | | | | | | | | | | | | |
| 3 | | | | | | | | | | | | | | | | | | | | | | |
| 4 | | | | | | | | | | | | | | | | | | | | | | |
| MATERIALS | | | | | | | | | | | | | ACTIVITY CODES | | | | | | | | | |
| MATERIAL MASTER CODE & EPA REGISTRATION NUMBER | | | | | | | | | | | | | MATERIAL MASTER CODE & EPA REGISTRATION NUMBER | | | | | | | | | |
| #57020293 Herbicide, Roundup Pro - #524-475 | | | | | | | | | | | | | #57020293 HERBICIDE, ROUNDUP PRO - #524-475 | | | | | | | | | |
| | | | | | | | | | | | | | #57020380 HERBICIDE, SURFLAN - #1471-113 | | | | | | | | | |
| | | | | | | | | | | | | | #57020770 HERBICIDE, TRANSLINE - #62719-73 | | | | | | | | | |
| | | | | | | | | | | | | | #57020220 HERBICIDE, KRENITE - #352-439 | | | | | | | | | |
| | | | | | | | | | | | | | #57020500 HERBICIDE, ESCORT - #352-439 | | | | | | | | | |
| | | | | | | | | | | | | | #57020540 HERBICIDE, PATHWAY - #62719-31 | | | | | | | | | |
| | | | | | | | | | | | | | #57020280 HERBICIDE, RODEO - #524-343 | | | | | | | | | |
| | | | | | | | | | | | | | #57020735 TORDON 101 - #62719-5 | | | | | | | | | |
| | | | | | | | | | | | | | #57020260 HERBICIDE, OUST - #352-401 | | | | | | | | | |
| | | | | | | | | | | | | | #57020092 HERBICIDE, PATHFINDER II - #62719-176 | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | |
| EQUIPMENT | | | | | | | | | | | | | | | | | | | | | | |
| NO. | EQUIPMENT NUMBER | LIC# | HRs on JOB | BEGIN | END | MILES | Hrs | 1 | 2 | 3 | 4 | UNIT | | | | | | | | | | |
| 1 | 2220607 | T6786 | 3 | 20450 | 20480 | 30 | | 1 | 2 | 3 | 4 | GAL | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | |
| LABOR | | | | | | | | | | | | | | | | | | | | | | |
| NO. | EMPLOYEE NAME | APPLICATOR LIC.# | TOTAL | R | O | R | O | R | O | R | O | UNIT | | | | | | | | | | |
| 1 | John Doe | 26939 | 3.5 | 3.5 | | | | | | | | | | | | | | | | | | |
| 2 | Jane Doe | none | 3.5 | 3.5 | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | |

DAILY PESTICIDE REPORT (M&R-629)

PAGE 2 of 2

| TIME OF DAY | WEATHER CONDITIONS | | | | | WIND | | |
|-------------|--------------------|-------|--------|------|-------|------|--|--|
| | TEMP | CLEAR | CLOUDY | RAIN | SPEED | DIR | | |
| MORNING | 52 | X | | | 2 | NW | | |
| MIDDAY | | | | | | | | |
| AFTERNOON | | | | | | | | |

| DESCRIPTION OF SPRAYING |
|--|
| <div style="border: 1px solid black; border-radius: 50%; padding: 2px; display: inline-block;"> GUARDRAIL / SIGNPOST </div> JOHNSON GRASS NOXIOUS WEEK BRUSH CONTROL BROADCAST SPRAY INSECTICIDES CUT STUMP MISCELLANEOUS |

RATE AND CONCENTRATION:

| MATERIAL MASTER CODE & EPA REGISTRATION NUMBER | JOB A | | JOB B | | JOB C | | JOB D | |
|--|------------|-------|-------|-------|-------|-------|-------|-------|
| | RATE | CONC. | RATE | CONC. | RATE | CONC. | RATE | CONC. |
| # 57020293 Herbicide, Roundup Pro - #524-475 | 2 qt./acre | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

TRAINED SERVICEPERSON'S NAME:
 SERVICEPERSON SIGNATURE:

APPLICATOR'S NAME & LIC. #:
 APPLICATOR'S SIGNATURE:

FACILITY ADDRESS:

ADDITIONAL COMMENTS:

AREA CONVERSIONS

Use the following tables as reference guides for converting spray width, lane miles, acres, and square feet. When planning an application and herbicide mix, use these tables to determine treatment length of 1 acre based on chosen spray width.

CONVERT MILES TO ACRES

| LENGTH | | SELECT DESIRED WIDTH TO DETERMINE ACREAGE | | | | | |
|------------|----------|---|--|---|---|---|---|
| | | 6 FEET | 10 FEET | 20 FEET | 30 FEET | 40 FEET | |
| 528 feet | 0.1 mile | 1 Lane Mile | 1 ACRE = 1.37 miles or 7,260 feet | 1 ACRE = 0.83 mile or 4,356 feet | 1 ACRE = 0.41 mile or 2,178 feet | 1 ACRE = 0.28 mile or 1,452 feet | 1 ACRE = 0.21 mile or 1,089 feet |
| 1,056 feet | 0.2 mile | | | | | | |
| 1,584 feet | 0.3 mile | | | | | | |
| 2,112 feet | 0.4 mile | | | | | | |
| 2,640 feet | 0.5 mile | | | | | | |
| 3,168 feet | 0.6 mile | | | | | | |
| 3,696 feet | 0.7 mile | | | | | | |
| 4,224 feet | 0.8 mile | | | | | | |
| 4,752 feet | 0.9 mile | | | | | | |
| 5,280 feet | 1 mile | | | | | | |

LANE MILE CONVERSIONS

| LANE MILE | = | LINEAR FEET |
|-----------|---|-------------|
| 10 | = | 52,800 |
| 5 | = | 26,400 |
| 1 | = | 5,280 |
| 1/2 | = | 2,640 |
| 1/4 | = | 1,320 |
| 1/5 | = | 1,056 |
| 1/10 | = | 528 |
| 1/20 | = | 264 |
| 1/25 | = | 211 |
| 1/50 | = | 106 |
| 1/75 | = | 70 |
| 1/100 | = | 53 |

ACREAGE CONVERSIONS

| ACRES | = | SQUARE FEET |
|-------|---|-------------|
| 1 | = | 43,560 |
| 1/2 | = | 21,780 |
| 1/4 | = | 10,890 |
| 1/5 | = | 8,712 |
| 1/10 | = | 4,356 |
| 1/20 | = | 2,178 |
| 1/25 | = | 1,743 |
| 1/50 | = | 871 |
| 1/75 | = | 581 |
| 1/100 | = | 436 |

VOLUME CONVERSIONS AND MIX RATES

Use the following tables as reference guides for converting gallons, ounces, quarts, pints, and percentage mix rates. When planning an herbicide mix, use these tables to convert volumes. Refer to the herbicide or adjuvant label for mixing order and use rates. Always use proper PPE according to the most restrictive herbicide or adjuvant label.

REMEMBER:



GALLONS TO OUNCES CONVERSIONS

| GALLONS | | OUNCES |
|---------|---|--------|
| 0.10 | = | 12.8 |
| 0.25 | = | 32 |
| 0.50 | = | 64 |
| 0.75 | = | 96 |
| 1 | = | 128 |
| 2 | = | 256 |
| 3 | = | 384 |
| 4 | = | 512 |
| 5 | = | 640 |
| 6 | = | 768 |
| 7 | = | 896 |
| 8 | = | 1,024 |
| 9 | = | 1,152 |
| 10 | = | 1,280 |

LIQUID VOLUME CONVERSIONS

| | | |
|----------|---|--------------|
| 1 GALLON | = | 128 OUNCES |
| 1 GALLON | = | 4 QUARTS |
| 1 GALLON | = | 8 PINTS |
| 1 QUART | = | 0.25 GALLON |
| 1 QUART | = | 2 PINTS |
| 1 QUART | = | 32 OUNCES |
| 1 PINT | = | 0.125 GALLON |
| 1 PINT | = | 0.50 QUART |
| 1 PINT | = | 16 OUNCES |



MIX RATES

| TOTAL DESIRED GALLONS OF HERBICIDE SOLUTION | HERBICIDE MIX RATE | | | | | |
|---|--------------------|---------------|---------------|---------------|---------------|---------------|
| | 0.25% | 0.5% | 1% | 2% | 3% | 5% |
| | OUNCES TO ADD | OUNCES TO ADD | OUNCES TO ADD | OUNCES TO ADD | OUNCES TO ADD | OUNCES TO ADD |
| 1 | 0.32 | 0.64 | 1.28 | 2.56 | 3.84 | 6.40 |
| 5 | 1.60 | 3.20 | 6.40 | 12.80 | 19.20 | 32 |
| 10 | 3.20 | 6.40 | 12.80 | 25.60 | 38.40 | 64 |
| 50 | 16 | 32 | 64 | 128 | 192 | 320 |
| 100 | 32 | 64 | 128 | 256 | 384 | 640 |





APPLICATOR WORKSHEETS



CALIBRATION FOR SPRAY GUN OR BACKPACK SPRAYER WORKSHEET

CALCULATE FLOW RATE IN GALLONS PER MINUTE:

- Determine the seconds it takes to fill a 1-gallon bucket with spray gun or backpack nozzle = (A) _____ seconds
- 60 (seconds per minute) ÷ (A) _____ seconds to fill a 1-gallon bucket with spray gun or backpack nozzle = (B) _____ (GPM) flow rate

CALCULATE MINUTES TO SPRAY 1 ACRE:

- Check the herbicide label for the recommended GPA _____ (GPA) application rate ÷ (B) _____ (GPM) flow rate = (C) _____ minutes to spray 1 acre

CALCULATE SECONDS TO SPRAY 1,000 SQUARE FEET:

- 0.02296 (acre per 1,000 square feet) × (C) _____ minutes to spray 1 acre = _____ minutes to spray 1,000 square feet
- 60 (seconds per minute) × _____ minutes to spray 1,000 square feet = (D) _____ seconds to spray 1,000 square feet

Calibration and understanding of equipment flow rates promote proper application rates, herbicide efficiency, and herbicide effectiveness. The following table and worksheet are intended to help calibrate directed herbicide applications using a spray gun or backpack sprayer. The flow rate (in gallons per minute, GPM) must be known to determine the time it takes to treat either 1 acre or 1,000 square feet. The recommended application rate of the herbicide solution in gallons per acre (GPA) can be found on the herbicide product label.

The table shows typical flow rates and calculated spray times. The worksheet below can be used to determine spray times for specific calculated flow rates. The time to fill a 1-gallon container in seconds (A) can be used to calculate the flow rate in GPM (B), which can then be used to calculate spray times for 1 acre (C) and 1,000 square feet (D).

Once the worksheet is complete and the time required to spray an area is determined, the next step is to practice with water and dye. The applicator should practice until the 1,000-square-foot area can be covered in the amount of time calculated in the worksheet above (line 5). The photographs below demonstrate how to set up a 1,000-square-foot practice area.

REMEMBER:



SAMPLE CALIBRATION TIMES

| SECONDS TO FILL 1 GALLON (A) | FLOW RATE IN GALLONS PER MINUTE (GPM) (B) | SPRAY TIME | |
|------------------------------------|---|-----------------------------------|--|
| | | MINUTES TO SPRAY 1 ACRE (C) | SECONDS TO SPRAY 1,000 SQUARE FEET (D) |
| 60 seconds | 1 GPM | 100 minutes | 138 seconds |
| 30 seconds | 2 GPM | 50 minutes | 69 seconds |
| 20 seconds | 3 GPM | 33 minutes | 46 seconds |
| 15 seconds | 4 GPM | 25 minutes | 34 seconds |
| 12 seconds | 5 GPM | 20 minutes | 28 seconds |

PRODUCTION BASED ON TANK SIZE WORKSHEET

Use the following worksheet to determine the area and lane miles that can be treated with one full spray tank. The appropriate amount of herbicide to add to the tank based on acreage can also be calculated. To calculate acreage that can be covered, the important variables are total volume mixed, gallons per acre (GPA) application rate of the equipment, and the width of the spray pattern. Reset the spray truck control panel to the appropriate settings. The recommended GPA of the herbicide solution can be found on the herbicide product label.

If using a truck with multiple nozzles, complete this worksheet for each nozzle spray width. Do not mix more herbicide solution than can be used in one day as herbicides can lose efficacy within hours after mixing. Check the nozzle manufacturer's specifications calibration table to determine flow rate in gallons per minute (GPM) based on nozzle spray width, pounds per square inch (PSI), GPA, and ground speed.

REMEMBER:



CALCULATE ACRES THAT CAN BE TREATED WITH ONE FULL TANK:

1. Reset spray truck control panel to the appropriate GPA application rate (A) GPA application rate
2. 1 Full Tank = (B) gallons ÷ (A) (GPA) application rate = (C) acres that can be treated with one full tank

CALCULATE AMOUNT OF HERBICIDE NEEDED FOR ONE FULL TANK OF HERBICIDE SOLUTION:

3. READ THE LABEL to determine appropriate herbicide rate per acre = (D) (ounces or gallons)
4. (C) acres that can be treated with one full tank x (D) (ounces or gallons) per acre labeled herbicide rate = (E) (ounces or gallons) herbicide to add for one full tank of herbicide solution

CALCULATE LINEAR MILES PER 1 ACRE TO BE TREATED:

5. 43,560 (square feet per acre) ÷ (F) (feet) nozzle spray width = _____ linear feet ÷ 5,280 (feet per mile) = (G) linear miles per acre

CALCULATE MILES THAT CAN BE SPRAYED WITH ONE FULL TANK:

6. (G) linear miles per acre x (C) acres that can be treated with one full tank = (H) total miles that can be treated with one full tank at the chosen nozzle spray width

PRODUCTION BASED ON WORK HOURS WORKSHEET

Use the following worksheet to determine how many gallons to mix based on available spray hours. To complete this worksheet, the applicator will need to know the nozzle spray width (feet), ground speed (mph), desired work day length (hours), and the gallons per acre (GPA) application rate of the equipment. Reset the spray truck control panel to the appropriate settings. The recommended GPA of the herbicide solution can be found on the herbicide product label.

This worksheet is designed for one nozzle; if multiple nozzles will be used the worksheet will need to be repeated for each nozzle. Check the nozzle manufacturer's specifications calibration table to determine flow rate in gallons per minute (GPM) based on nozzle spray width, pounds per square inch (PSI), GPA, and ground speed.

REMEMBER:



CALCULATE TIME NEEDED TO TREAT ONE ACRE:

1. 43,560 (square feet per acre) \div _____ (feet) nozzle spray width = (A) _____ linear feet in 1 acre
2. 0.000189 (mile per foot) \times (A) _____ linear feet in 1 acre = (B) _____ lane miles in 1 acre
3. (B) _____ lane miles in 1 acre \div _____ (mph) ground speed = (C) _____ hours to spray 1 acre

CALCULATE ACRES TREATED PER DAY:

4. _____ (hours) desired work day length \div (C) _____ hours to spray 1 acre = (D) _____ acres sprayed per day

CALCULATE AMOUNT OF HERBICIDE SOLUTION NEEDED:

5. (D) _____ acres sprayed per day \times _____ (GPA) application rate = _____ (gallons) amount of herbicide solution to mix for available spray hours

HERBICIDE PER ACRE RATE WORKSHEET

(For labeled herbicide rates provided in ounces or gallons)

CALCULATE ACRES TO BE TREATED:

- _____ (feet) area width \times 10,000 (feet) area length = (A) _____ (square feet) spray area
- (A) _____ (square feet) spray area \div 43,560 (square feet per acre) = (B) _____ acres to be treated

REMEMBER:



CALCULATE HERBICIDE VOLUME TO BE USED:

- READ THE LABEL to determine appropriate herbicide rate per acre: (C) _____ (ounces or gallons) per acre
- (C) _____ (ounces or gallons) per acre \times (B) _____ acres to be treated = (D) _____ (ounces or gallons) herbicide volume to be used

CALCULATE HERBICIDE SOLUTION NEEDED:

- If using a spray truck reset control panel to the appropriate GPA application rate for broadcast applications (E) _____ (GPA) application rate
- (E) _____ (GPA) application rate \times (B) _____ acres to be treated = (F) _____ (gallons) mixed herbicide solution needed
- Convert to ounces if needed (F) _____ \times 128 (ounces per 1 gallon) = _____ ounces
- If herbicide label recommends using adjuvants, check adjuvant label for rate [_____ ounces of adjuvant per 100 gallons of herbicide solution \times (F) _____ gallons mixed herbicide solution needed = _____ \div 100 = (G) _____ ounces of adjuvant to use]

CALCULATE GALLONS OF WATER NEEDED:

- If needed convert herbicide volume and adjuvant volume from ounces to gallons [(D) _____ ounces \div 128 (ounces per 1 gallon) = (H) _____ gallons herbicide volume to be used and (G) _____ ounces \div 128 (ounces per 1 gallon) = (I) _____ gallons adjuvant volume to be used]
- Add (H) _____ gallons herbicide volume to be used + (I) _____ gallons adjuvant volume to be used = (J) _____ gallons of additives
- Subtract (J) _____ (gallons) additives from (F) _____ (gallons) mixed herbicide solution to be use = _____ gallons of water to be used

The guidance in this section is intended for a licensed applicator. The entire APPLICATOR GUIDANCE section should be reviewed before mixing herbicides. Use the above worksheet to help determine the volume of herbicide to use in a spray solution.

- Identify target vegetation as grass, broadleaf, or woody.
- Determine if the goal is to achieve total vegetation control (bare ground) or selective control to preserve some existing vegetation.
- Review COMMON RIVM HERBICIDES page and herbicide labels to determine which herbicide is appropriate for target vegetation and goal; select herbicide.
- Measure the target area's length and width.
- Check herbicide label for per acre rates. Never exceed the maximum allowable rate per acre per year.
- If herbicide label rate is provided in ounces or gallons per acre, use the Herbicide Per Acre Rate Worksheet. If herbicide label rate is provided in percent per acre, use the Herbicide Percent Solution Worksheet.
- Read the herbicide label to determine if tank mix partner herbicide or adjuvants are needed. Also, check the label to determine in what order water and herbicide or adjuvant should be mixed.
- See the VOLUME CONVERSIONS AND MIX RATES page to maintain common volume units throughout worksheet.
- When using herbicide in liquid or solid form use the proper measuring containers and follow the product label instructions.
- The application rate in gallons per acre (GPA) of the herbicide solution can be found on the herbicide product label. Set the spray truck control panel to the appropriate (GPA) setting prior to each spray job.
- Check the nozzle manufacturer's specifications calibration table to determine flow rate in gallons per minute (GPM) based on nozzle spray width, pounds per square inch (PSI), GPA, and ground speed.
- Always refer to product labels and safety data sheets (SDS) to determine proper personal protective equipment (PPE).
- Check the local weather forecast to determine if rain and wind conditions are suitable for application prior to mixing herbicide solution.

HERBICIDE PERCENT SOLUTION WORKSHEET

(For labeled herbicide rates provided in percent)

CALCULATE ACRES TO BE TREATED:

- _____ (feet) area width \times _____ (feet) area length = (A) _____ (square feet) spray area
- (A) _____ (square feet) spray area \div 43,560 (square feet per acre) = (B) _____ acres to be treated

REMEMBER:



CALCULATE HERBICIDE SOLUTION TO BE USED:

- If using a spray truck reset control panel to the appropriate (GPA) application rate for broadcast applications (C) _____ (GPA) application rate
- (C) _____ (GPA) application rate \times (B) _____ acres to be treated = (D) _____ (gallons) mixed herbicide solution to be used

CALCULATE HERBICIDE VOLUME TO BE USED:

- READ THE LABEL to determine appropriate herbicide rate by percent solution: (E) _____ (%) herbicide rate
- (D) _____ (gallons) mixed herbicide solution needed \times (E) _____ (%) herbicide rate = (F) _____ (gallons) herbicide needed
- If herbicide recommends using adjuvants, check adjuvant label for rate [_____ ounces of adjuvant per 100 gallons of herbicide solution \times (D) _____ (gallons) mixed herbicide solution needed = _____ \div 100 = (G) _____ ounces of adjuvant to use]

CALCULATE GALLONS OF WATER NEEDED:

- If needed convert adjuvant volume from ounces to gallons [(G) _____ (ounces) adjuvant volume \div 128 = (H) _____ gallons adjuvant volume to be used
- Add (F) _____ (gallons) herbicide needed + (H) _____ (gallons) adjuvant volume to be used = (I) _____ gallons of additives
- Subtract (I) _____ (gallons) additives from (D) _____ (gallons) mixed herbicide solution to be used = _____ gallons of water to be used

The guidance in this section is intended for a licensed applicator. The entire APPLICATOR GUIDANCE section should be reviewed before mixing herbicides. Use the above worksheet to help determine the percent of herbicide to use in a spray solution.

- Identify target vegetation as grass, broadleaf, or woody.
- Determine if the goal is to achieve total vegetation control (bare ground) or selective control to preserve some existing vegetation.
- Review COMMON RIVM HERBICIDES page and herbicide labels to determine which herbicide is appropriate for target vegetation and goal; select herbicide.
- Measure the target area's length and width.
- Check herbicide label for per acre rates. Never exceed the maximum allowable rate per acre per year.
- If herbicide label rate is provided in ounces or gallons per acre, use the Herbicide Per Acre Rate Worksheet. If herbicide label rate is provided in percent per acre, use the Herbicide Percent Solution Worksheet.
- Read the herbicide label to determine if tank mix partner herbicide or adjuvants are needed. Also, check the label to determine in what order water and herbicide or adjuvant should be mixed.
- See the VOLUME CONVERSIONS AND MIX RATES page to maintain common volume units throughout worksheet.
- When using herbicide in liquid or solid form use the proper measuring containers and follow the product label instructions.
- The application rate in gallons per acre (GPA) of the herbicide solution can be found on the herbicide product label. Set the spray truck control panel to the appropriate (GPA) setting prior to each spray job.
- Check the nozzle manufacturer's specifications calibration table to determine flow rate in gallons per minute (GPM) based on nozzle spray width, pounds per square inch (PSI), GPA, and ground speed.
- Always refer to product labels and safety data sheets (SDS) to determine proper personal protective equipment (PPE).
- Check the local weather forecast to determine if rain and wind conditions are suitable for application prior to mixing herbicide solution.

DAILY PESTICIDE REPORT (M&R-629)

(This ODOT required form must be completed on a daily basis when making herbicide applications.)

SHEET ___ OF ___ DATE: _____

| LOCATION | | | | | | | | | | WORK | | | | |
|--|------------------|------------------|------------|----------------|-------------|-----------------|---------------------------|------------|-----------|--------------------------|----------------|------|---|---|
| KEY | COUNTY | ROUTE | ROUTE TYPE | LANE DIRECTION | SPOT OR SLM | FACILITY OR SLM | MAINTENANCE ACTIVITY CODE | START TIME | STOP TIME | DESCRIPTION (SEE PAGE 2) | ACCOMPLISHMENT | UNIT | | |
| 1 | | | | | | | | | | | | | | |
| 2 | | | | | | | | | | | | | | |
| 3 | | | | | | | | | | | | | | |
| 4 | | | | | | | | | | | | | | |
| MATERIALS | | | | | | | | | | | | | | |
| MATERIAL MASTER CODE & EPA REGISTRATION NUMBER | | | | | | | | | | UNIT OF MEASURE | 1 | 2 | 3 | 4 |
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| EQUIPMENT | | | | | | | | | | | | | | |
| NO. | EQUIPMENT NUMBER | LIC# | HRs on JOB | BEGIN | END | MILES | Hrs | 1 | 2 | 3 | 4 | | | |
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| | | | | | | | | | | | | | | |
| LABOR | | | | | | | | | | | | | | |
| NO. | EMPLOYEE NAME | APPLICATOR LIC.# | TOTAL | R | O | R | O | R | O | R | O | | | |
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| TIME OF DAY | WEATHER CONDITIONS | | | | | WIND | |
|-------------|--------------------|-------|--------|------|-------|------|--|
| | TEMP | CLEAR | CLOUDY | RAIN | SPEED | DIR | |
| MORNING | | | | | | | |
| MIDDAY | | | | | | | |
| AFTERNOON | | | | | | | |

| DESCRIPTION OF SPRAYING |
|-------------------------|
| GUARDRAIL / SIGNPOST |
| JOHNSON GRASS |
| NOXIOUS WEEK |
| BRUSH CONTROL |
| BROADCAST SPRAY |
| INSECTICIDES |
| CUT STUMP |
| MISCELLANEOUS |

RATE AND CONCENTRATION:

| MATERIAL MASTER CODE & EPA REGISTRATION NUMBER | JOB A | | JOB B | | JOB C | | JOB D | |
|--|-------|-------|-------|-------|-------|-------|-------|-------|
| | RATE | CONC. | RATE | CONC. | RATE | CONC. | RATE | CONC. |
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TRAINED SERVICEPERSON'S NAME:
SERVICEPERSON SIGNATURE:

APPLICATOR'S NAME & LIC. #:
APPLICATOR'S SIGNATURE:

FACILITY ADDRESS:

ADDITIONAL COMMENTS:



GLOSSARY OF TERMS

GLOSSARY OF TERMS

ADJUVANT: Any substance added to an herbicide mix to improve herbicide efficacy.

ALS-INHIBITING HERBICIDE: A common type of herbicide with a mode of action that affects normal plant growth and development.

ANNUAL: A life cycle that takes a plant one year to grow from seed through reproduction before dying. See summer annual or winter annual for description of life cycles.

BIENNIAL: A life cycle that takes two years to reproduce before dying. Seeds germinate in the first spring and overwinter as a rosette. In the second season the plants develop flowers and produce seed.

BLADDER: Leaf-like structures that grow at the base of a flower.

BOLT: A stage in a plant's life cycle when a low-growing rosette changes form and begins growing vertically. Stems elongate and grow tall eventually producing flower and seed.

BOOT-TO-HEAD: The boot-to-head stage is when the seed head begins to develop but has not yet emerged. This usually happens around midsummer, and after this point the grass rapidly grows taller while producing flower/seed heads. The boot-to-head stage occurs just after the grass has produced substantial leaves and begins to develop the flowers within a sheath.

BROADCAST APPLICATION: Herbicide applied from a spray truck on a boom or with boomless nozzles from the road edge to a specified width. Broadcast applications are effective in covering large areas or many lane miles.

BROADLEAF: An herbaceous plant that has a taproot and leaves that grow wide or radially.

DIEBACK: When the vegetative portion of the plant dies at the end of a plant's life cycle.

DIRECTED APPLICATION: Herbicide applied with a skid sprayer and hand gun or backpack and spray wand. Herbicides are specifically directed at a target plant or a colony of target plants to reduce collateral damage or application to nontarget plants. This method may also be used when weeds are growing in areas that roadside equipment cannot reach.

FLOWER: A portion of a plant that contains the reproductive organs of the plant. The flower is often the most colorful and noticeable portion of the plant.

FLOWER HEAD: A grouping of flowers that can appear in different arrangements and shapes along the stalk. The flower group grows as a terminal cluster at the very top of the plant.

GRASS: A plant with a fibrous root system and long linear leaves with parallel veins.

HERBICIDE RESISTANCE: A genetic adaptation in a plant population in which some plants develop the ability to survive specific herbicide treatments.

LEAF BASE: The bottom area of the leaf where the leaf attaches to other plant parts.

LEAF MARGIN: The outer edge of a leaf.

LEAF TIP: The area of the leaf that is furthest away from the leaf stalk.

LEAFLET: A division of smaller leaves that compose the whole leaf in a compound leaf.

LOBE: The part of a leaf where the margin extends inward towards the center of the leaf.

MODE OF ACTION: The way an herbicide disrupts the health of the plant.

NODE: A point on a stem where a branch or leaf occurs.

NON-SELECTIVE HERBICIDE: An herbicide that is designed to disrupt the health of all plants; both grasses and broadleaf plants will be affected.

OVERWINTER: A plant that germinates in the fall will remain alive and green aboveground, but dormant. Plants that overwinter are the first to start growing in the spring.

PERENNIAL: A life cycle where root systems remain alive for multiple years, while the upper plant may die each year.

PRE-EMERGENT HERBICIDE: Herbicides that are applied to the soil forming a chemical barrier and preventing seed germination. Pre-emergent has no effect on perennial plants.

REPRODUCTIVE PARTS: A general term used to describe the male and female reproductive organs of a flower.

RESIDUAL HERBICIDE: Herbicides that are active in the soil and work through a plant's root system and control germinating seeds past the time of application. Residual herbicides are recommended for difficult-to-control weeds and perennials.

RHIZOMES: Thick, fleshy, or bulbous roots of perennial plants that are capable of vegetative reproduction. Rhizomes help perennial colonies spread by developing new plant shoots by spreading laterally and sending up new vegetative shoots.

RIBBED STEM: Raised edges running the vertical length of the stem.

ROSETTE: A dense cluster of leaves that grow low to the ground radially arranged from a common central point. Rosettes store energy in preparation for stem production when the plant changes form, usually bolting and producing stems, flowers, and seeds.

SEEDLING: A young plant that has developed after the seed germinates. Once the seedling is established it will convert to the active growth stage in its life cycle.

SELECTIVE HERBICIDE: An herbicide that is designed to disrupt the health of only a certain group of plants, such as broadleaf or grass.

SPIKE (FLOWER HEAD): A flower head where many flowers are directly attached to a single tall-growing stalk.

SPINE: A sharp growth that extends from inside a plant surface. Mostly found on the tip of leaves or leaf margins.

STALK: The supporting structure of the flower(s).

STEM: The main supporting structure of the plant. Stems are also the water and nutrient transportation systems between leaves and root systems.

SUMMER ANNUAL: A life cycle in which seeds germinate in spring completing the life cycle in the fall.

SUMMER/WINTER ANNUAL: Some plants have the ability to complete two life cycles in one season. Wild mustard, for example, can germinate in early spring, flower, and seed by early summer. That seed can germinate and complete a second life cycle producing seed again by fall. This only happens in years with favorable conditions such as a warm fall and lack of frost events.

SURFACTANT: A type of adjuvant or additive that will increase the surface area of an herbicide droplet in contact with leaf surfaces.

TENDRIL: A flexible branch-like structure that a plant uses to attach and pull itself on other plants or objects.

TERMINAL: The top of a plant or end of a branch.

TILLERING: Plant shoots that emanate from the root or bottom of the original stalk.

TRAILING VINES: A vine that grows across the ground and puts down roots at nodes in the stem.

VEGETATIVE REPRODUCTION: A type of plant reproduction where an existing plant will develop cloned plants from the parent plant's living parts. Different types of vegetative reproduction include stump sprouts, root shoots, cut stem regeneration, etc.

VEGETATIVE GROWTH: A phase in a plant's life cycle where it is growing in length or height, developing new leaves and shoots, and converting energy into plant development. This stage is shortly after the seedling develops or in the spring after dormancy.

WHORLED: A leaf arrangement where three or more leaves grow around the stem at a single node.

WING: a thin, leaf-like outgrowth that can be found growing along a stem, fruit, or flower.

WINTER ANNUAL: A life cycle in which seeds germinate in fall and overwinter as a seedling before the life cycle is completed in the following spring.





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OHIO DEPARTMENT *of* TRANSPORTATION

OHIO EPA 24-HOUR SPILL RESPONSE: 1(800)-282-9378

MARCH 2017

