Iowa Code section 317.11 states: *The county boards of supervisors and the state department of transportation shall control noxious weeds growing on the roads under their jurisdiction. Spraying for control of noxious weeds shall be limited to those circumstances when it is not practical to mow or otherwise control the noxious weeds.*

**Objective**

Develop a county weed control program that provides:

- Responsible weed control
- Wise use of taxpayer dollars
- Groundwater and surface water protection

An *integrated* approach to roadside vegetation management means relying on a variety of weed control methods: mechanical, biological, chemical and cultural. IRVM emphasizes cultural control – establishing and promoting healthy, native vegetation – and tries not to rely exclusively on herbicides for controlling weeds.

**Establish native vegetation**

Native vegetation is the cornerstone of IRVM. Plant the best-adapted vegetation and keep it healthy. Iowa native plants are naturally adapted to the state’s climate and growing conditions. They handle tough roadside conditions. Their tall growth and deep roots help prevent weeds. Keep the natives healthy with the use of prescribed fire.

**Do not overuse herbicides**

Overuse of herbicides weakens all vegetation, making roadsides more susceptible to invasion by weeds. Overuse of herbicides also eliminates desirable and harmless broadleaf species that would otherwise reduce weed invasion by occupying the same niche sought by weeds. For these reasons IRVM promotes careful *spot-treatment* of weeds when using herbicides.

**Consider mowing**

Mowing must be considered before resorting to herbicides. The effectiveness of mowing depends on targeted species and timing. The feasibility of mowing depends on roadside slope and available equipment. County road right-of-way is often not suited to tractors. Still, spot-mowing for weed control is encouraged and counties should look for ways to make this a more frequent and viable weed control option.

*Canada thistle, a perennial, spreads aggressively by seeds and rhizomes. Maintaining a healthy native plant community helps prevent its establishment.*
Pay attention to timing
Timing is key to successful vegetation management; the effectiveness of mowing and spraying depends on it. IRVM recommends hiring a full-time roadside manager as the best way to provide professional, proactive and systematic weed control.

Keep goals realistic
IRVM recognizes there is no such thing as total weed eradication, so have realistic goals. Accept the presence of some weeds and keep them at a manageable level. Weed species that pose no real threat to agriculture or natural areas should be tolerated. Prioritize weed control efforts, beginning with highly traveled roads.

Weed Life Cycles and Control Strategies

Annual weeds have a one-year life cycle. They germinate, grow, flower, set seed and die in one year or less. They reproduce by seed only. Common roadside annuals include common ragweed and giant ragweed.

To control:
- Mow prior to seed-set.
- Eliminate bare soil and disturbances to vegetation.

Biennial weeds have a two-year life cycle. In the first year a basal rosette (circular cluster of leaves on or near the ground) is produced. The second year a central, flowering stalk elongates and the plant dies after seed maturation. Biennials spread only by seed. Common roadside biennials include musk thistle, bull thistle, poison hemlock, wild parsnip and wild carrot.

To control:
- Mow prior to seed-set five consecutive years.
- Treat rosette plants with herbicides in fall or early spring when results are typically the best and damage to desirable plants can be minimized. (Biennials become much more tolerant of herbicides after the stem has elongated.)
- Establish native vegetation to deprive biennials of sunlight during their weak seedling stage.

Perennial weeds can live for a few years or for many years. Some perennials reproduce only by seed; many spread by seed and a variety of underground reproductive structures. Control of these perennials may be very difficult because of their extensive root systems.

To control:
- Treat with herbicides. (continued, next page)
Iowa’s Herbaceous Roadside Vegetation Threats

Iowa’s noxious weed list is outdated. It includes several species that no longer pose a threat to agriculture, and it does not include certain plant species now considered troublesome in the state.

The state’s primary herbaceous (non-woody) roadside threats are listed in Table 2 (page 47). Herbicides remain the most practical means of controlling these weeds in county road right-of-way.

Herbicide labels

Labels explain how to use the product effectively while protecting yourself, non-target plants and the environment. Take time to read the labels; it may be the most valuable time spent in weed control.

Adjuvants

Adjuvants are often added to the herbicide solution to increase its effectiveness. These products are put in the water tank at labeled rates.

- **Surfactants** improve dispersion and reduce surface tension of spray droplets resulting in increased penetration.
- **Crop oils and crop oil concentrates** also improve dispersion and, by being oil, keep leaf surfaces moist longer than water allowing more time for penetration.
- **Stickers** help prevent the solution from being washed off leaves.
- **Drift inhibitors** control drift.
- **Antifoaming agents** reduce foaming in the tank so it can be filled more easily.

Iowa’s Roadside Trees and Brush

Iowa’s noxious weed list includes a few woody species, and several non-listed trees and shrubs have become troublesome in non-agricultural land throughout the state. In roadsides, all trees and brush are potential safety hazards. The primary goal of county roadside tree and brush control is to provide safe roads for the traveling public. Safety goals include:

- Provide motorists unobstructed lines of sight.
- Ensure visibility of traffic control and warning signs.
- Eliminate immovable objects.
- Alleviate substantial and chronic drifting of snow.
- Reduce shade where it prolongs ice on the road.

Most roadside tree and brush control is accomplished by mechanical or chemical means. A correctly timed prescribed burn can also control brush.

Refer to Tree and Brush Control for County Road Right-of-Way, a 2002 Iowa Highway Research Board/UNI-IRVM publication, for complete brush control information. Herbicide recommendations from that publication – with updates – are shown in Appendix 5a.
Table 2: **IOWA’S PRIMARY ROADSIDE THREATS AND HERBICIDE RECOMMENDATIONS**

<table>
<thead>
<tr>
<th>Species</th>
<th>Roadside Manager recommendations (2011)</th>
<th>Application schedule and notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canada Thistle perennial</td>
<td>• Milestone • Transline (early season) • Telar (late season) • Transline/Telar (mid-season) • Perspective</td>
<td>Most effective control: Bud to bloom, or late fall just before frost; mowing increases efficacy of fall treatments. Growth stage is key, so treatment time can be flexible: • We’ve had success killing thistles with Milestone in early-August if they were mowed in June/July and have adequate regrowth. • We’ve also had good luck with Milestone after hard frosts, as late as the last week in October. As long as it’s green in the fall, spray it! Volatility may be an issue with Perspective in the summer.</td>
</tr>
<tr>
<td>Musk Thistle biennial</td>
<td>• Milestone • Opensight • Escort XP • Transline • Garlon • Perspective • Roundup/2,4-D</td>
<td>Most effective control: Rosette stage during spring or fall. Herbicides with good residual activity (e.g., Milestone, Opensight) appear to be the most effective over the long-term. Adding 2,4-D helps with burndown. Tank mixing 2,4-D with Overdrive = very rapid burndown.</td>
</tr>
<tr>
<td>Bull Thistle biennial</td>
<td>• Milestone • Opensight • Escort XP • Transline • Garlon • Perspective • 2,4-D</td>
<td>Same as musk thistle.</td>
</tr>
<tr>
<td>Teasel biennial</td>
<td>• Milestone • Escort XP • Garlon • Roundup • 2,4-D</td>
<td>Most effective control: Rosette stage during spring or fall. For small populations, cut off seedheads, destroy and dispose properly. Use a stout dose of herbicide and monitor. Teasel is tough; flowerheads and seed can be produced after treatment.</td>
</tr>
<tr>
<td>Poison Hemlock biennial</td>
<td>• Opensight • Telar • Roundup • 2,4-D</td>
<td>Most effective control: Rosette through pre-bloom, early spring.</td>
</tr>
<tr>
<td>Leafy Spurge perennial</td>
<td>• Plateau • Banvel • Vanquish • Perspective • Roundup/2,4-D</td>
<td>Most effective control: Spring or fall. Plateau works well and is most effective in the fall, just before frost. Pull or respray plants that appear after treatment. Use biocontrol for large infestations: flea beetles (<em>Aphthona</em> spp.).</td>
</tr>
<tr>
<td>Purple Loosestrife perennial</td>
<td>• Garlon 3A • Aquatic Roundup • Habitat</td>
<td>Most effective control: June to August.</td>
</tr>
<tr>
<td>Wild Parsnip biennial</td>
<td>• Escort • Opensight • 2,4-D</td>
<td>Most effective control: Rosette stage.</td>
</tr>
<tr>
<td>Japanese Knotweed perennial</td>
<td>• Habitat • Polaris • Arsenal Powerline • Roundup</td>
<td>Most effective control: Summer. Use a good surfactant, e.g., MSO with Arsenal, and Liberate with Habitat.</td>
</tr>
<tr>
<td>Sericea Lespedeza perennial</td>
<td>• Garlon • Escort XP</td>
<td>Can use either herbicide all summer. For best results use Garlon prior to branching (~July 4), and Escort in Aug. &amp; Sept.</td>
</tr>
<tr>
<td>Russian Knapweed perennial</td>
<td>• Milestone • Perspective</td>
<td>Most effective control: Spring.</td>
</tr>
<tr>
<td>Garlic Mustard biennial</td>
<td>• Roundup</td>
<td>Spray rosettes in early spring (late Feb - early April) or late fall when little else is green to avoid non-target plants. Escort XP and Streamline may be effective, but due to residual activity should not be used where non-target species could be affected.</td>
</tr>
</tbody>
</table>

Notes: The mostly commonly used brand names are shown here. Many of these products are now available under other (often less-expensive) labels. Where Garlon (triclopyr) is noted, either Garlon 3A (amine formulation) or Garlon 4 (ester) can be used. Garlon 4 is usually more effective but in hot weather can volatilize, drift and affect non-target species. 3A is non-volatile and usually considered the best choice for hot weather.
Ways to Reduce Herbicide Use

- Know which weeds (under what circumstances) actually constitute threats.
- Know each herbicide’s target species and appropriate application schedule.
- Know the latest, most accurate herbicide application technology.
- Work with adjacent landowners to eliminate disturbances that cause weeds.
- Hire conservation-minded operators for county spray crews.
- Resist outside pressure to do more spraying.

Landowner Education

Resisting outside pressure to apply more chemicals might require educating a landowner – or even a member of the board of supervisors – why it may be inappropriate to spray. The following points can be helpful when talking to someone whose weed control philosophy is based primarily on experience with row crops and lawns.

- Roadside weed control bears no resemblance to row-crop weed control. Corn and soybeans are annual species maintained in bare soil, a practice that invites weeds and requires continual cultivation and herbicide use. Native seed mixes designed for roadsides create diverse stands of perennial vegetation that prevent weeds by occupying all available space. Overuse of herbicides works against this method of weed control.
- Native prairie grasses and wildflowers may be tall and can appear unkempt, but these are the plant species most adapted to Iowa’s climate and growing conditions. Their extremely deep roots enable them to survive environmental stresses and their unique metabolism allows them to grow tall and thrive during long, hot summers. Because of these characteristics, native plants out-compete weeds.
- Broadleaf species (wildflowers) included in native seed mixes are part of the plan. They occupy a niche in the plant community otherwise used by weeds. They are not a threat to agriculture.
- A pure stand of any grass is an unnatural condition sustainable only through the use of herbicide.
- Overuse of herbicides in any roadside creates openings for weeds by weakening grasses and eliminating beneficial broadleaf species.
County Weed Control

Most counties that provide their own weed control:

- Dedicate one full-time employee for much of the summer
- Hire two seasonal employees
- Purchase and maintain one primary spray rig
- Spend between $8000 and $24,000 on chemicals each year
- Cover at least half the county each year
- Maintain herbicide applicator licenses and certifications
- Provide proper herbicide storage
- Properly dispose of herbicide containers
- Keep up with the latest developments in herbicide and sprayer technology

Benefits of providing in-house county weed control:

- The county has more control over how roadsides are managed. Sensitive areas such as gardens, bee hives, organic farms, prairie remnants and roadside wildflowers are protected.
- Having someone on staff who knows how to apply herbicides and effectively control weeds is a great asset for roadside management and management of county recreation areas as well.
- When the person overseeing the program lives in the county, personal pride and accountability become part of the equation resulting in a more conscientious effort.

IRVM Herbicide Application History

In the early days of IRVM, many counties sent crews into the ditch equipped with backpack sprayers. They carefully spot-sprayed weeds. While this method provided good weed control with a minimal amount of herbicide, roadside managers soon learned they could not cover enough of the county.

Since then IRVM has helped drive the development of spray truck technology that delivers herbicides with the accuracy and control needed to live up to the program’s original principles – killing target species without weakening non-target species or putting too much chemical on the ground.

Progress has been made, not just with more responsive on/off control switches and multi-directional spray nozzles, but with systems that monitor flow, record data and greatly reduce operator exposure. As with any spray equipment, these systems are only as good as the person whose finger is on the trigger. The objective is still to spot-spray. Beware of getting comfortable and sitting too long in the cab. Be conscientious, stay alert and be ready to grab the handheld sprayer and walk to that distant shrub to treat it properly. Never underestimate the value of your own labor; sometimes it’s still best to put on the old backpack.

This truck is equipped with an exterior seat for more accurate spraying.
Spray Systems

Counties typically use truck- or trailer-mounted chemical injection (high-end) or tank mix (basic) spray systems. The following is one county’s description of its two spray rigs. These fairly well represent the range of equipment available.

Our high-end unit is a Legacy 6000 chemical injection system from Mid Tech. This unit has a GPS to record the rate, type and amount of chemical used. We download that info to our desktop and print out reports. Our system has three injection pumps with three chemical tanks, and a 300-gallon water tank all on a skid for easy loading and unloading on the pickup. All the controls and the electric start are mounted in the cab on a computer stand. We have three bumper-mounted spray nozzles – 6 ft., 20 ft. and 30 ft. – and a hose reel with 300 ft. of hose in the back. We like this unit because we can easily switch chemicals to spray something else and one person can load and unload everything in less than an hour. A downside of this system: we can only use liquid chemicals, otherwise everything gets plugged up.

Our basic unit can also be loaded in the truck by one person. Just about any chemical can be used because it’s a tank mix system with an agitator in the tank. It has a 200-gallon tank, also on a skid, run by a 5½ HP motor. We have two nozzles, a 6 ft. and a 30 ft., on the right-front bumper. There is a hose reel in the back with 200 ft. of hose. There’s no GPS on this system, so we have to keep track of everything. We mounted switches in the cab to run the nozzles, but we have to get out to turn the system on and off.
Another type of truck-mounted spray system used in roadsides is an invert emulsion sprayer. Invert emulsion was developed to reduce herbicide drift and volatilization by producing large droplets of water surrounded by oil. The mayonnaise-textured droplets do not dry as fast as water, so leaf penetration is improved. Invert emulsion sprayers do not work with all types of chemical products; liquid formulations usually work best.

**Spray Nozzles**

Bumper-mounted nozzles or raised, multi-section, nutating spray nozzles are typically used on county rigs. The following is one county’s description of both nozzle types:

*A multi-section, nutating spray head allows a mindful operator to choose which section of the ditch to spray – in 2, 4 or 6 foot increments out to 30 feet. A system with multiple bumper-mounted nozzles can spray different distances too, but they tend to spray everything up to that distance. The multi-section system uses less herbicide primarily by hitting a narrower band. But if operators of multi-section systems hit all seven switches every time they spray a single thistle – just to make sure they don’t miss – there won’t be much reduction in herbicide. Ultimately a good operator still makes the difference.*
Spray System Components with Options

- Skid-mounted or permanent truck or trailer installation
- Water tank: typically 300 – 750-gal; 1,000-gal requires CDL
- Chemical mixing systems: tank-mix system with mechanical agitation (chemicals added manually to the large water tank) or chemical injection system with 2 to 3 separate chemical tanks (chemicals mixed with water after passing from tank)
- Water pump: roller, piston, centrifugal and diaphragm pumps are used
- Water pump motor: 5.5 – 11 HP; Honda is popular
- Injection pumps: at least 20 to 40 GPM; electric start optional
- Hose reel: 200 to 300 ft.; ½ in. to ¾ in.; electric rewind recommended
- Spray gun or spray wand attached to hose
- Truck-mounted spray heads, one side: generally either 2 to 4 bumper-mounted nozzles or a raised, nutating head with multi-direction spray sections
- Console: holds controllers, switches, GPS, computer
- Controller: sets application rate
- Flow meter: records herbicide application data
- GPS: maps spray location
- Software

Backpack Sprayers

The backpack sprayer is the best way to reduce herbicide use and target specific invasive plants, especially in diverse wildflower plantings.

- Use a low-volume backpack sprayer. Birchmeier™ and Solo™ are good brands.
- A 4-ft. wand reaches right down to the target plant.
- Herbicides made to kill broadleaf weeds will also kill wildflowers.
- Transline works on tough weeds without a lot of residual effect.
- Follow the rates on the label for mixing the spray.

Pesticide Applicator Certification

Anyone who applies pesticides for a county agency or other government entity must be certified. The Iowa Department of Agriculture and Land Stewardship – Pesticide Bureau administers the state’s pesticide applicator certification process. A description of this process – and related information – is in Appendix 5b.
Internet Resources

Excellent, up-to-date information about invasive species and their control is available on the web. Take advantage of the following websites.

Weed and invasive species information

www.dcnr.state.pa.us/forestry/plants/invasiveplants/index.htm
From the Pennsylvania Department of Conservation and Natural Resources, many of the species covered are also troublesome in Iowa. Fact Sheets discuss identification, distribution and biology; Management and Control information covers mechanical, chemical and bio-control compiled from a variety of invasive species websites.

http://mdc.mo.gov/landwater-care/plant-management/invasive-plant-management
From the Missouri Department of Conservation – Plant Management, note especially the links to Invasive Plant Management and Nuisance Plant Management. These pages outline ID and control of many invasive and troublesome Iowa species.

www.invasive.org/eastern
Many of Iowa’s invasive/nuisance plants are included in this list of invasive species of the Eastern United States. Pictures and control methods are provided.

fyi.uwex.edu/weedsci
Invasive plant management information from the University of Wisconsin Weed Science Cooperative Extension.

Herbicide information

http://onlinemanuals.txdot.gov/txdotmanuals/veg/quick_rate_chart_for_percentage_solutions.pdf
Use this chart to determine percentage rate of herbicide per gallon of water.

A downloadable UW-Extension chart highlighting the effectiveness of 32 herbicides on 32 different invasive plants in Wisconsin.

http://www.cdms.net/LabelsMsds/LMDefault.aspx
Use this ag chemical database to find MSDS sheets and product labels. Search by manufacturer or product name.

www.epa.gov/pesticides/chemicalsearch
The EPA’s Office of Pesticide Programs has created this Chemical Search with access to a broad array of published scientific and regulatory information on active ingredients used in registered pesticides.
**Herbicide Resources**

**Herbicide Suppliers**
- Midwest Spray Team & Sales, Inc., Lyle Christensen, 515-238-1616
- Van Diest Supply, Chris Roberts, 515-314-3898

**Herbicide Manufacturers & Reps**
- Dow AgroSciences, Jamie Baumgardner, 712-299-2583, jdbaumgardner@dow.com
- DuPont Land Management, Scott Ohnoutka, 605-731-9772, scott.ohnoutka@bayer.com
- Crop Production Services (UAP), Bill Walker, 605-645-1636, william.walker@cpsagu.com

**Herbicide Spray Equipment Companies**
- C & R Supply, Kevin Crisp, 800-322-2637
- Dultmeier Sales, Mike Sall, 800-228-9666 x5537
- Minnesota Wanner, Tom Wanner, 612-929-1070
General Weed Control

I publicize in the paper when we will start spraying, and encourage people to call me with locations of sensitive areas – gardens, bee hives, allergies, etc. I have “No Spray Zone” signs for willing landowners. **Jeff Chase, Des Moines County, 2009**

Higher diversity roadides are more robust, more resistant to weeds. Maintain high diversity even if you don’t have the opportunity to establish natives. Don’t spray species that are not problems, even if they’re considered weedy. **Wes Gibbs, Jones County, 2009**

One half of our county is sprayed each year for noxious weeds, by contractor. 99% of the spraying is for thistles because that’s the only species I receive complaints about. Nobody cares about sour dock, etc. All brush spraying is done by the roadside manager. We try to get half the county opposite the contractor sprayed for brush. Maintainer operators report high priority areas for brush spraying and I try to address those first. **Wes Gibbs, Jones County, 2009**

I mostly use the web or my sales rep for technical support. It’s too hard to maintain up-to-date, written information on the most effective herbicides for each species. But like anything else, the advice is only as good as the source. **Josh Brandt, Cerro Gordo County, 2009**

My weed control procedure is to first check Muenscher’s book, *Weeds*. Suggested control is usually of a manual or mechanical nature, i.e. mowing, hand hoeing, cutting roots below the surface, etc. In certain situations this can be helpful, but more importantly it gives me a feel for the plant I’m trying to control. **Linn Reece, Hardin County, 2010**

We don’t spray shoulders, just bridge abutments and guardrails. **Jim Uthe, Dallas County, 2010**

We plan on spraying garlic mustard since we just have it in isolated patches along timber and small creeks. We don’t spray wild parsnip unless asked or if there’s a really rank patch. Unfortunately, if we tried to spray every parsnip plant we’d essentially be blanket spraying many areas. **Jim Uthe, Dallas County, 2010**

We have isolated patches of garlic mustard that get sprayed. However, what exists in the ditch is usually spill over from the woods. What makes it to the ROW is just the tip of the iceberg, so I don’t get too excited about chasing it down. We have plenty of parsnip that, historically, was sprayed every year. Still have plenty of it. We do not spray parsnip anymore. **Wes Gibbs, Jones County, 2010**

Patches of most biennials (e.g., musk thistle) can be controlled in 2-3 years with diligence. **Linn Reece, Hardin County, 2011**

I know we use much less herbicide when we treat cut stumps as compared to when we foliar spray trees – with much less collateral damage to adjacent plants. And taxpayers are saved the cost of cutting or mowing the same tree over and over. **Rob Roman, Linn County, 2011**
Spray Systems

We have an 800 gal tank. I like using a lot of water; bigger droplets = less drift.  
Jim Uthe, Dallas County, 2011

Bigger tanks mean less time mixing and loading. Bryce Schaben, Shelby County, 2011

Our spray rig came with an 8HP engine which failed due to a mechanic’s error and was replaced with an 11HP due to availability; the 11HP has worked great pumping 136GPM & 180 PSI, minimum. More water = bigger drops = less drift. Jim Uthe, Dallas County, 2011

If using a high pressure pump, get two separate discharge ports to lock out the hose reel when not in use. Hose can come unwound. Hannay hose reels and Hypro spray wands work well.  
Andy Friederichsen, Clinton County, 2011

The Legacy 6000 can be used as a datalogger and rate controller. When our old datalogger died, we just piggybacked the Legacy onto our existing rate controller because it was a lot less work than redoing everything. Jim Uthe, Dallas County, 2011

We recommend a minimum of 2 chemical injection tanks, 1 brush, 1 thistle. A third tank is nice to hold 2,4-D for use on large patches of various undesirable weeds (giant ragweed, hemp, crown vetch, parsnip, hemlock, etc.). Jim Uthe, Dallas County, 2011

We’re simplifying things by using a “multi-use” chemical on the trucks, so we suggest only two injection tanks … or just one. The reason we’ve gone to one chemical for controlling brush and thistles is more due to operator and controller issues, than chemical issues. A good, versatile chemical means less operator error and eliminates “lag” in the controller.  
Andy Friederichsen, Clinton County, 2011

We recommend a centrifugal pump if using spray nozzles and a diaphragm pump if using a spray wand. Andy Friederichsen, Clinton County, 2011

We have a C&R Supply Roadside Actuator with three Boombuster nozzles. We use only two of them. The system uses a lot of water (which is why we like a bigger tank), but it was relatively inexpensive and provides very good coverage. Andy Friederichsen, Clinton County, 2011

We use eight boom widths with additional fan nozzle for tall brush. Jim Uthe, Dallas County, 2011

The multi-section heads are great, however if spraying large brush, 6-8 ft. tall, striping is a big concern. The head does not produce a spray pattern to provide good coverage. Andy Friederichsen, Clinton County, 2011

You need to get good ball valves to turn on and off every spray section in the spray head. Solenoid valves, like the TeeJet 144a, do not last; there’s constant replacement of diaphragms. We condensed the 9-section head to a 5-section head. It still has the same amount of nozzles, just using fewer valves by tying the nozzles together. Andy Friederichsen, Clinton County, 2011

Chapter 5 - WEED CONTROL
A flatbed sprayer with a crew member standing on the back of the truck spraying thistles and brush with a hand wand seems to be more accurate than a top-of-the-line spray head and the initial costs are way less expensive. But OSHA may not be allowing a crew member to stand on the back of the truck much longer. *Andy Friederichsen, Clinton County, 2011*

With our rig, we can’t go the 10 mph the literature states; we go in the 3-5 mph range. *Andy Friederichsen, Clinton County, 2011*