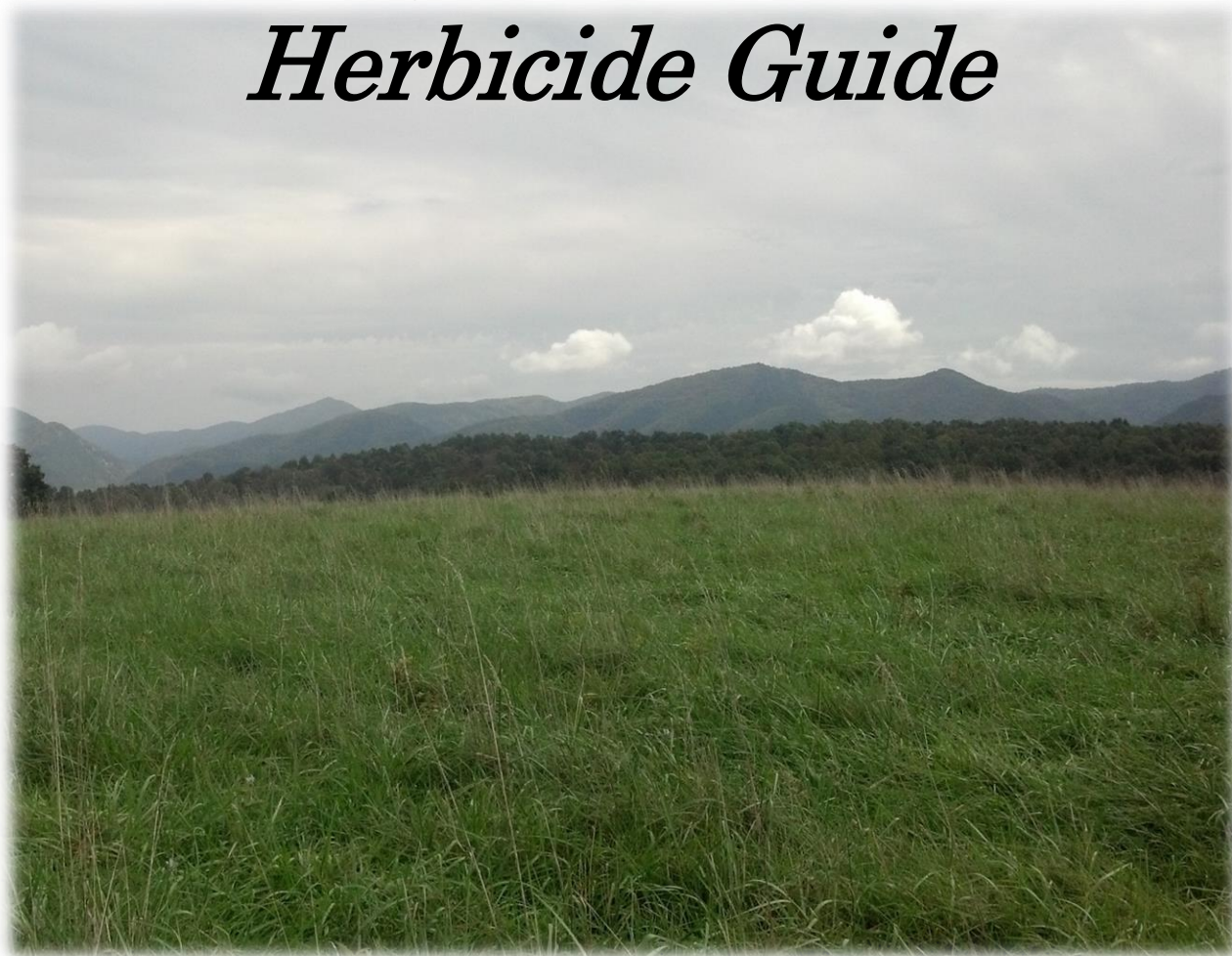




Virginia Cooperative Extension
Virginia Tech • Virginia State University

Hay & Pasture Herbicide Guide



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The herbicide recommendations in this guide were generated using Virginia Cooperative Extension's 'Pest Management Guide', local herbicide trials, label recommendations, and local experience.


There may be instances where herbicides other than those mentioned may be legal and effective. Virginia Cooperative Extension does not endorse any specific company or product; product names are used when a product represents a unique combination of active ingredients not found elsewhere on the market, or if use of a product name clarifies the recommendation. In many cases generic herbicides with active ingredients identical to trade-named herbicides exist, and this guide attempts to highlight some of those options. Be sure to read all labels as generics may differ in concentration from the products listed in this guide.

How to use this guide

- The example applications are given on both a *per acre* basis for calibrated application equipment, and on a *per gallon* basis for spot spraying.
- The example applications are calculated using label specifications for mid-to-high application rates. “Doubling up” on the rate can sometimes result in reduced control by promoting top-kill before herbicide translocation occurs to roots and other underground storage organs.
- The *per gallon* herbicide rates were calculated under the assumption that most people, **when spot spraying by hand, will apply a total volume of somewhere around 75 gallons/acre.** It’s also assumed that weeds will be sprayed until thoroughly wet, but not to the point of runoff. This is a starting point only, your case may vary dramatically depending on weed density, sprayer type, and individual application technique.

Horsenettle, Sand Briar (*Solanum carolinense*)

Best herbicide timing:
At first appearance of flowers (July/August)



hiltonpond.org

Horsenettle is a thorny perennial (underground stems) that flowers early-flowering in July/August through berries containing yellow berries.

Multiple products are available for control of Horsenettle. dicamba, Cimarron, Cimarron Plus would be the most effective herbicides listed for control of this weed. Dicamba is stronger on perennials and can be applied to several months.

Example applications:

Per acre		Per gallon of water (spot treatment)
2.1 pints <u>GrazonNext HL</u>	\$\$	9.75 mL (1/3 oz) <u>GrazonNext HL</u>
9.5 oz non-ionic surfactant		9.5 mL (1/3 oz) non-ionic surfactant
Per acre		Per gallon of water (spot treatment)
2.5 pints 2,4-D LV4	\$	12 mL (1/2 oz) 2,4-D LV4
8 oz <u>dicamba</u>		2.5 mL (1/4 oz) <u>dicamba</u>
6.5 oz non-ionic surfactant		9.5 mL (1/3 oz) non-ionic surfactant

Example applications:

Per acre		Per gallon of water (spot treatment)
2.1 pints <u>GrazonNext HL</u>	\$\$	9.75 mL (1/3 oz) <u>GrazonNext HL</u>
9.5 oz non-ionic surfactant		9.5 mL (1/3 oz) non-ionic surfactant
Per acre		Per gallon of water (spot treatment)
2.5 pints 2,4-D LV4	\$	12 mL (1/2 oz) 2,4-D LV4
8 oz <u>dicamba</u>		2.5 mL (1/4 oz) <u>dicamba</u>
6.5 oz non-ionic surfactant		9.5 mL (1/3 oz) non-ionic surfactant

Herbicide Timing for *Summer Annual Weeds*

SPRAY



Seedling
spring & summer

SPRAY



Vegetative
(less than 10" tall)



Flowering & seeding
Summer

Annuals are relatively simple to kill during the seedling and early vegetative stages. Increased size and age result in significantly reduced control as tissues harden off and the plant becomes reproductive.

Herbicide Timing for *Biennial Weeds*

SPRAY



Seedling

Typically late summer or fall

SPRAY



Rosette

Fall - early spring



Bolting

Late spring

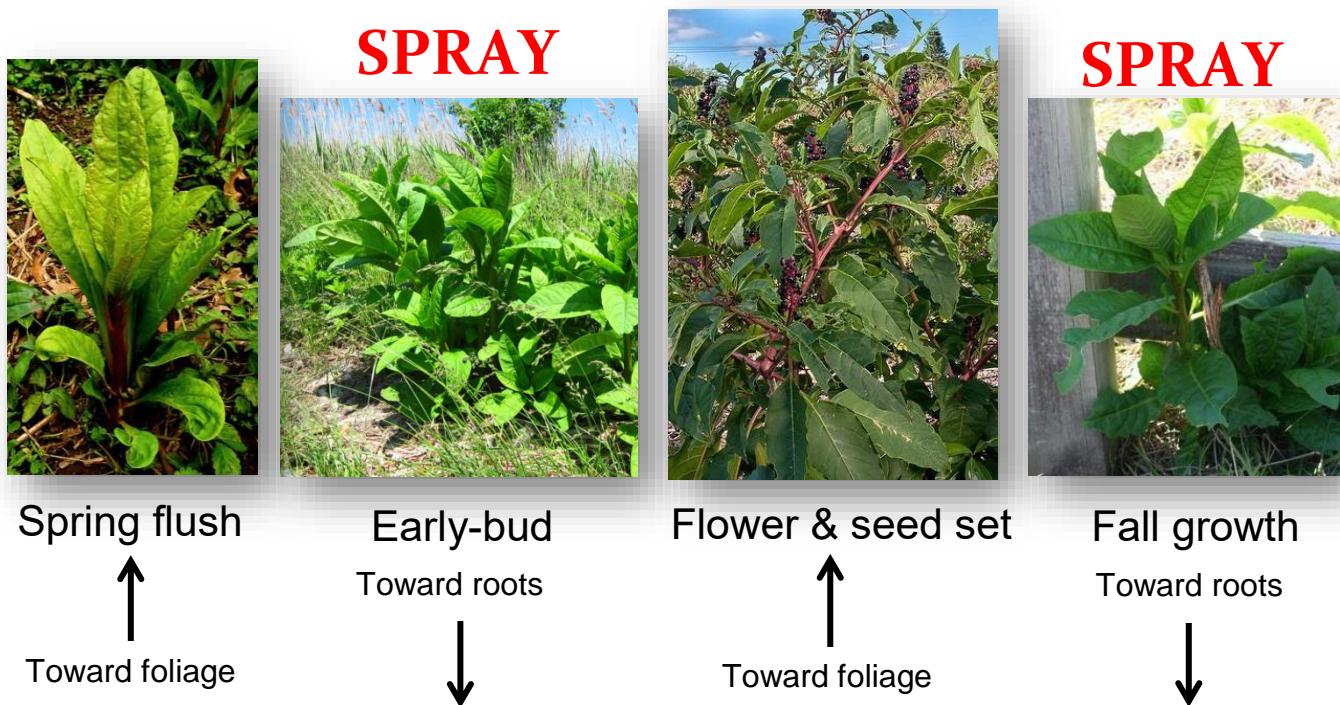


Flowering

Summer

Biennials are relatively simple to kill during the seedling and rosette stage with most broadleaf herbicides. Once biennials begin to bolt in spring, control is significantly reduced.

Herbicide Timing for *Perennial Weeds*



General direction of sugar and herbicide movement

Two periods are ideal for spraying perennials: the early-bud stage (the 2 weeks before flowering), and fall. Why?

1. Sugar direction is moving toward underground perennial structures
2. Plenty of leaf area to take in herbicide
3. Perennial structures at lowest energy level

Herbicide Products & Active Ingredients

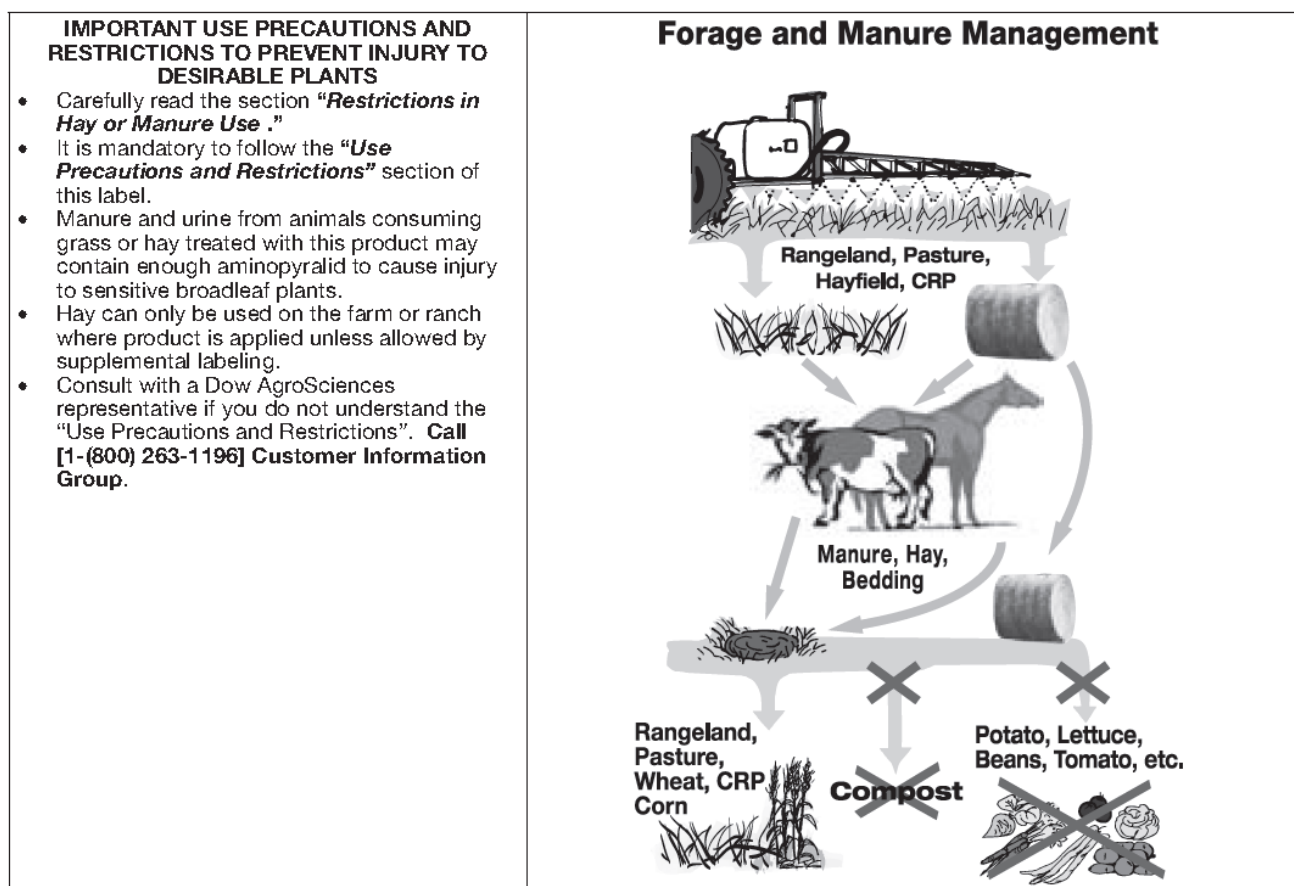
	Active Ingredient	Acid Equivalents		General-use or Restricted-use
		%	lbs./gal	
Grazon P+D	picloram	5.70%	0.54	Restricted
	2,4-D	21.20%	2	
Surmount	picloram	13.20%	0.67	Restricted
	fluroxypyr	10.60%	0.67	
Milestone	aminopyralid	21.10%	2	General
GrazonNext HL	aminopyralid	4.28%	0.41	General
	2,4-D	34.25%	3.33	
DuraCor	aminopyralid	7.56%	0.67	General
	florpyrauxifen- benzyl		0.067	
Chaparral	aminopyralid	52.50%	0.525	General
	metsulfuron methyl	9.45%	0.0945	
Remedy Ultra	triclopyr	43.46%	4	General
Crossbow	triclopyr	11.90%	1	General
	2,4-D	23.70%	2	
Cimmaron Plus	metsulfuron methyl	48.00%	N/A	General
	chlorsulfuron	15.00%		
Chisum	metsulfuron methyl	48.00%	N/A	General
	chlorsulfuron	15.00%		
PastureGard HL	triclopyr	32.40%	1.5	General
	fluroxypyr	10.80%	0.5	
Redeem R&P	triclopyr	23.7	2.25	General
	clopyralid	7.90%	0.75	
2,4-D LV4	2,4-D	45.50%	3.8	General
Banvel	dicamba	40.00%	4	General
Facet L	quinclorac	18.90%	1.5	General
Quinstar	quinclorac	75.00%		General
Prowl H20	pendimethalin	38.70%	3.8	General

Precautions with Residual Herbicides

While all herbicides have some persistence in the environment, some active ingredients have a relatively long persistence and are often referred to as “residual” herbicides. This can be good, as it allows for extended control of weeds as plants take up residual chemical over time. It also poses a risk that chemicals could move off site through animal manures or hay. There have been cases where manure from animals grazing or consuming hay from treated fields was used in gardens or commercial vegetable fields, causing catastrophic losses of high-value crops. Lawsuits and bad publicity related to these cases threaten our ability to use these products in the future, so it is critical to follow the precautions and restrictions outline by the manufacturer.

The specific active ingredients mentioned in this guide that pose a risk are picloram, aminopyralid, and clopyralid, which belong to a class of herbicides known as “pyridines”. You will most likely encounter these active ingredients in the products *Milestone*, *GrazonNext HL*, *Chaparral*, and *Surmount*. These products should only be used on sites where manure or hay will remain on-farm in fields where they are acceptable. The practical life-span of these products can vary from several months to a year in an open field setting where chemicals are subject to breakdown by ultraviolet light and microbial organisms. In a closed setting such as stockpiled manure or stored hay, chemicals can retain their integrity for years.

The following illustration is taken from a label, and outlines forage and manure management when using residual herbicides.



Contents

Bladder Campion.....	9
Horsenettle, Sand Briar.....	10
Pokeweed, Pokeberry.....	11
Milkweed.....	11
Dogbane.....	13
Cedar.....	14
Osage Orange, Hedgeapple.....	15
Sumac.....	16
Ailanthus, Tree-of-Heaven.....	16
Honey Locust.....	17
Black Locust.....	17
Multiflora Rose.....	18
Autumn Olive.....	19
Black Hawthorn.....	20
Sericea Lespedeza.....	21
Buckbrush, Devil's Shoestring.....	22
Queen Ann's Lace, Wild Carrot.....	23
Stickweed.....	24
Wingstem.....	24
Ironweed.....	24
Buckhorn Plantain.....	25
Broadleaf Plantain.....	25
Yucca.....	26
Bull thistle.....	27
Musk thistle.....	27
Plumeless thistle.....	27
Canada thistle.....	28
Spiny Amaranth, Spiny Pigweed.....	29
Curly Dock.....	30
Broadleaf Dock.....	30
Burdock.....	31
Cocklebur.....	32
Common Mullein.....	33
Brambles: Dewberry, Blackberry.....	34
Foxtails.....	35
Perilla mint.....	40
Japanese stiltgrass.....	44
Jointhead arthraxon, small carpetgrass.....	45

Bladder Champion (*Silene alba*)

Best herbicide timing:

Early bud stage (early-summer & fall)



Bladder champion is a perennial that sprouts from a spreading, underground stem (rhizome). Target the plant during the bud stage to maximize delivery of herbicide to roots and rhizomes.

Research has shown good results with metsulfuron methyl, which is an active ingredient in *Cimarron Plus*, *Chisum*, *Chaparral*, and *Ally XP*. You can also purchase metsulfuron methyl as generic *metsulfuron*. All of these products can cause grass injury in fescue, and especially Timothy. It may be a good idea to tank-mix metsulfuron-containing products with either dicamba or 2,4-D to increase the spectrum of weeds controlled; *Chaparral* already contains an additional active ingredient for this purpose.

Example applications:

<p><u>Per acre</u></p>
<p>0.5 oz <i>Cimarron Plus</i></p>
<p>8 oz dicamba</p>
<p>8 oz non-ionic surfactant</p>

<p><u>Per acre</u></p>
<p>2.5 oz <i>Chaparral</i></p>
<p>8 oz non-ionic surfactant</p>

Horsenettle, Sand Briar (*Solanum carolinense*)

Best herbicide timing:

At first appearance of flowers (July/August)



hiltonpond.org



backyardnature.net

Horsenettle is a thorny perennial that sprouts from spreading roots or rhizomes (underground stems). Target roots and rhizomes by herbicide applications timed at early-flowering in July or August. It produces many seeds, which are often spread through berries contained in hay, so be sure to prevent it from maturing.

Multiple products are effective on horsenettle when sprayed at high rates, including: 2,4-D+ dicamba, *Cimarron Plus*, *GrazonNext HL*, *Chaparral*, and *Surmount*. 2,4-D + dicamba or *Cimarron Plus* would be a slightly less expensive than the other options, however, the other herbicides listed contain either picloram or aminopyralid. These chemicals are usually stronger on perennials and have residual soil activity on existing or germinating weeds for up to several months.

Example applications:

<u>Per acre</u> 2.1 pints <i>GrazonNext HL</i> 8 oz non-ionic surfactant	<u>Per gallon of water (spot treatment)</u> 13 mL (1/2 oz) <i>GrazonNext HL</i> 9.5 mL (1/3 oz) non-ionic surfactant
<u>Per acre</u> 2.5 pints 2,4-D ester 8 oz dicamba 8 oz non-ionic surfactant	<u>Per gallon of water (spot treatment)</u> 16 mL (1/2 oz) 2,4-D ester 3 mL (1/10 oz) dicamba 9.5 mL (1/3 oz) non-ionic surfactant

Pokeweed, pokeberry (*Phytolacca americana*)

Best herbicide timing:

Early bud stage (early-to-mid summer); fall regrowth



Pokeweed is a perennial that sprouts from a large fleshy taproot. Target the plant and taproot by herbicide applications at the bud stage (early summer & also fall-regrowth). Because pokeweed has a taproot rather than spreading roots or rhizomes, its main strategy for spreading is by seed.

In university testing, the best results were obtained with *Crossbow*, *GrazonNext HL*, and *Surmount*. *Crossbow* is generally too expensive to use as a broadcast application, but a home tankmix of triclopyr (*Remedy Ultra*) + 2,4-D would be an equivalent but more cost-effective option. *GrazonNext HL* and *Surmount* have residual soil activity on many herbaceous weeds, and may be your best choice if you are targeting those in addition to pokeweed. *GrazonNext HL* is general-use while *Surmount* requires a license.

Example applications:

<u>Per acre</u> 2.1 pints GrazonNext HL 8 oz non-ionic surfactant	<u>Per gallon of water (spot treatment)</u> 13 mL (1/2 oz) GrazonNext HL 9.5 mL (1/3 oz) non-ionic surfactant
<u>Per acre</u> 1 pint Remedy Ultra 3 pints 2, 4-D ester 8 oz non-ionic surfactant	<u>Per gallon of water (spot treatment)</u> 6.25 mL (1/4 oz) Remedy Ultra 19 mL (2/3 oz) 2,4-D ester 9.5 mL (1/3 oz) non-ionic surfactant
	<u>Per gallon of water (spot treatment)</u> 47 mL (1.5 oz) Crossbow 9.5 mL (1/3 oz) non-ionic surfactant

Milkweed (*Asclepias syriaca*)

Best herbicide timing:

Early bud stage (early-to-mid summer); fall regrowth



Milkweed is a perennial that sprouts from large, fleshy roots and deep, spreading rhizomes (underground stems). Target the roots and rhizomes through herbicide applications at the early-bud stage in early-summer or on fall growth. Milkweed cannot tolerate frequent mowing.

Few herbicides are good on milkweed. In university testing, the best results were obtained with Surmount at 80% control. *Crossbow* (or homemade equivalent of *Remedy* + 2,4-D) and *GrazonNext HL* are not quite as effective but can provide acceptable control. *Surmount* is a restricted-use product. *Surmount* and *GrazonNext HL* are both labeled for pasture only.

Example applications:

<u>Per acre</u> 2.1 pints GrazonNext HL 8 oz non-ionic surfactant	<u>Per gallon of water (spot treatment)</u> 13 mL (1/2 oz) GrazonNext HL 9.5 mL (1/3 oz) non-ionic surfactant
<u>Per acre</u> 3 pints Surmount 8 oz non-ionic surfactant	<u>Per gallon of water (spot treatment)</u> 19 mL (2/3 oz) Surmount 9.5 mL (1/3 oz) non-ionic surfactant
<u>Per acre</u> 1.5 pints Remedy Ultra 3 pints 2, 4-D ester 8 oz non-ionic surfactant	<u>Per gallon of water (spot treatment)</u> 9.5 mL (1/3 oz) Remedy Ultra 19 mL (2/3 oz) 2,4-D ester 9.5 mL (1/3 oz) non-ionic surfactant
	<u>Per gallon of water (spot treatment)</u> 47 mL (1.5 oz) Crossbow 9.5 mL (1/3 oz) non-ionic surfactant

Dogbane (*Apocynum cannabinum*)

Best herbicide timing:

Early bud stage (early-to-mid summer); fall regrowth



Dogbane is a perennial that sprouts from a large taproot and spreading root system. Target the plant, taproot, and root system through herbicide application at the early-bud stage in early-summer & again on any fall growth.

Surmount, *Crossbow*, and *PastureGard HL* have been effective on dogbane in university trials. When you base your selection on price, the spectrum of weeds controlled, and the persistence of weed control, *Surmount* is probably the best fit. The presence of fluroxypyr also makes *Surmount* strong on other woody species, so its suitability for fencerow applications is on par with *Crossbow*.

Example applications:

<u>Per acre</u> 3 pints <i>Surmount</i> 8 oz non-ionic surfactant	<u>Per gallon of water (spot treatment)</u> 19 mL (2/3 oz) <i>Surmount</i> 9.5 mL (1/3 oz) non-ionic surfactant
<u>Per acre</u> 1 pint <i>Remedy Ultra</i> 3 pints 2, 4-D ester 8 oz non-ionic surfactant	<u>Per gallon of water (spot treatment)</u> 6.25 mL (1/4 oz) <i>Remedy Ultra</i> 19 mL (2/3 oz) 2,4-D ester 9.5 mL (1/3 oz) non-ionic surfactant
	<u>Per gallon of water (spot treatment)</u> 47 mL (1.5 oz) <i>Crossbow</i> 9.5 mL (1/3 oz) non-ionic surfactant

Eastern Red Cedar (*Juniperus virginiana*)

Best herbicide timing:
late-spring to early-summer or fall



Cedar is a widespread and troublesome tree that spreads rapidly by seed and proliferates in pastures with poor fertility; especially when the pasture is underutilized. Like other perennial weeds, try to target foliar herbicide applications in late-spring & early-summer, or apply fall basal bark herbicide treatments. Long-term management of cedar is dependent on proper soil pH (>6.0) and adequate soil phosphorous. The long-term effectiveness of foliar herbicide applications on cedars is generally not much better than about 50-75% control. The rate of control decreases as the size of the tree increases; at 10 *inches* tall or larger, less than 50% of trees will be controlled. The following herbicide recipe using Surmount and Remedy will be your best option. If you do not have a private pesticide applicator's license, *Cimarron* is the next best option, but control will likely only approach 40%.

Anecdotal observations have suggested that control of cedar is more effective when using a higher application volume (30+ gallons water/acre) and additional surfactant (as indicated below), with the goal of achieving greater plant coverage and herbicide exposure.

Example applications:

<u>Per acre</u>	<u>Per gallon of water (spot treatment)</u>
3 pints Surmount	19 mL (2/3 oz) Surmount
1 pint Remedy Ultra	6.25 mL (1/4 oz) Remedy Ultra
12 oz non-ionic surfactant	14 mL (1/2 oz) non-ionic surfactant

<u>Per acre</u>
0.5 oz <i>Cimarron Plus</i>
8 oz dicamba
12 oz non-ionic surfactant

Osage orange, Hedge Apple (*Maclura pomifera*)

Best herbicide timing:
late-spring to early-summer; fall



Osage orange can reproduce by seed or by stump or root suckers. Cutting is the most effective control method for mature trees; re-sprouts from cut stumps can be prevented at time of cutting with a cut-stump herbicide treatment such as picloram or triclopyr. Application of these herbicides to trunks that have been girdled has shown some success, as has basal bark application on small trees. Foliar herbicide applications of PastureGard HL or Remedy Ultra (triclopyr) at a high rate are labeled for osage orange and can be effective as an individual plant treatment on small trees; explore tank-mixing options if spraying additional species. Total coverage of foliage is essential.

Example applications:

Per gallon (foliar spray)

25 mL (3/4 oz) Remedy Ultra
9.5 mL (1/3 oz) non-ionic surfactant

Per gallon (cut stump treatment)

1 part Remedy Ultra
3 parts diesel fuel or fuel oil

Per gallon (basal bark treatment on trees <6" diameter)

1 part Remedy Ultra
3 parts diesel fuel or fuel oil

*Apply basal bark treatment to lower 15" of trunk

*Soak trunk until thoroughly wet but not to point of runoff

*If must apply to point of runoff, use 1 part Remedy Ultra to 20 parts diesel or fuel oil

You can also purchase Tordon RTU, a "ready-to-use" cut stump product.

Sumac
(*Russ spp.*)



Ailanthus (tree-of-heaven)
(*Ailanthus altissima*)



Best herbicide timing:
late-spring to early-summer; fall

Although often confused, sumac species and ailanthus are separate species. While sumac only sometimes acts as a weed, Ailanthus is well known to be extremely invasive.

Example applications:

Per gallon (foliar spray)
25 mL (3/4 oz) Remedy Ultra
9.5 mL (1/3 oz) non-ionic surfactant

Per gallon (cut stump treatment)
1 part Remedy Ultra
3 parts diesel fuel or fuel oil

Per gallon (basal bark treatment on trees <6" diameter)
1 part Remedy Ultra
3 parts diesel fuel or fuel oil
*Apply basal bark treatment to lower 15" of trunk
*Soak trunk until thoroughly wet but not to point of runoff
*If must apply to point of runoff, use 1 part Remedy Ultra to 20 parts diesel or fuel oil

You can also purchase Tordon RTU, a "ready-to-use" cut stump product.

Honey locust (*Gleditsia triacanthos*); **Black locust** (*Robinia pseudoacacia*)

Best herbicide timing:

late-spring to early-summer; fall



Honey locust thorns & pods



Black locust thorns & pods



Locust trees can reproduce by seed or by stump or root suckers. Cutting is the most effective control method for mature trees; re-sprouts from cut stumps can be prevented at time of cutting with a cut-stump herbicide treatment such as *Remedy* (triclopyr) or picloram. A foliar herbicide application with a high rate of *GrazonNext HL*, *PastureGard HL*, or *Surmount* are labeled for small locust trees. Additionally, a 2,4-D + dicamba mixture can be effective. *GrazonNext HL* will probably provide the best combination of locust control and broad spectrum weed control if other problem weeds are present. *Remedy* (triclopyr) can be tank-mixed with either herbicide to increase effectiveness on brushy weeds.

Example applications:

<u>Per acre</u>	<u>Per gallon of water (spot treatment)</u>
2.1 pints GrazonNext HL	13 mL (1/2 oz) GrazonNext HL
1 pint Remedy Ultra	6.25 mL (1/4 oz) Remedy Ultra
8 oz non-ionic surfactant	9.5 mL (1/3 oz) non-ionic surfactant

Per gallon (cut stump treatment)

1 part Remedy Ultra
3 parts diesel fuel or fuel oil

You can also purchase Tordon RTU, a “ready-to-use” cut stump product.

***Multiflora rose* (*Rosa multiflora*)**

Best herbicide timing:

Spring (before flowering is over); fall



Gary Fewless



Apply herbicide from full leaf emergence through the flowering period, or in late-summer/fall. For a **spring treatment**, multiple herbicides are labeled for and effective, including: GrazonNext HL alone or in a tankmix with *Remedy Ultra* is effective. Metsulfuron (a component of *Cimarron Plus* and *Chisum*, and *Chaparral*) is also effective, along with *Surmount*, *PastureGard HL*, and *Crossbow*. For a **late-summer/fall** application, metsulfuron has shown excellent control. The cheapest, most effective herbicide for a spring application is probably *GrazonNext HL* alone or in combination with *Remedy*. Additionally, *GrazonNext HL* provides broad spectrum weed control and residual soil activity. Metsulfuron works well spring or fall and is fairly inexpensive but high rates are required and it does not offer as much soil residual activity. Caution: *Cimarron* will stunt fescue. *Crossbow* is a popular brushy weed product, but is not a good choice if residual control is desired. If the plant has been mown, wait 9-12 months before applying herbicide in order to maximize leaf area exposure to the treatment.

Example applications:

<u>Per acre</u> 2.1 pints GrazonNext HL 8 oz non-ionic surfactant	<u>Per gallon of water (spot treatment)</u> 13 mL (1/2 oz) GrazonNext HL 9.5 mL (1/3 oz) non-ionic surfactant
<u>Per acre</u> 0.5 oz Cimarron Plus 8 oz non-ionic surfactant	
<u>Per acre</u> 1.5 pints Remedy Ultra 3 pints 2, 4-D ester 8 oz non-ionic surfactant	<u>Per gallon of water (spot treatment)</u> 9.5 mL (1/3 oz) Remedy Ultra 19 mL (2/3 oz) 2,4-D ester 9.5 mL (1/3 oz) non-ionic surfactant
<u>Per gallon of water (spot treatment)</u> 57 mL (2 oz) Crossbow 9.5 mL (1/3 oz) non-ionic surfactant	

Autumn olive (*Elaeagnus umbellata*)

Best herbicide timing:
Late-spring through summer



Based on VT trials, multiple herbicides are effective on autumn olive including 2,4-D + dicamba, *Surmount*, *PastureGard HL*, and *Crossbow* (2,4-D + triclopyr). An additional option that should provide broad spectrum weed control and residual soil activity is *GrazonNext HL + Remedy*. *Cimarron* has been shown to be very ineffective on autumn olive. *Crossbow* is a popular brushy weed product, but not a good choice if residual control is desired. Apply herbicide from full leaf emergence through the flowering period. If the plant has been mown, wait 9-12 months before applying herbicide in order to maximize leaf area exposure to the treatment. Basal treatments can be effective.

<u>Per acre</u> 2.1 pints GrazonNext HL 1 pint Remedy Ultra 8 oz non-ionic surfactant	<u>Per gallon of water (spot treatment)</u> 13 mL (1/2 oz) GrazonNext HL 6.25 mL (1/4 oz) Remedy Ultra 9.5 mL (1/3 oz) non-ionic surfactant
<u>Per acre</u> 3 pints Surmount 8 oz non-ionic surfactant	<u>Per gallon of water (spot treatment)</u> 19 mL (2/3 oz) Surmount 9.5 mL (1/3 oz) non-ionic surfactant
<u>Per acre</u> 1.5 pints Remedy Ultra 3 pints 2, 4-D ester 8 oz non-ionic surfactant	<u>Per gallon of water (spot treatment)</u> 9.5 mL (1/3 oz) Remedy Ultra 19 mL (2/3 oz) 2,4-D ester 9.5 mL (1/3 oz) non-ionic surfactant
	<u>Per gallon of water (spot treatment)</u> 57 mL (2 oz) Crossbow 9.5 mL (1/3 oz) non-ionic surfactant

Basal bark treatment

1 part Remedy Ultra

3 parts diesel fuel or fuel oil

*Spray basal bark treatment to lower 15" of trunk

*Soak trunk until thoroughly wet but not to point of runoff

*If must apply to point of runoff, use 1 part *Remedy Ultra* to 20 parts diesel or fuel oil

Black Hawthorn (*Crataegus douglasii*)

Best herbicide timing:

Late-spring and early-summer



Multiple herbicides are labeled and effective on hawthorn including: *GrazonNext HL* + *Remedy Ultra*, *Cimarron Plus*, *PastureGard HL*, *Surmount*, and *Crossbow*. *GrazonNext HL* + *Remedy Ultra* or *Surmount* are probably the most economical and multi-purpose in a broadcast situation. Apply herbicide from full leaf emergence through the flowering period. If the plant has been mown, wait 9-12 months before applying herbicide in order to maximize leaf area exposure to the treatment.

Example applications:

<u>Per acre</u> 1.5 pints PastureGard HL 8 oz non-ionic surfactant	<u>Per gallon of water (spot treatment)</u> 9.5 mL (1/3 oz) PastureGard HL 9.5 mL (1/3 oz) non-ionic surfactant
<u>Per acre</u> 2.1 pints GrazonNext HL 1 pint Remedy Ultra 8 oz non-ionic surfactant	<u>Per gallon of water (spot treatment)</u> 13 mL (1/2 oz) GrazonNext HL 6.25 mL (1/4 oz) Remedy Ultra 9.5 mL (1/3 oz) non-ionic surfactant
<u>Per acre</u> 1.5 pints Remedy Ultra 3 pints 2, 4-D ester 8 oz non-ionic surfactant	<u>Per gallon of water (spot treatment)</u> 9.5 mL (1/3 oz) Remedy Ultra 19 mL (2/3 oz) 2,4-D ester 9.5 mL (1/3 oz) non-ionic surfactant
	<u>Per gallon of water (spot treatment)</u> 57 mL (2 oz) Crossbow 9.5 mL (1/3 oz) non-ionic surfactant

Sericea Lespedeza (*Lespedeza cuneata*)

Best herbicide timing:

Early bud stage (mid-summer); fall



Sericea lespedeza is a warm-season, perennial legume that sprouts in early-summer from underground crown buds. Frequent mowing, especially including a mowing late in the season, limits carbohydrate storage to reduce stand productivity the following year. Herbicide applications made in early-summer at the flower bud stage target herbicide to the crown and root system and deplete plant energy reserves. Additionally, a fall herbicide application suppresses crown bud formation that is responsible for the following year's growth.

Triclopyr or triclopyr-containing herbicides (e.g. generic triclopyr, *Remedy Ultra*, *PastureGard HL*, *Crossbow*) have been shown to be most effective on *Sericea lespedeza*, resulting in around a 75% reduction in weed density one year after treatment. Metsulfuron-containing products (e.g. *Cimarron Plus*, *Chisum*, *Chaparral*, generic metsulfuron) have been shown to be equally effective when applied in fall (but not in spring).

Example applications:

<u>Per acre</u> 1.5 pints PastureGard HL 8 oz non-ionic surfactant	<u>Per gallon of water (spot treatment)</u> 9.5 mL (1/3 oz) PastureGard HL 9.5 mL (1/3 oz) non-ionic surfactant
<u>Per acre</u> 2 pints Surmount 8 oz non-ionic surfactant	<u>Per gallon of water (spot treatment)</u> 12.5 mL (1/2 oz) Surmount 9.5 mL (1/3 oz) non-ionic surfactant
<u>Per acre</u> 0.5 oz Cimarron Plus 8 oz non-ionic surfactant	

Buckbrush, Devil's shoestring (*Symphoricarpos orbiculatus*)

Best herbicide timing:

Before tender new growth hardens off (spring); fall



Buckbrush is a perennial bush that sprouts from aggressive rhizomes. Target the plant and rhizomes through an early spring or fall herbicide application, followed by spot herbicide applications or mowing of any regrowth. For spring applications, spray after new leaves and stems emerge, but before new growth becomes woody. Because of its rhizomatous nature, it may take several years to get an infestation under control.

In university testing, the best results were obtained with a high rate of 2,4-D alone, or with a tankmix of *GrazonNext HL* + *Remedy Ultra*. Both options gave about 97% control when assessed 3 ½ months after treatment. If you are targeting weeds in addition to buckbrush—especially other perennials - *GrazonNext HL* + *Remedy* is probably the better choice. Because of the effectiveness of 2,4 D on buckbrush when it is young, many common pasture herbicides should be effective when boosted with 2,4-D. For example, *GrazonNext HL* & 2,4-D has shown good results.

Example applications:

<u>Per acre</u>	<u>Per gallon of water (spot treatment)</u>
2.1 pints GrazonNext HL	13 mL (1/2 oz) GrazonNext HL
1 pint Remedy Ultra	6.25 mL (1/4 oz) Remedy Ultra
8 oz non-ionic surfactant	9.5 mL (1/3 oz) non-ionic surfactant

<u>Per acre</u>	<u>Per gallon of water (spot treatment)</u>
4 pints 2,4-D ester	25 mL (3/4 oz) 2,4-D ester
8 oz non-ionic surfactant	9.5 mL (1/3 oz) non-ionic surfactant

Queen Anne's Lace, Wild Carrot (*Daucus carota*)

Best herbicide timing:

Seedling or rosette stage (spring, summer, & fall of first year)



Queen Anne's Lace is a biennial weed that germinates in *spring*, develops a rosette (shown in middle above) and taproot the first summer, dies back to the taproot over winter, and flowers the following summer before dying. The first leaves to emerge look similar to a grass seedling; followed by leaves that can appear similar to a fern. Target the plant during the seedling and rosette stages the first summer; it is very easy to kill during the rosette stage with any broadleaf herbicide. During the second year it is best to mow-off the flower stalks since there is limited leaf area on mature plants to take in herbicide—you may still need to apply herbicide to control the younger generation of seedling plants. Preventing seed production is an important management tool since each Queen Anne's Lace plant can produce around 4,000 seeds.

In university testing, good results were obtained with 2,4-D + dicamba, *Chaparral*, *Crossbow*, and *Cimarron Plus*- all providing about 85-100% control. *Surmount* and *GrazonNext HL* showed 75-85% control but would do well in most cases to address additional weed species and to control later weed flushes. Hay situations would achieve best results with a 2,4-D + dicamba tankmix.

Example applications:

<u>Per acre</u> 12 oz DuraCor 8 oz non-ionic surfactant	<u>Per gallon of water (spot treatment)</u> 5 mL (2/10 oz) DuraCor 9.5 mL (1/3 oz) non-ionic surfactant
<u>Per acre</u> 2.5 pints 2,4-D ester 8 oz dicamba 8 oz non-ionic surfactant	<u>Per gallon of water (spot treatment)</u> 16 mL (1/2 oz) 2,4-D 3 mL (1/10 oz) dicamba 9.5 mL (1/3 oz) non-ionic surfactant
<u>Per acre</u> 2.5 oz <i>Chaparral</i> 8 oz non-ionic surfactant	

Stickweed

(*Verbesina occidentalis*)

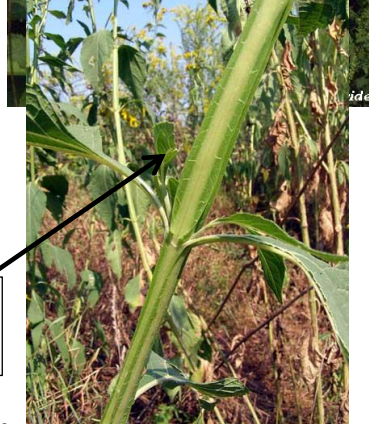


All 3 species possess “wings” that run along the stems

Best herbicide timing:
early bud stage (early summer)

Wingstem

(*Verbesina alternifolia*)



Ironweed

(*Vernonia noveboracensis*)



Stickweed, wingstem, and ironweed are similar species from the same family that are commonly referred to interchangeably. Their life cycle and growth form is very similar, and they are managed similarly as well. All species are large (6- 12 feet tall) perennials that sprout new plants annually from a large, underground crown. Target the plant during the early-bud stage in early-summer. You may spray regrowth following mowing or seasonal fall regrowth after the plant reaches about 2-3 feet in height.

In university testing, good results were obtained with numerous herbicides including: *Crossbow*, 2,4-D + dicamba, *Surmount*, and *GrazonNext HL*. The least expensive option will most likely be 2,4-D + dicamba but the best would be *Surmount* or *GrazonNext HL*.

Example applications:

<u>Per acre</u>	<u>Per gallon of water (spot treatment)</u>
2.1 pints GrazonNext HL	13 mL (1/2 oz) GrazonNext HL
8 oz non-ionic surfactant	9.5 mL (1/3 oz) non-ionic surfactant

<u>Per acre</u>	<u>Per gallon of water (spot treatment)</u>
2.5 pints 2,4-D ester	16 mL (1/2 oz) 2,4-D ester
8 oz dicamba	3 mL (1/10 oz) dicamba
8 oz non-ionic surfactant	9.5 mL (1/3 oz) non-ionic surfactant

Plantain species

Best herbicide timing: late-spring or fall

Buckhorn (*Plantago lanceolata*)

Broadleaf (*Plantago major*)



Broadleaf and buckhorn plantains are perennial weeds with dense clumps of leaves that grow close to the ground; they also form a taproot. Although the plant itself will send up new shoots from its crown year after year, it spreads mainly by seed. Most of these seeds germinate in spring or early fall, and unlike many seeds that require light as a trigger to germinate, plantains can germinate and establish even in a thick stand of grass. They tend to do well in compacted soils and tolerate close mowing or grazing.

Target the mature plant during spring prior to flowering, or in fall. This will also target seedlings. University testing shows that good results can be obtained with many of the common pasture herbicides including *Cimarron Plus*, *Crossbow*, *Chaparral*, *PastureGard HL*, *Surmount*, and 2,4-D alone or with dicamba. *GrazonNext HL* has shown reduced control when compared to the above-mentioned herbicides.

Example applications:

<u>Per acre</u>	<u>Per gallon of water (spot treatment)</u>
2.5 pints 2,4-D ester	16 mL (1/2 oz) 2,4-D ester
8 oz dicamba	3 mL (1/10 oz) dicamba
8 oz non-ionic surfactant	9.5 mL (1/3 oz) non-ionic surfactant

<u>Per acre</u>	<u>Per gallon of water (spot treatment)</u>
12 oz DuraCor	5 mL (2/10 oz) DuraCor
8 oz non-ionic surfactant	9.5 mL (1/3 oz) non-ionic surfactant

Yucca (*Yucca filamentosa*)

Best herbicide timing: Late-spring and early-summer



Yucca is a tall perennial weed with thick underground rootstocks. Effective control can be obtained by spot treatment with a triclopyr + diesel fuel mixture.

Example applications:

<p>(Spot treatment) 2.5 oz Remedy Ultra 1 gallon diesel fuel</p>

Biennial thistles

Best herbicide timing: fall or early-spring (seedling or rosette stage)

Bull thistle
(*Cirsium vulgare*)



Musk thistle
(*Carduus nutans*)



Plumeless thistle
(*Carduus acanthoides*)



There are many thistle species. With the exception of Canada thistle, most are biennial and are managed similarly. The three shown on this page are some of the most common species. Biennial thistles spread only by seed, which can germinate from fall through spring and early summer. The first year is spent as a seedling rosette, the plant then overwinters as a rosette prior to shooting a flowering stalk (bolting) in summer. Target the plant during the rosette stage in fall or spring. Most broadleaf herbicides are effective on biennial thistles when applied in the rosette stage. Timing is critical as control declines sharply once bolting begins.

Example applications:

<u>Per acre</u>	<u>Per gallon of water (spot treatment)</u>
2.1 pints GrazonNext HL	13 mL (1/2 oz) GrazonNext HL
8 oz non-ionic surfactant	9.5 mL (1/3 oz) non-ionic surfactant

<u>Per acre</u>	<u>Per gallon of water (spot treatment)</u>
2.5 pints 2,4-D ester	16 mL (1/2 oz) 2,4-D ester
8 oz dicamba	3 mL (1/10 oz) dicamba
8 oz non-ionic surfactant	9.5 mL (1/3 oz) non-ionic surfactant

Canada Thistle (*Cirsium arvense*)

Best herbicide timing:

Early-bud stage (June-August) and fall



Jan Samanek



Canada is a thorny perennial that sprouts from spreading rhizomes (underground stems) and can form large colonies. Unlike the biennial thistles which should be sprayed when small, Canada thistle should be targeted after they have reached about $\frac{3}{4}$ of their maximum height- around the early-bud stage. The goal in controlling Canada thistle is to deliver herbicides to roots and rhizomes and to expend energy reserves through subsequent regrowth. Fall can also be a good time to spray Canada thistle as it sends sugars (and herbicides) to belowground storage organs.

Example applications:

<u>Per acre</u>	<u>Per gallon of water (spot treatment)</u>
2.1 pints GrazonNext HL	13 mL (1/2 oz) GrazonNext HL
1 pint 2,4-D ester	6.25 mL (1/4 oz) 2,4-D ester
8 oz non-ionic surfactant	9.5 mL (1/3 oz) non-ionic surfactant

<u>Per acre</u>
3 oz Chaparral
8 oz non-ionic surfactant

<u>Per acre</u>	<u>Per gallon of water (spot treatment)</u>
1 pint Remedy Ultra	6.25 mL (1/4 oz) Remedy Ultra
3 pints 2, 4-D ester	19 mL (2/3 oz) 2,4-D ester
8 oz non-ionic surfactant	9.5 mL (1/3 oz) non-ionic surfactant

<u>Per gallon of water (spot treatment)</u>
47 mL (1.5 oz) Crossbow
9.5 mL (1/3 oz) non-ionic surfactant

Spiny Amaranth, Spiny pigweed (*Amaranthus spinosus*)

Best herbicide timing:

Seedling stage (throughout summer)



Spiny amaranth is a summer annual weed that thrives in bare or high traffic areas of pasture and hay. Each plant is capable of producing over 100,000 seeds per plant, so preventing seed production is an important management tool. Seeds germinate throughout summer. Seeds are sensitive to burial- burial to as little as 1/4" will stop most seeds from germinating.

Target the plant during the seedling stage throughout summer. It is easy to kill with most broadleaf herbicides when less than about 4" tall. Control becomes difficult as plant size increases. Additionally, one application of a residual chemical is not always dependable since seeds can germinate all summer. University testing has shown multiple herbicides to be effective on plants in the 6-20" range including dicamba, *Cimarron Plus*, *Chaparral*, *Surmount*, and *GrazonNext HL*. Applying 2,4-D alone is generally not effective. Due to the likely necessity of repeated applications, an inexpensive option such as dicamba or *Cimarron Plus* is probably the best choice if other weed issues are not being targeted.

Example applications:

<u>Per acre</u> 0.3 oz Cimarron Plus 8 oz non-ionic surfactant	
<u>Per acre</u> 1 pint dicamba 8 oz non-ionic surfactant	<u>Per gallon of water (spot treatment)</u> 6.25 mL (1/4 oz) dicamba 9.5 mL (1/3 oz) non-ionic surfactant
<u>Per acre</u> 2.5 pints 2,4-D ester 8 oz dicamba 8 oz non-ionic surfactant	<u>Per gallon of water (spot treatment)</u> 16 mL (1/2 oz) 2,4-D ester 3 mL (1/10 oz) dicamba 9.5 mL (1/3 oz) non-ionic surfactant

Dock species

Best herbicide timing: late-spring or fall

Curly (*Rumex crispus*)



Broadleaf (*Rumex obtusifolius*)



These are taprooted perennials that form dense rosettes. Although the plant will send up new shoots every year, it spreads mainly by seed. Most seeds germinate spring through fall.

Target the mature plant during late spring prior to flowering, or in fall. This will also target seedlings. University testing shows that good results can be obtained with many herbicides including *Cimarron Plus*, *Crossbow*, *GrazonNext HL*, *Surmount*, dicamba, or 2,4-D + dicamba. Additionally, *Chaparral* and *PastureGard HL* list control of dock on the label.

Example applications:

<u>Per acre</u>	<u>Per gallon of water (spot treatment)</u>
2.1 pints GrazonNext HL	13 mL (1/2 oz) GrazonNext HL
8 oz non-ionic surfactant	9.5 mL (1/3 oz) non-ionic surfactant
<u>Per acre</u>	
0.3 oz Cimarron Plus	
1 pint 2,4-D ester	
8 oz non-ionic surfactant	
<u>Per acre</u>	<u>Per gallon of water (spot treatment)</u>
2.5 pints 2,4-D ester	16 mL (1/2 oz) 2,4-D ester
8 oz dicamba	3 mL (1/10 oz) dicamba
8 oz non-ionic surfactant	9.5 mL (1/3 oz) non-ionic surfactant

Burdock (*Arcticum minus*)

Best herbicide timing: fall or early spring (seedling or rosette stage)



Burdock is a biennial that forms a large rosette the first year and a large upright plant the second year. Although technically a biennial, it may take more than two years to flower. It has a large, fleshy taproot. Reproduction is by seed that usually germinates in early-spring.

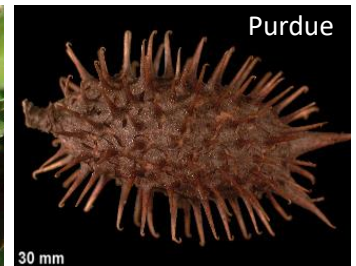
Target the plant during the first year rosette stage, or the following year prior to bolting (emergence of reproductive stem). Herbicides that have been shown to be effective on burdock include: *Crossbow*, 2,4-D alone or with dicamba, and *GrazonNext HL*. *PastureGard HL*, *Surmount*, and *Chaparral* are also labeled for burdock.

Example applications:

<u>Per acre</u> 2.1 pints GrazonNext HL 8 oz non-ionic surfactant	<u>Per gallon of water (spot treatment)</u> 13 mL (1/2 oz) GrazonNext HL 9.5 mL (1/3 oz) non-ionic surfactant
<u>Per acre</u> 2.5 pints 2,4-D ester 8 oz dicamba 8 oz non-ionic surfactant	<u>Per gallon of water (spot treatment)</u> 16 mL (1/2 oz) 2,4-D ester 3 mL (1/10 oz) dicamba 9.5 mL (1/3 oz) non-ionic surfactant
<u>Per acre</u> 1 pint Remedy Ultra 2.0 pints 2, 4-D ester 8 oz non-ionic surfactant	<u>Per gallon of water (spot treatment)</u> 6.25 mL (1/4 oz) Remedy Ultra 12.5 mL (1/2 oz) 2,4-D ester 9.5 mL (1/3 oz) non-ionic surfactant
<u>Per gallon of water (spot treatment)</u> 19 mL (3/4 oz) Crossbow 9.5 mL (1/3 oz) non-ionic surfactant	

Cocklebur (*Xanthium strumarium*)

Best herbicide timing: spring & summer (seedling stage)



Cocklebur is a summer annual with a thick, woody taproot. Reproduction is by seed that germinate in early-spring through summer.

Target the plant during the seedling stage – the smaller the plant, the easier it is to kill. Most common broadleaf herbicides are reported to be highly effective on cocklebur. Crossbow, 2,4-D alone or with dicamba will probably be the most practical to select, since cocklebur usually occurs in isolated patches conducive to spot-spraying. The use of products with residual activity such as *GrazonNext HL* would help to prevent future flushes of cocklebur in-season.

Example applications:

<u>Per acre</u> 2.1 pints GrazonNext HL 8 oz non-ionic surfactant	<u>Per gallon of water (spot treatment)</u> 13 mL (1/2 oz) GrazonNext HL 9.5 mL (1/3 oz) non-ionic surfactant
<u>Per acre</u> 2.5 pints 2,4-D ester 8 oz dicamba 8 oz non-ionic surfactant	<u>Per gallon of water (spot treatment)</u> 16 mL (1/2 oz) 2,4-D ester 3 mL (1/10 oz) dicamba 9.5 mL (1/3 oz) non-ionic surfactant
<u>Per acre</u> 1 pint Remedy Ultra 2.0 pints 2, 4-D ester 8 oz non-ionic surfactant	<u>Per gallon of water (spot treatment)</u> 6.25 mL (1/4 oz) Remedy Ultra 12.5 mL (1/2 oz) 2,4-D ester 9.5 mL (1/3 oz) non-ionic surfactant
<u>Per gallon of water (spot treatment)</u> 19 mL (3/4 oz) Crossbow 9.5 mL (1/3 oz) non-ionic surfactant	

Common Mullein (*Verbascum thapsus*)

Best herbicide timing: fall or early spring (seedling or rosette stage)



Common mullein is a biennial that forms a large rosette the first year and a tall upright stem the second year. It has a large taproot. Reproduction is by seed that usually germinates in late-summer, early-fall, or spring.

Target the plant during the first year rosette stage, or the following year prior to bolting (emergence of reproductive stem). Mullein is difficult to kill. University testing has shown best control with metsulfuron (*Cimarron*) followed by picloram (*Grazon P+D*), and aminopyralid (*GrazonNext HL* or *Milestone*).

Example applications:

<p><u>Per acre</u> 0.5 oz Cimarron Plus 8 oz non-ionic surfactant</p>
--

<p><u>Per acre</u> 2.5 oz Chaparral 8 oz non-ionic surfactant</p>
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Brambles: dewberries, blackberries, etc. (Rubrus spp.)

Best herbicide timing:

Pre bloom & early bloom, or after fruit drop



Assorted species are referred to as brambles. They are perennial, spreading by root sprouts, rhizomes, or rooting aboveground stems, in addition to seed. All species are difficult to control. Plants should be sprayed in the pre-bloom to early-bloom stages, or after fruit drop. The best control is achieved when applications are made to unmowed plants.

In university testing, *Crossbow*, *Surmount*, and metsulfuron-containing (e.g. *Cimarron Plus*, *Chaparral*) products achieved 75-80% control. GrazonNext HL has shown less than 55% control. *PastureGard HL* should provide acceptable control but is probably less cost-effective for use on brambles due to the high rates required.

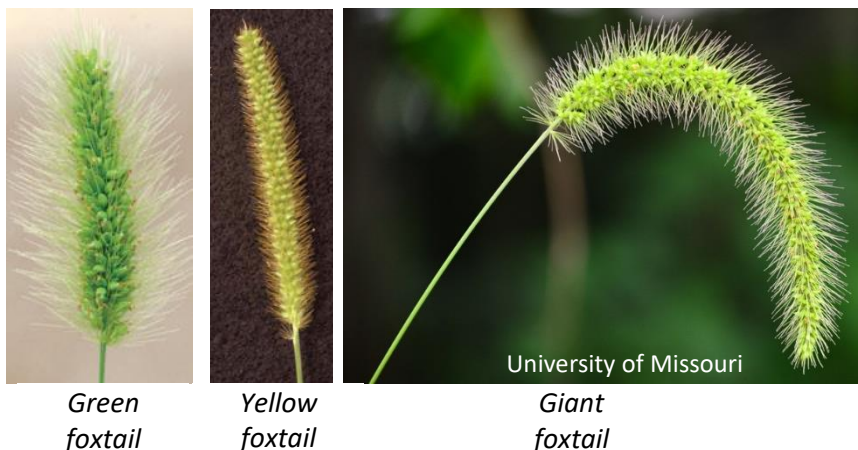
Example applications:

<u>Per acre</u> 2 pints 2,4-D ester 1 pint dicamba 8 oz non-ionic surfactant	<u>Per gallon of water (spot treatment)</u> 12.5 mL (1/2 oz) 2,4-D ester 6.25 mL (1/4 oz) dicamba 9.5 mL (1/3 oz) non-ionic surfactant
<u>Per acre</u> 3 pints Surmount 8 oz non-ionic surfactant	<u>Per gallon of water (spot treatment)</u> 19 mL (2/3 oz) Surmount 9.5 mL (1/3 oz) non-ionic surfactant
<u>Per acre</u> 1.5 pints Remedy Ultra 3 pints 2, 4-D ester 8 oz non-ionic surfactant	<u>Per gallon of water (spot treatment)</u> 9.5 mL (1/3 oz) Remedy Ultra 19 mL (2/3 oz) 2,4-D ester 9.5 mL (1/3 oz) non-ionic surfactant
<u>Per gallon of water (spot treatment)</u> 57 mL (2 oz) Crossbow 9.5 mL (1/3 oz) non-ionic surfactant	

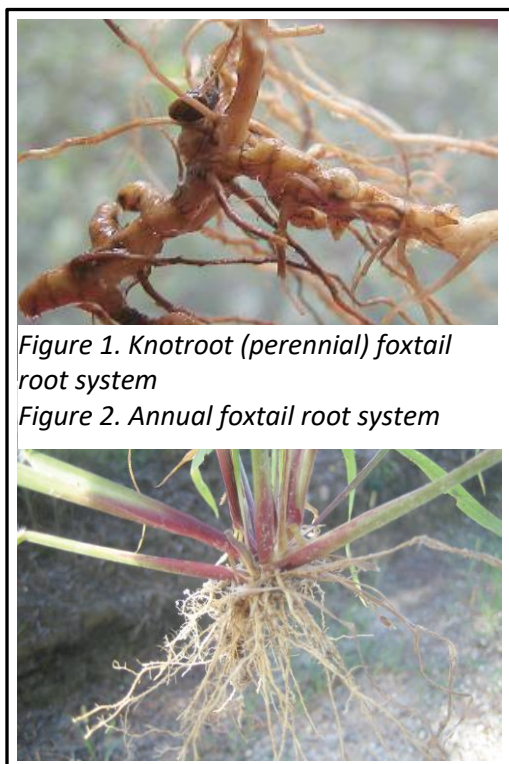
Foxtails species (*Setaria spp.*)

Best herbicide timing:

Very early spring with preemergent herbicides, or immediately following first cutting with postemergent herbicide



Two herbicide options are available for controlling annual foxtail species in grass hay. These options have been the subject of on-farm herbicide trials in the Shenandoah Valley, as well as state trials by the Extension weed specialist at Virginia Tech. It has taken a few years to get a feel for what herbicide approaches offer consistent control and can provide hay growers confidence that their herbicide dollars are being well spent. This paper seeks to summarize the applicable findings of this work.



To understand foxtail control, you must first understand some things about the identification and biology of foxtail. While the subject of this paper is annual foxtails, a perennial version of foxtail (known as knotroot foxtail) exists. It is not susceptible to the herbicides discussed here. We aren't sure how prevalent knotroot foxtail is, so just be of aware of it as you evaluate your fields. The most noticeable difference between perennial and annual foxtail will be the presence of knotty rhizomes (Fig.1) in addition to the normal fibrous root system. The annual foxtails will only possess the fibrous root system (Fig 2). Knotroot foxtail would also set seed in early summer rather than late summer.

There are three common types of annual foxtails: yellow, green, and giant. From a biology and control standpoint they are identical, though the plants and seedhead look different.

Life cycle: Annual foxtails germinate whenever the ground temperature reaches about 60°F - around mid-March or later depending on your location. There is also a light requirement for germination, basically, a biological sensor that “tells” the seed there is enough of an opening for the plant to thrive if it germinates. The presence and density of the hay stand will therefore influence germination. Seedlings may not emerge until the first hay cutting is removed.

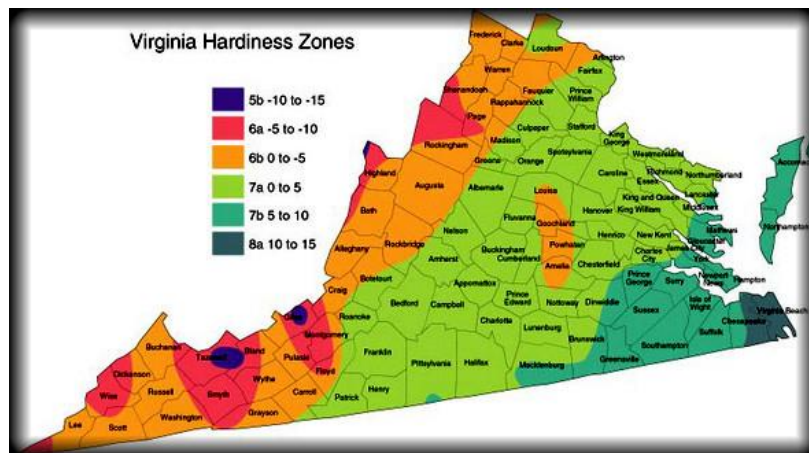
Germination time may vary, however, seedheads will not show up until late-summer. Once foxtail has germinated it will most likely end up going to seed, regardless of if it is mowed or not. Mowing prior to the presence of seedheads may make the foxtail regrowth shorter, and may reduce seed production, but the plant will still seed out. The one exception is a foxtail plant that experiences a killing frost prior to seed production.



Foxtail pressure in any given field seems to be unpredictable at times. A seed-producing stand of foxtail in previous years is a good bet that it will be present again, but experience has shown this is not always the case. It is thought the reasons for this relate to year-to-year variation in germination date, late-spring frosts, and hay competitiveness. Therefore, it can be difficult to evaluate the success of herbicides and application timing without a scientific approach using untreated control areas.

The two herbicides labeled for foxtail control in hay are *pendimethalin* ('Prowl H₂O') and *quinclorac* ('Facet L' or 'QuinStar'). They work differently and require different control strategies.

Pendimethalin is almost entirely dependent on preemergence activity to control weeds. It provides about 4-6 weeks of control per quart applied. Not only must it be applied prior to



foxtail germination, it must also reach the soil and be watered-in to be effective. A dense canopy of hay can inhibit *pendimethalin* from reaching the ground, a scenario which can make spring applications a challenge. Higher spray volumes and selecting nozzles that producer coarse droplets (such as air-induction tips) should help some with this. Applying

pendimethalin later in spring – after the first cutting for example – can often fail because foxtail may have already germinated. Lack of rain following first cutting is another cause of concern with late-spring applications. The only strategy which has consistently worked has been to apply 3-4 quarts/acre ‘*Prowl H₂O*’ in early-spring – typically mid-March to early-April in zone 6b of the USDA plant hardiness zone. Other areas of Virginia may be up to several weeks later or earlier.

In 2017 Virginia Tech trials, 4 quarts of ‘*Prowl H₂O*’ applied in early-spring provided up to 90% control in late-summer evaluations. Where foxtail pressure was very high, the rate of control was less (as low as 55%). While other rates and application dates work in theory, they have not worked as well in practice. In central and western Virginia, on-farm demonstrations and discussions with early-adopters of *pendimethalin* have shown mixed results with 2 quarts of ‘*Prowl H₂O*’ applied in early-spring. Similarly, *pendimethalin* applied immediately after the first hay cutting either as a standalone application or as part of a split-application, have not shown consistent results. Additional research and on-farm trials are trying 3 quarts of ‘*Prowl H₂O*’ in early-spring of 2018; we are awaiting reports of their efficacy this summer. ‘*Prowl H₂O*’ currently retails for around \$12/quart. A generic, aqueous version of *pendimethalin*, named ‘*Satellite HydroCap*’ also has a supplemental label for hay and pasture, and seems to run slightly less expensive than ‘*Prowl H₂O*’.

Quinclorac has both preemergence and postemergence activity to control weeds. It is therefore a good fit for applying after the first cutting of hay, since there may exist foxtail pressure ranging from un-germinated seeds to multiple-leaf seedlings. In both university trials and on-farm demonstrations, quinclorac has shown good results. **A 2017 Virginia Tech trial showed near 90% control at late-summer evaluations from 1 quart per acre of ‘*Facet L*’ applied immediately after the first hay cutting.** Tankmixing ‘*Prowl H₂O*’ with ‘*Facet L*’ provided no improvement over ‘*Facet L*’ alone. ‘*Facet L*’ is a liquid formulation which retails for about \$30/quart. A generic, dry-flowable version of *quinclorac*, named ‘*QuinStar*’, is available at about two-thirds the cost of ‘*Facet L*’.

Caution should be used when applying *quinclorac* on orchardgrass under stress, as crop injury can occur. Stress is increased by hot, dry weather during or immediately following herbicide application. The risk is inherently intensified by the requirement to add crop oil or MSO to *quinclorac* to achieve the required efficacy on foxtail. A 2017 Virginia Tech research trial looked at orchardgrass stunting by 'Facet L' and found season-long stunting of 10-15% after an herbicide application in late-May. Our recommendation is to use 'Facet L' only after a *true* first cutting taken prior to mid-June, and only if moisture and temperature conditions are favorable for orchardgrass growth and recovery. Do not mix fertilizer with the herbicide. Avoid applying to a new stand of orchardgrass. Lastly, to get optimal postemergence efficacy on foxtail, make sure any quinclorac application is followed by the appropriate rain-fast period specified by the label.

Summary

At this point, it appears that 0.375 pounds of the active ingredient *quinclorac* per acre (**1 quart 'Facet L' or 8 oz. 'QuinStar' per acre**) applied immediately after first cutting is the most reliable control strategy. Both 'Facet L' and 'QuinStar' need to be tankmixed with a crop oil or methylated seed oil. *Pendimethalin*, while effective, has been more variable, but somewhere between **3 to 4 quarts of 'Prowl H₂O' /acre** applied in early spring should provide 75-80% control. Because the cost of any of these treatments may approach \$50/acre, they are likely only economical for premium horse hay markets. Even with herbicide treatment, it is very possible that some foxtail will still be present in late-summer hay. Many producers have asked how long it would take to eliminate the foxtail seedbank from a field. Its likely most foxtail seed is viable in the soil for 2-3 years, so controlling seed production for several years will likely be required. Hay equipment can easily carry foxtail seed from field to field, so be aware of this. Included below is some information geared toward buyers of hay, it may be a good idea to share this with your customers.

Example applications:

Per acre

1 quart 'Facet L' (immediately following first cutting)
2 pints crop oil concentrate (COC) or 1-2 pints methylated seed oil (MSO)

Per acre

8 oz 'QuinStar' (immediately following first cutting)
2 pints crop oil concentrate (COC) or 1-2 pints methylated seed oil (MSO)

Per acre

4 quarts 'Prowl H₂O' (early spring)

FOR THE HAY CUSTOMER: What to expect with foxtail and your hay

Recently, two herbicide options have become available for offering some level of control of foxtail in hay and pasture. Here is what you should know about them and how they may affect the hay you purchase and the price you pay.

First of all, foxtail is a warm-season, annual weed. It is geared to complete its entire life-cycle between the time it germinates in spring and the time it sets seed in late summer. What this means is that foxtail is fast growing, hard-to-control, and resilient in the face of efforts to stop it from going to seed. For example, I have mowed foxtail plants weekly in my yard – only to have them produce seed as 4 inch-tall plants at the end of the season.

Now that we have some herbicide options foxtail control should be easy, right? Not exactly. Farmer's efforts to control foxtail are hampered by several aspects of foxtail biology. Foxtail seed can germinate all spring and summer long, so an herbicide applied preventatively in April may run out steam by mid-summer. Herbicides targeted at emerged plants are only effective on foxtail plants less than about 3 inches tall, so some herbicide applications may catch foxtail when it has grown beyond the susceptible, seedling stage. To make matters more difficult, farmers can only apply herbicides before hay growth starts in spring, or after hay is made and removed from the field– that leaves a lot of time in between for foxtail to grow. Lastly, a *lack* of rain to activate the chemical can cause failure in the case of one of the herbicide options, while rain *following* application will cause failure in the case of the other herbicide option.

With excellent timing and a lot of luck, farmers should be able to reduce the amount of foxtail in late-season hay by 50-90% (remember, foxtail only seeds in late-summer cuttings- not spring cuttings). However, it is important to realize that the timing of foxtail emergence and the variable weather from month to month can wreak even the best plan. Success or not, farmer's attempts to control foxtail will cost them a lot of money. Including time, equipment, and herbicides, the cost of an attempted control will run somewhere around \$60-\$70/acre.

Everything else being equal, you should expect to pay more for reduced-foxtail blade hay, and significantly more for perfect, foxtail-free blade hay. It may be worth a conversation with your vet about how much foxtail constitutes a real risk to your horse. It may be that a small amount of foxtail in your hay can be avoided by your horse and causes no real risk. If you cannot tolerate any foxtail in your hay, that's fine – but you should be prepared to pay significantly more for it. I've spoken with many hay producers who are frustrated by their honest efforts to control foxtail, and the costs they incur in doing so. I encourage you to work with (and compensate) your hay grower so that they can put in the time and technology to improve the product for you.

Perilla Mint (*Perilla frutescens*)

Best herbicide timing:

Mid- summer

Biology

Perilla mint (*Perilla frutescens*)—also known as beefsteak plant or purple mint—is a member of the mint family. It is an erect, bushy, herbaceous annual that grows to an average height of 2 feet or more at maturity. The plant gives off a distinctive minty odor when stems and leaves are



Perilla mint in the vegetative stage (Univ.of Missouri)



Perilla mint varies in leaf shape and color (Invasive.org)

crushed. Additionally, perilla mint has a square stem, which is typical of species in mint family. It grows best in moist shady areas, but is also very capable of growing in open pasture field edges, and barn lots.

Being an annual, reproduction is by seed, which can be as much as 1,500 seeds per plant. Seed dispersal is through seedfall, wildlife, or surface water movement. Late-season hay, and mowing/bushhogging equipment are likely transport mechanisms across farms and fields. Seed readily germinates in highly disturbed areas, and can remain viable after lying dormant for 4 years or more. It's adaptability to shady conditions allows perilla mint to spread—often unnoticed—through forest and wooded field edges. These areas become a refuge for the invading population, and create a seed source that enables continual invasion into pastures.

Toxicity

All stages of both the green and dried plant are toxic to ruminants and to horses, with the highest concentration of toxins found in flowers and seeds. Cases of poisoning are a concern during the late summer and early fall when forages might be in short supply and perilla mint is prominent and flowering. Livestock will normally not feed on perilla mint unless there is a shortage of other feed. There is not much research exploring the lethal dose of perilla mint. One of the few studies on the subject found a wide variation in the amount of perilla mint required to produce toxicosis in cattle. The lethal dose of green, seed-stage perilla mint in this study ranged from 3-17% of bodyweight consumed over a period ranging from 1-10 days, with some individuals never developing clinical signs after 15 days of consumption. According to the Merck Veterinary Manual (9th edition):

“Perilla ketone toxicity is caused by a pneumotoxin. Signs occur 2-10 days after exposure and include dyspnea (especially on exhaling), open-mouth breathing, lowered head, reluctance to

move, and death on exertion. Lesions include pulmonary emphysema and edema. Treatment is ineffective once clinical signs are severe. Parenteral steroids, antihistamines, and antibiotics may help. Gentle handling helps prevent exertion and death.”



Perilla mint in seed set (Doug Horn)

Control

As an annual plant, perilla mint must germinate from seed each year. It does not possess underground, perennial structures to allow it to overwinter. Perilla mint germination can begin whenever soil temperatures reach 60°F and can persist all summer. West of the Blue Ridge, germination may begin as early as late-April. Because annual weeds are easiest to kill in the early vegetative stages of development, conventional spray strategies for annuals often apply a residual herbicide in early summer. However, the long germination period of perilla mint has

been shown to result in poor season-season long control once residual chemicals disintegrate (the efficacy of residual chemicals can vary from several weeks to a couple months).



Perilla mint in flower (Univ. of Missouri)

Since university studies have shown that perilla mint can be effectively killed through the late-vegetative stages with a number of herbicides, it may be best to postpone spraying until mid-summer when more plants have emerged. For some producers the weed competition incurred during this waiting period may be unacceptable, in which case a combination of mowing and spraying, or multiple spray applications is an option. Mowing can reduce both plant height and seed production, but will not kill the plant. Controlling seed production is critical to stopping the spread of perilla mint, and should be an important part of any decision. The following are example applications of effective herbicides for control of perilla mint:

Example herbicide options

<u>Per acre</u>	<u>Per gallon of water (spot treatment)</u>
2.5 pints 2,4-D ester	16 mL (1/2 oz) 2,4-D ester
8 oz dicamba	3 mL (1/10 oz) dicamba
8 oz non-ionic surfactant	9.5 mL (1/3 oz) non-ionic surfactant

<u>Per acre</u>	<u>Per gallon of water (spot treatment)</u>
2.1 pints GrazonNext HL	13 mL (1/2 oz) GrazonNext HL
8 oz non-ionic surfactant	9.5 mL (1/3 oz) non-ionic surfactant

Other management considerations

When conditions such as drought or overgrazing limit the supply of pasture, it is crucial to ensure plenty of quality hay or other feed is available for livestock. If perilla mint is abundant on the farm, it would be wise to designate one fall pasture in which livestock will be fed in the event of drought, and intensively eradicate the perilla mint in that field. This may require spraying or spraying plus mowing, but be sure to begin control well in advance of confining animals in the field since wilted plants are often more palatable to livestock. Researchers have noted that perilla mint can commonly remain in a wilted stage for up to a month.

Perilla mint look-alikes

Several common species are abundant in the same forested areas and field edges preferred by perilla mint, and they look—and even smell—similar to perilla mint in the vegetative stages. They can be easily misidentified, however, they do not possess the toxicity of perilla mint.



White vervain (University of Minnesota)



White vervain (*Verbena urticifolia*) is an annual or biennial with leaves that look similar to perilla mint and are also opposite one another on the stem. It can also have a square stem, but lacks a minty smell. Its seedheads are long spikes of tiny white flowers, which is very different from perilla mint.



Horse balm (National Gardening Assoc.)

Horse balm (*Collinsonia canadensis*) is a perennial with leaves that look similar to perilla mint and are also opposite one another on the stem. It has a square stem, and the crushed foliage often has the distinct smell of lemon or citronella. The seedhead is a terminal cluster of yellow flowers.



Catnip. (Kansas Native Plant Assoc.)

Catnip (*Nepeta cataria*) is a perennial weed similar in appearance to perilla mint. Both have a square stem; similarly-shaped, opposite leaves; and a minty odor. One major way in which catnip differs from perilla mint is that its leaves are densely hairy. Catnip may also develop rhizomes as it ages.

Japanese stiltgrass (*Microstegium veminium*)

Best herbicide timing:
Mid- to late spring



Japanese stiltgrass is an annual, invasive grass weed. It is most abundant in moist, shady, and forested areas; but can also be found in pastures, field edges, and barn lots.

It can grow up to 2 feet tall, but usually falls over, rooting at the plant nodes and forming a prostrate mat of vegetation that can choke out desirable plants. The seed is dispersed by wildlife and water movement, and readily spreads into disturbed areas, so controlling seed production is important.

It is best to time spray applications when the majority of plants are around 12" tall to ensure that most of the year's seed germination has occurred by the time of spraying.

A 2017 study by Virginia Tech showed *Chaparral* applied late post-emergence (applied in June to 12" stiltgrass) achieved around 95% control 3 months after treatment. Conversely, less than 60% control was achieved when spraying of *Chaparral* was done in early spring to seedling stiltgrass plants. Aminopyralid, one of the ingredients in *GrazonNext HL*, showed 80% control in latepost-emergence applications. Both *Chaparral* and *GrazonNext HL* are labelled for use in pasture. In forested settings, *Segment* herbicide provides a grass-selective option that will not harm broadleaf trees and herbaceous plants.

Example applications:

<u>Per acre</u>	<u>Per gallon of water (spot treatment)</u>
2.1 pints GrazonNext HL	13 mL (1/2 oz) GrazonNext HL
8 oz non-ionic surfactant	9.5 mL (1/3 oz) non-ionic surfactant

<u>Per acre</u>
2.5 oz Chaparral
8 oz non-ionic surfactant

Jointhead arthraxon or small carpetgrass (*Arthraxon hispidus*)

Best herbicide timing:
mid-Summer



Jointhead arthraxon, also called small carpetgrass, is an annual, invasive grass weed. It thrives in sunny, moist areas. Identifying features include a smooth hairless stem and clasping leaves with hairy margins. It can form 1-2' tall, carpet-thick stands in pastures and hayfields, which can choke out desirable plants. Carpetgrass seeds can germinate throughout summer, so timing herbicide applications in mid-to-late summer will offer a better chance of controlling plants without subsequent germination occurring. Controlling seed production is an important to minimizing future problems.

In the few studies that exist on herbicides for carpetgrass, the active ingredients aminopyralid and metsulfuron seem to offer the some control. GrazonNextHL or Milestone would provide aminopyralid, but its effectiveness is variable on carpetgrass. Chaparral contains both aminopyralid and metsulfuron, and limited anecdotal observations have shown decent success on carpetgrass.

Example applications:

<u>Per acre</u> 2.1 pints GrazonNext HL 8 oz non-ionic surfactant
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<u>Per acre</u> 2.5 oz Chaparral 8 oz non-ionic surfactant
