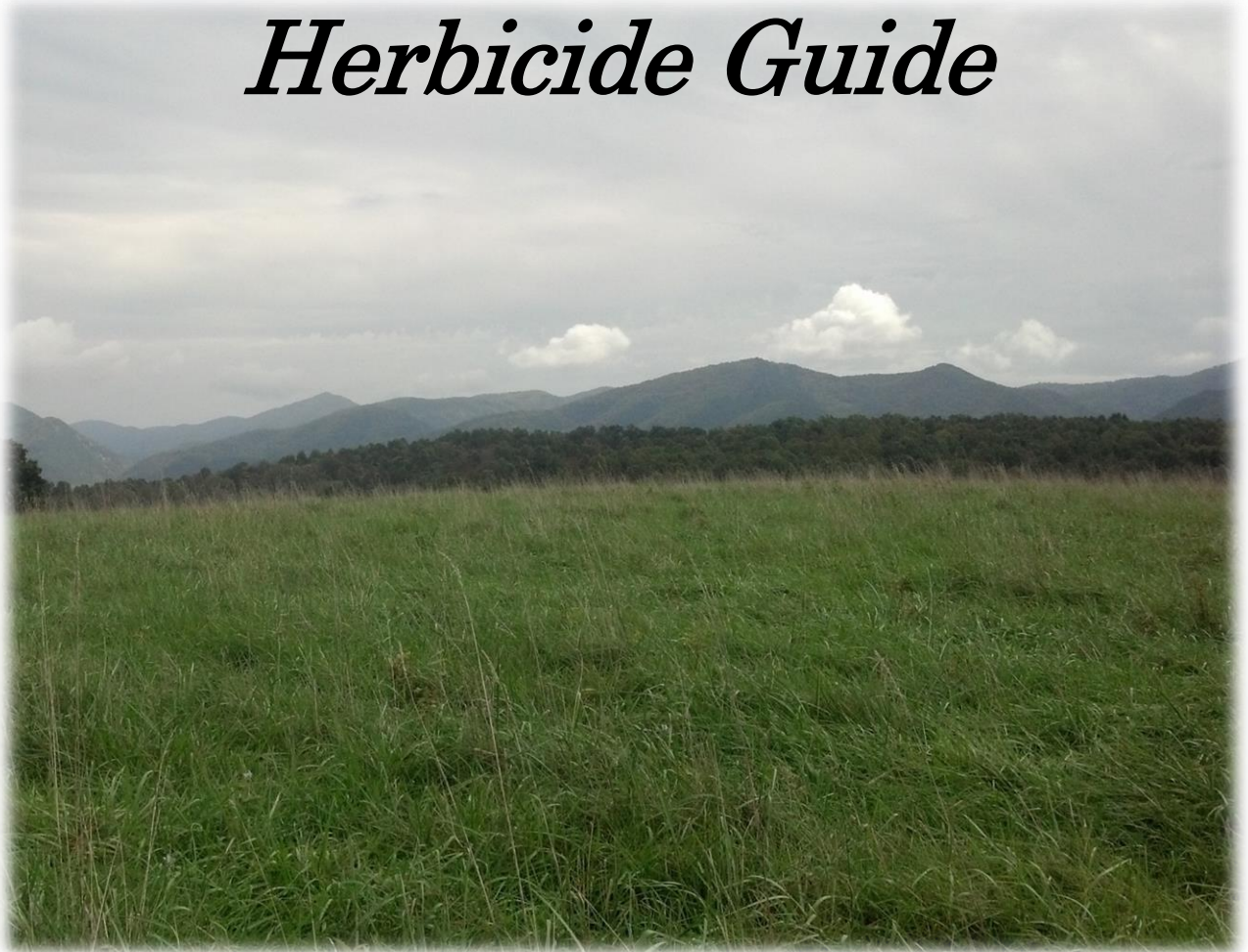




Virginia Cooperative Extension
Virginia Tech • Virginia State University

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 through berries containing yellow berries.

Multiple products are available for control. dicamba, Cimarron, and Cimarron Plus would be the herbicides listed control. dicamba is stronger on perennials and can last to several months.

Example applications:

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

Example applications:

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

Herbicide Timing for *Summer Annual Weeds*

SPRAY



SPRAY



Seedling through vegetative stage

*Less than 10" tall.
Occurring through spring & summer
depending on species*



Flowering & seeding
Summer/fall

Annuals are relatively simple to kill during the seedling and early vegetative stages. Increased size and age result in significantly reduced control.

Herbicide Timing for *Biennial Weeds*

SPRAY



Seedling

Typically summer or fall

SPRAY



Rosette

Year 1. Target in fall through early spring.



Bolting

Late spring/summer of year 2

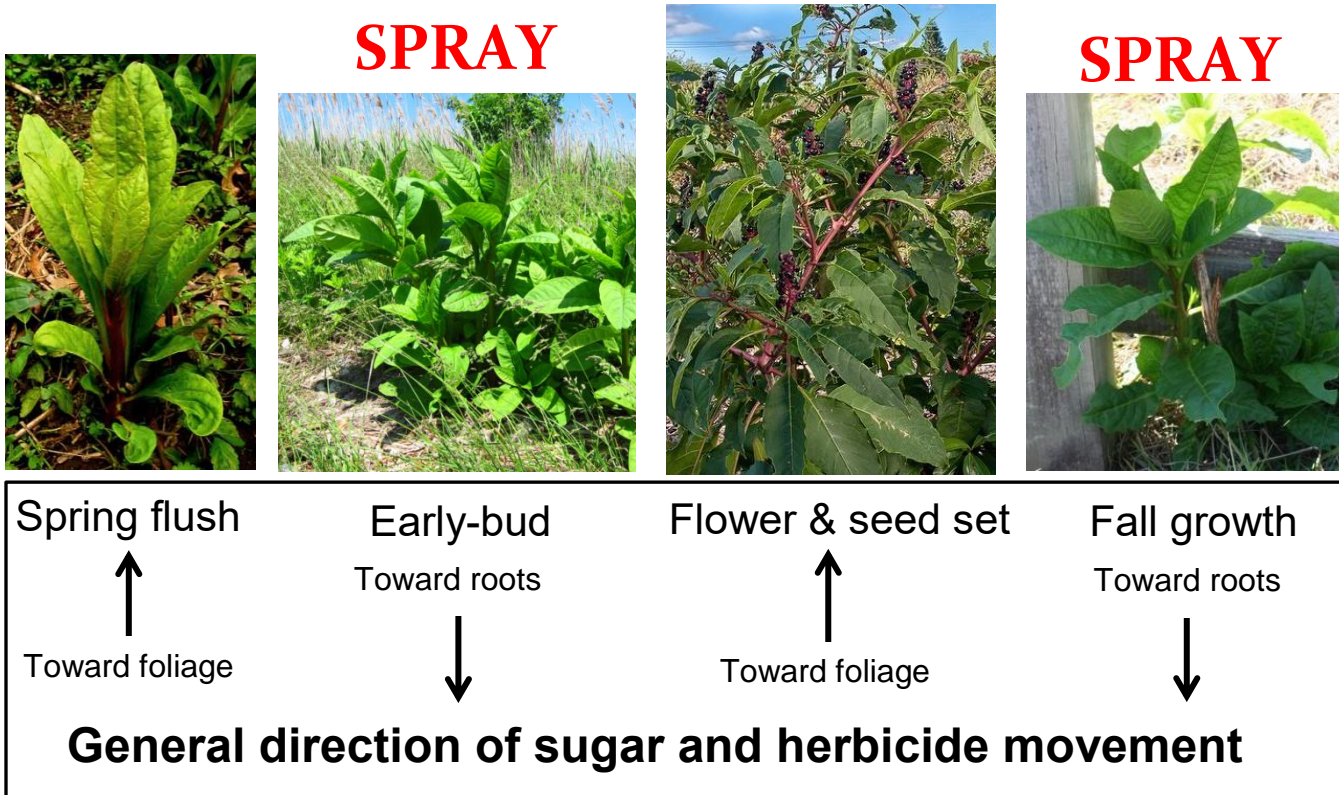


Flowering

Spring/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*



Two periods are ideal for spraying perennials: the early-bud stage (just prior to 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

Herbicides & Active Ingredients

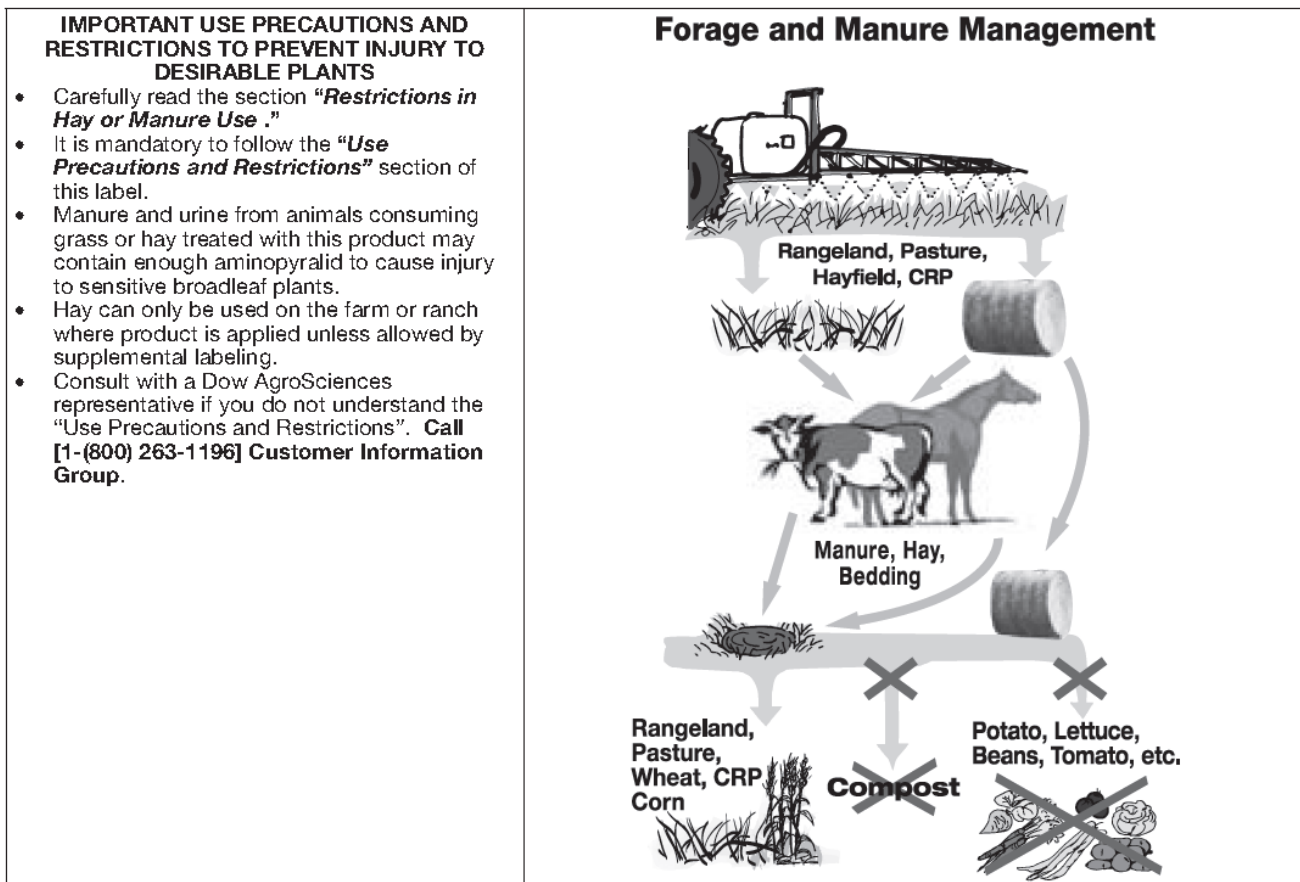
Product	Active Ingredient(s)	Active Ingredient	Acid Equivalents	General-use or Restricted-use	Residual activity?
		%	lbs./gal		
2,4-D LV4	2,4-D (ester)	63.70%	3.8	General	No
Banvel	dicamba (amine)	48.20%	4	General	No
Chaparral	aminopyralid	62.13%	0.525	General	Yes
	metsulfuron methyl	9.45%			
Chisum	metsulfuron methyl	48.00%		General	No
	chlorsulfuron	15.00%			
Cimarron Plus	metsulfuron methyl	48.00%		General	No
	chlorsulfuron	15.00%			
Crossbow	triclopyr (ester)	16.50%	1	General	No
	2,4-D (ester)	34.40%	2		
DuraCor	aminopyralid	8.95%	0.67	General	Yes
	florpyrauxifen-benzyl	0.76%	0.067		
Facet L	quinclorac	18.92%	1.5	General	Yes
Glyphosate 4 Plus	glyphosate	41.00%	3	General	No
Grazon P+D	picloram	10.20%	0.54	Restricted	Yes
	2,4-D (amine)	39.60%	2		
GrazonNext HL	aminopyralid	8.24%	0.41	General	Yes
	2,4-D (amine)	41.26%	3.33		
Milestone	aminopyralid	40.60%	2	General	Yes
PastureGard HL	triclopyr (ester)	45.07%	3	General	No
	fluroxypyr	15.56%	1		
Prowl H20	pendimethalin	38.70%		General	Yes
Quinstar	quinclorac	75.00%		General	Yes
Remedy Ultra	triclopyr (ester)	60.45%	4	General	No
Stinger	clopyralid	40.90%	3	General	Yes
Surmount	picloram	13.20%	0.67	Restricted	Yes
	fluroxypyr	10.60%	0.67		

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*, *Grazon P+D*, *Chaparral*, *Surmount*, and *DuraCor*. These products should only be used on sites where manure or hay will be several months or more 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.



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Bladder Campion (*Silene alba*)

Best herbicide timing: Early bud stage (periodically from early-summer through fall)



Bladder campion 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 in 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>Per acre 0.5 oz <i>Cimarron Plus</i> 8 oz dicamba 8 oz non-ionic surfactant</p>
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<p>Per acre 2.5 oz <i>Chaparral</i> 8 oz non-ionic surfactant</p>
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The herbicides mentioned here are formulated as water dispersible granules with low use rates, therefore, is often difficult to properly measure herbicide for use in spot treatments.

Horsenettle, Sand Briar (*Solanum carolinense*)

Best herbicide timing: At first appearance of flowers (from July through fall)



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 typically beginning 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 as well as being acceptable for use in hay. However, the other herbicides listed contain either picloram or aminopyralid, which are usually stronger on perennials and have residual soil activity on existing or germinating weeds for up to several months.

Example applications:

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

Pokeweed, pokeberry (*Phytolacca americana*)

Best herbicide timing: Early bud stage (early-to-mid summer through fall)



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 through fall). 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 other species 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 3 mL (1/10 oz) non-ionic surfactant
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<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 3 mL (1/10 oz) non-ionic surfactant
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<u>Per gallon of water (spot treatment)</u> 47 mL (1.5 oz) Crossbow 3 mL (1/10 oz) non-ionic surfactant
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Milkweed (*Asclepias syriaca*)

Best herbicide timing: Early bud stage (early-to-mid summer through fall)



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 when present, from early-summer through fall. 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:

<p><u>Per acre</u> 2.1 pints GrazonNext HL 8 oz non-ionic surfactant</p>	<p><u>Per gallon of water (spot treatment)</u> 13 mL (1/2 oz) GrazonNext HL 3 mL (1/10 oz) non-ionic surfactant</p>
<p><u>Per acre</u> 3 pints Surmount 8 oz non-ionic surfactant</p>	<p><u>Per gallon of water (spot treatment)</u> 19 mL (2/3 oz) Surmount 3 mL (1/10 oz) non-ionic surfactant</p>
<p><u>Per acre</u> 1.5 pints Remedy Ultra 3 pints 2, 4-D ester 8 oz non-ionic surfactant</p>	<p><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 3 mL (1/10 oz) non-ionic surfactant</p>
	<p><u>Per gallon of water (spot treatment)</u> 47 mL (1.5 oz) Crossbow 3 mL (1/10 oz) non-ionic surfactant</p>

Dogbane (*Apocynum cannabinum*)

Best herbicide timing:
Early bud stage (early-to-mid summer); fall regrowth



University of Illinois Crop Science



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:

<p><u>Per acre</u> 3 pints Surmount 8 oz non-ionic surfactant</p>	<p><u>Per gallon of water (spot treatment)</u> 19 mL (2/3 oz) Surmount 3 mL (1/10 oz) non-ionic surfactant</p>
<p><u>Per acre</u> 1 pint Remedy Ultra 3 pints 2, 4-D ester 8 oz non-ionic surfactant</p>	<p><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 3 mL (1/10 oz) non-ionic surfactant</p>
	<p><u>Per gallon of water (spot treatment)</u> 47 mL (1.5 oz) Crossbow 3 mL (1/10 oz) non-ionic surfactant</p>

Eastern Red Cedar (*Juniperus virginiana*)

Best herbicide timing: late-spring to early-summer; early-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. Target foliar herbicide applications in late-spring, early-summer or early-fall. Fall or winter basal bark herbicide treatments can also be effective. 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 may 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 with herbicide

Example applications:

<p><u>Per acre</u> 3 pints Surmount 1 pint Remedy Ultra 12 oz non-ionic surfactant</p>	<p><u>Per gallon of water (spot treatment)</u> 19 mL (2/3 oz) Surmount 6.25 mL (1/4 oz) Remedy Ultra 5 mL (2/10 oz) non-ionic surfactant</p>
<p><u>Per acre</u> 0.5 oz Cimarron Plus 8 oz dicamba 12 oz non-ionic surfactant</p>	<p><i>Cimarron Plus is formulated as water dispersible granule with a low use rate, therefore, is often difficult to properly measure herbicide for use in spot treatments.</i></p>

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. Sprouting may be prevented at time of cutting with a cut-stump herbicide treatment such as picloram (*Tordon RTU*) or triclopyr (*Remedy Ultra* or *Garlon 4 Ultra*). Application of these herbicides to trunks that have been girdled have shown some success, as have 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*
3 mL (1/10 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 a well-known invasive.

Example applications:

Per gallon (*foliar spray*)
25 mL (3/4 oz) Remedy Ultra
3 mL (1/10 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 Ultra* (triclopyr) or *Tordon RTU* (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 Ultra* (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	3 mL (1/10 oz) non-ionic surfactant
<u>Per gallon (cut stump treatment)</u>	
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 (if leaves are healthy)



Garv Fewless



Apply herbicide from full leaf emergence through the flowering period, or in late-summer/fall. Multiple herbicides are labeled for and effective, including: *GrazonNext HL*, *Remedy Ultra*, metsulfuron (a component of *Cimarron Plus*, *Chisum*, and *Chaparral*) and *Crossbow* (a tank-mix of 2,4-D and *Remedy Ultra* is a good, economical substitute for *Crossbow*). When selecting a herbicide, keep in mind that *GrazonNext HL* or *Chaparral* provide broad spectrum weed control and residual soil activity. Caution: products containing metsulfuron can 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:

<p><u>Per acre</u> 2.1 pints GrazonNext HL 8 oz non-ionic surfactant</p>	<p><u>Per gallon of water (spot treatment)</u> 13 mL (1/2 oz) GrazonNext HL 3 mL (1/10 oz) non-ionic surfactant</p>
<p><u>Per acre</u> 0.5 oz Cimarron Plus 8 oz non-ionic surfactant</p>	<p><i>Cimarron Plus is formulated as water dispersible granule with a low use rate, therefore, is often difficult to properly measure herbicide for use in spot treatments.</i></p>
<p><u>Per acre</u> 1.5 pints Remedy Ultra 3 pints 2, 4-D ester 8 oz non-ionic surfactant</p>	<p><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 3 mL (1/10 oz) non-ionic surfactant</p>
<p><u>Per gallon of water (spot treatment)</u> 57 mL (2 oz) Crossbow 3 mL (1/10 oz) non-ionic surfactant</p>	

Autumn olive (*Elaeagnus umbellate*)

Best herbicide timing: Late-spring through summer



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 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.

<p><u>Per acre</u> 2.1 pints GrazonNext HL 1 pint Remedy Ultra 8 oz non-ionic surfactant</p>	<p><u>Per gallon of water (spot treatment)</u> 13 mL (1/2 oz) GrazonNext HL 6.25 mL (1/4 oz) Remedy Ultra 3 mL (1/10 oz) non-ionic surfactant</p>
<p><u>Per acre</u> 3 pints Surmount 8 oz non-ionic surfactant</p>	<p><u>Per gallon of water (spot treatment)</u> 19 mL (2/3 oz) Surmount 3 mL (1/10 oz) non-ionic surfactant</p>
<p><u>Per acre</u> 1.5 pints Remedy Ultra 3 pints 2, 4-D ester 8 oz non-ionic surfactant</p>	<p><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 3 mL (1/10 oz) non-ionic surfactant</p>
	<p><u>Per gallon of water (spot treatment)</u> 57 mL (2 oz) Crossbow 3 mL (1/10 oz) non-ionic surfactant</p>

<p><u>Basal bark treatment</u> 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 <i>Remedy Ultra</i> to 20 parts diesel or fuel oil</p>

Black Hawthorn (*Crataegus douglasii*)

Best herbicide timing: Late-spring and early-summer



Utah State Univ.

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 effective and multi-purpose in a broadcast situation. Apply herbicide from full leaf emergence through the flowering period. If the plant has been mowed, wait 9-12 months before applying herbicide in order to maximize leaf area exposure to the treatment.

Example applications:

<p><u>Per acre</u> 1.5 pints PastureGard HL 8 oz non-ionic surfactant</p>	<p><u>Per gallon of water (spot treatment)</u> 9.5 mL (1/3 oz) PastureGard HL 3 mL (1/10 oz) non-ionic surfactant</p>
<p><u>Per acre</u> 2.1 pints GrazonNext HL 1 pint Remedy Ultra 8 oz non-ionic surfactant</p>	<p><u>Per gallon of water (spot treatment)</u> 13 mL (1/2 oz) GrazonNext HL 6.25 mL (1/4 oz) Remedy Ultra 3 mL (1/10 oz) non-ionic surfactant</p>
<p><u>Per acre</u> 1.5 pints Remedy Ultra 3 pints 2, 4-D ester 8 oz non-ionic surfactant</p>	<p><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 3 mL (1/10 oz) non-ionic surfactant</p>
<p><u>Per gallon of water (spot treatment)</u> 57 mL (2 oz) Crossbow 3 mL (1/10 oz) non-ionic surfactant</p>	

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. Similarly, a fall herbicide application suppresses crown bud formation that is responsible for the following year's growth.

Triclopyr or triclopyr-containing herbicides (e.g. *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:

<p><u>Per acre</u> 1.5 pints Remedy Ultra 3 pints 2, 4-D ester 8 oz non-ionic surfactant</p>	<p><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 3 mL (1/10 oz) non-ionic surfactant</p>
<p><u>Per acre</u> 2 pints Surmount 8 oz non-ionic surfactant</p>	<p><u>Per gallon of water (spot treatment)</u> 12.5 mL (1/2 oz) Surmount 3 mL (1/10 oz) non-ionic surfactant</p>
<p><u>Per acre</u> 0.5 oz Cimarron Plus 8 oz non-ionic surfactant</p>	<p><i>Cimarron Plus is formulated as water dispersible granule with a low use rate, therefore, is often difficult to properly measure herbicide for use in spot treatments.</i></p>

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:

<p><u>Per acre</u> 2.1 pints GrazonNext HL 1 pint Remedy Ultra 8 oz non-ionic surfactant</p>	<p><u>Per gallon of water (spot treatment)</u> 13 mL (1/2 oz) GrazonNext HL 6.25 mL (1/4 oz) Remedy Ultra 3 mL (1/10 oz) non-ionic surfactant</p>
<p><u>Per acre</u> 4 pints 2,4-D ester 8 oz non-ionic surfactant</p>	<p><u>Per gallon of water (spot treatment)</u> 25 mL (3/4 oz) 2,4-D ester 3 mL (1/10 oz) non-ionic surfactant</p>

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 through fall; 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, best results were obtained with 2,4-D + dicamba, *Chaparral*, *Crossbow*, *Cimarron Plus*, and *DuraCor*, all providing about 85-100% control. Hay situations would obtain best results with *Crossbow* or its equivalent tankmix of 2,4-D + dicamba. A tankmix of 2,4-D + dicamba would do very well also.

Example applications:

<u>Per acre</u>	<u>Per gallon of water (spot treatment)</u>
16 oz DuraCor	6 mL (2/10 oz) DuraCor
8 oz non-ionic surfactant	3 mL (1/10 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
8 oz dicamba	3 mL (1/10 oz) dicamba
8 oz non-ionic surfactant	3 mL (1/10 oz) non-ionic surfactant

<u>Per acre</u>	
2.5 oz <i>Chaparral</i>	<i>Chaparral is formulated as water dispersible granule with a low use rate, therefore, is often difficult to properly measure herbicide for use in spot treatments.</i>
8 oz non-ionic surfactant	

Stickweed

(*Verbesina occidentalis*)



Best herbicide timing:
early bud stage (summer)

Wingstem

(*Verbesina alternifolia*)



Ironweed

(*Vernonia noveboracensis*)



Stickweed, wingstem, and ironweed are similar species from the same family that are sometimes 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 or rhizomes. Target the plant during the early-bud stage in early- to mid-summer. You may spray regrowth following mowing or seasonal fall regrowth after the plant reaches about 2 feet in height.

In university testing, good results were obtained with numerous herbicides including: 2,4-D + dicamba, *Surmount*, *Chaparral*, and *GrazonNext HL*. The least expensive option will most likely be 2,4-D + dicamba but the best would be *Chaparral* 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	3 mL (1/10 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	3 mL (1/10 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, where they 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 common herbicides including *DuraCor*, *Cimarron Plus*, *Crossbow*, *Chaparral*, *PastureGard HL*, *Surmount*, and 2,4-D + dicamba. *GrazonNext HL* has shown reduced control when compared to other 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	3 mL (1/10 oz) non-ionic surfactant

<u>Per acre</u>	<u>Per gallon of water (spot treatment)</u>
16 oz DuraCor	6 mL (2/10 oz) DuraCor
8 oz non-ionic surfactant	3 mL (1/10 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)

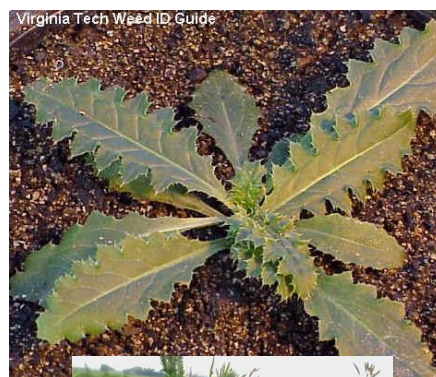
Bull thistle
(*Cirsium vulgare*)



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 mainly in summer and fall. 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 seedling or rosette stage in year one, or up to bolting in its second year. 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	3 mL (1/10 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	3 mL (1/10 oz) non-ionic surfactant

Canada Thistle (*Cirsium arvense*)

Best herbicide timing: Early-bud stage (June-August); fall



Jan Samanek



Canada thistle is a perennial that sprouts from creeping rhizomes (underground stems) and can form large colonies. One way to differentiate Canada thistle from biennial thistles is that Canada thistle has smooth stems (with spiny leaves). Unlike the biennial thistles, which should be sprayed when small, Canada thistles 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	3 mL (1/10 oz) non-ionic surfactant

<u>Per acre</u>	<i>Cimarron Plus is formulated as water dispersible granule with a low use rate, therefore, is often difficult to properly measure herbicide for use in spot treatments.</i>
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	3 mL (1/10 oz) non-ionic surfactant

<u>Per gallon of water (spot treatment)</u>
47 mL (1.5 oz) Crossbow
3 mL (1/10 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. An 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:

Per acre 0.3 oz Cimarron Plus 8 oz non-ionic surfactant	<i>Cimarron Plus is formulated as water dispersible granule with a low use rate, therefore, is often difficult to properly measure herbicide for use in spot treatments.</i>
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Per acre 1 pint dicamba 8 oz non-ionic surfactant	Per gallon of water (spot treatment) 6.25 mL (1/4 oz) dicamba 3 mL (1/10 oz) non-ionic surfactant
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Per acre 2.5 pints 2,4-D ester 8 oz dicamba 8 oz non-ionic surfactant	Per gallon of water (spot treatment) 16 mL (1/2 oz) 2,4-D ester 3 mL (1/10 oz) dicamba 3 mL (1/10 oz) non-ionic surfactant
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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 from late spring through 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:

<p><u>Per acre</u> 2.1 pints GrazonNext HL 8 oz non-ionic surfactant</p>	<p><u>Per gallon of water (spot treatment)</u> 13 mL (1/2 oz) GrazonNext HL 3 mL (1/10 oz) non-ionic surfactant</p>
<p><u>Per acre</u> 0.5 oz Cimarron Plus 8 oz non-ionic surfactant</p>	<p><i>Cimarron Plus is formulated as water dispersible granule with a low use rate, therefore, is often difficult to properly measure herbicide for use in spot treatments.</i></p>
<p><u>Per acre</u> 2.5 pints 2,4-D ester 8 oz dicamba 8 oz non-ionic surfactant</p>	<p><u>Per gallon of water (spot treatment)</u> 16 mL (1/2 oz) 2,4-D ester 3 mL (1/10 oz) dicamba 3 mL (1/10 oz) non-ionic surfactant</p>

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* (or equivalent tankmix of 2,4-D + *Remedy Ultra*), 2,4-D alone or 2,4-D + dicamba, *Grazon P+D*, *PastureGard HL*, and *Chaparral*.

Example applications:

<u>Per acre</u>	<u>Per gallon of water (spot treatment)</u>
2 pints <i>Remedy Ultra</i>	13 mL (1/2 oz) <i>GrazonNext HL</i>
8 oz non-ionic surfactant	3 mL (1/10 oz) non-ionic surfactant

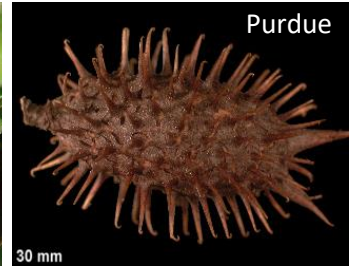
<u>Per acre</u>	<u>Per gallon of water (spot treatment)</u>
2.5 pints 2,4-D ester	16 mL (1/2 oz) 2,4-D ester
8 oz dicamba	3 mL (1/10 oz) dicamba
8 oz non-ionic surfactant	3 mL (1/10 oz) non-ionic surfactant

<u>Per acre</u>	<u>Per gallon of water (spot treatment)</u>
1 pint <i>Remedy Ultra</i>	6.25 mL (1/4 oz) <i>Remedy Ultra</i>
2.0 pints 2, 4-D ester	12.5 mL (1/2 oz) 2,4-D ester
8 oz non-ionic surfactant	3 mL (1/10 oz) non-ionic surfactant

<u>Per gallon of water (spot treatment)</u>
19 mL (3/4 oz) <i>Crossbow</i>
3 mL (1/10 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>	<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	3 mL (1/10 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	3 mL (1/10 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
2.0 pints 2, 4-D ester	12.5 mL (1/2 oz) 2,4-D ester
8 oz non-ionic surfactant	3 mL (1/10 oz) non-ionic surfactant

<u>Per gallon of water (spot treatment)</u>
19 mL (3/4 oz) Crossbow
3 mL (1/10 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* or a generic metsulfuron) followed by picloram (*Grazon P+D*).

Example applications:

Per acre
0.5 oz Cimarron Plus
8 oz non-ionic surfactant

Per acre
2.5 oz Chaparral
8 oz non-ionic surfactant

The herbicides mentioned here are formulated as water dispersible granules with low use rates, therefore, is often difficult to properly measure herbicide for use in spot treatments.

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*, *Remedy Ultra*, and metsulfuron-containing products (e.g. *Cimarron Plus*, *Chaparral*) achieved 70-80% control. *GrazonNext HL* and *PastureGard HL* have both shown less than 55% control.

Example applications:

<p><u>Per acre</u> 2 pints Remedy Ultra 8 oz non-ionic surfactant</p>	<p><u>Per gallon of water (spot treatment)</u> 12.5 mL (1/2 oz) 2,4-D ester 3 mL (1/10 oz) non-ionic surfactant</p>
<p><u>Per acre</u> 3 pints Surmount 8 oz non-ionic surfactant</p>	<p><u>Per gallon of water (spot treatment)</u> 19 mL (2/3 oz) Surmount 3 mL (1/10 oz) non-ionic surfactant</p>
<p><u>Per acre</u> 1.5 pints Remedy Ultra 3 pints 2, 4-D ester 8 oz non-ionic surfactant</p>	<p><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 3 mL (1/10 oz) non-ionic surfactant</p>
	<p><u>Per gallon of water (spot treatment)</u> 57 mL (2 oz) Crossbow 3 mL (1/10 oz) non-ionic surfactant</p>

Foxtails species (*Setaria spp.*)

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



Green foxtail
seedhead



Yellow foxtail
seedhead



Giant foxtail
seedhead



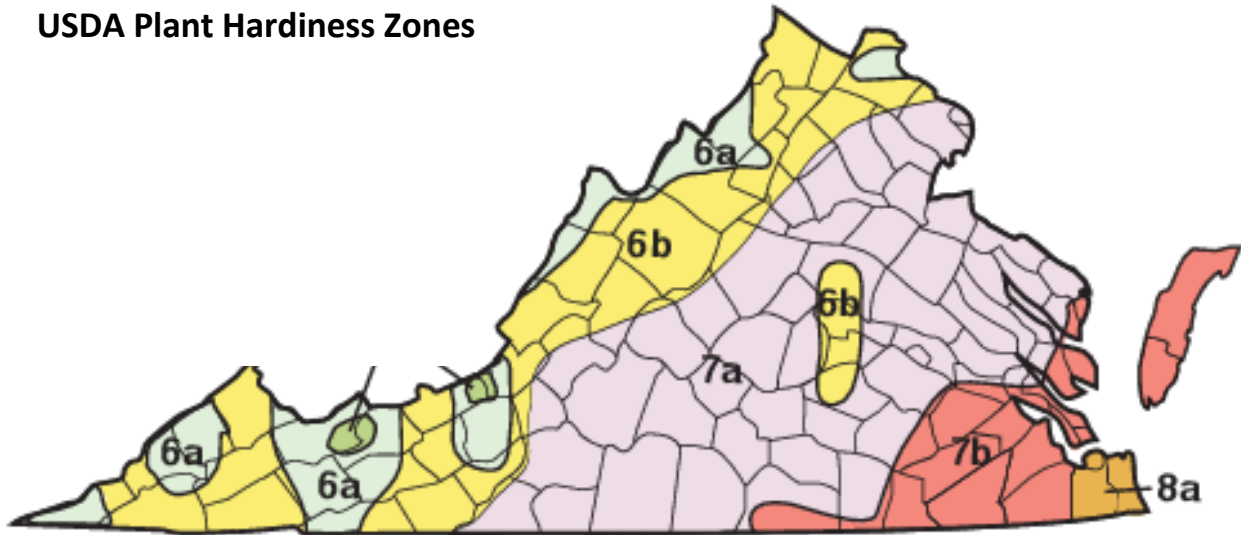
Foxtail seedlings

There are three common types of annual foxtail species: yellow, green, and giant. From a biology and control standpoint they are identical, though the plants and seedheads look different. Annual foxtails germinate once the ground temperature reaches about 60°F –around mid-March or later depending on your location. Because there is also a light requirement for germination, the density of the hay or pasture stand will influence germination. Some seeds may not germinate until the first hay cutting is removed. While germination time may vary, seedheads will not show up until at least mid-summer. Mowing foxtail may make the foxtail head-out shorter, and may reduce seed production some.

There are 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 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 in Virginia Tech trials 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.

USDA Plant Hardiness Zones



In 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 has been 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. '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. Virginia Tech trials have shown near 90% control at late-summer evaluations from 1 quart per acre of 'Facet L' applied immediately after the first hay cutting. '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. In Virginia Tech trials, tankmixing 'Prowl H₂O' with 'Facet L' provided no improvement over 'Facet L' alone.

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. Beware that hay equipment can easily carry foxtail seed from field to field.

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)

Perilla Mint (*Perilla frutescens*)

Best herbicide timing: Mid- summer



Perilla mint is a member of the mint family. It is an erect, bushy, annual that grows to an 2 feet or more at maturity. The plant gives off a distinctive minty odor when crushed. Perilla mint has a square stem. It grows best in moist shady areas, but is also very capable of growing in open pasture field edges, and barn lots. Reproduction is by seed only. 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.

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).

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.

Example applications:

<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 3 mL (1/10 oz) non-ionic surfactant
<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 3 mL (1/10 oz) non-ionic surfactant

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. It grows up to 2 feet tall, usually falling over and rooting at the plant nodes to form a mat. Seed is dispersed by wildlife and water, 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. Presumably, most germination occurs before June.

Virginia Tech studies have shown aminopyralid provides season-long control of around 80% or better from a mid-May application. *Milestone*, *Chaparral*, and *GrazonNext HL* contain aminopyralid and are labelled for use in pasture. Low rates of glyphosate can be very effective *if applied when stiltgrass is around 18” in height*. It should only be used where temporary damage to desirable grass can be tolerated. Since *Chaparral* and *GrazonNext HL* can be less than fully effective, areas that are infested with broadleaf weeds in addition to stiltgrass provide the best return on investment. In forested settings, *Segment* herbicide provides a grass-selective option that will not harm broadleaf trees and herbaceous plants.

Example applications:

<p><u>Per acre</u> 2.1 pints GrazonNext HL 8 oz non-ionic surfactant</p>	<p><u>Per gallon of water (spot treatment)</u> 13 mL (1/2 oz) GrazonNext HL 3 mL (1/10 oz) non-ionic surfactant</p>
<p><u>Per acre</u> 4 oz glyphosate</p>	<p><u>Per gallon of water (spot treatment)</u> 1.5 mL (0.04 oz) glyphosate</p>

* Add a surfactant to glyphosate only if specified by the label

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, meaning preemergent herbicide application must provide residual control for several months, and postemergent 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.

Prowl H₂O has offered a consistent high level of control (>95%). Rates and timing of *Prowl H₂O* are important; please see the section on Foxtail for more information. Aminopyralid (a component of *Milestone*, *GrazonNextHL*, & *Chaparral*) has postemergence activity on carpetgrass, but has not consistently resulted in acceptable control by the end of the season. Glyphosate works well as a postemergent, and rates as low as 3 oz/acre have been shown to be effective in killing carpetgrass—this method could work well in pasture or hay situations, since glyphosate at 3-4 oz/acre would have only a temporary effect on established perennial grasses. *Studies using this strategy have shown best results by waiting until carpetgrass is around 18 inches tall.*

Example applications:

<p>Per acre 4 quarts 'Prowl H₂O' (early spring)</p>

<p>Per acre 4 oz glyphosate 8 oz non-ionic surfactant (if specified by the label)</p>
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Buttercup species

Best herbicide timing: species dependent

Tall buttercup (*Ranunculus acris*)



Bulbous buttercup (*Ranunculus bulbosus*)



Two main buttercup species are seen in Virginia pastures and hayfields. Both contain toxic to livestock, though poisoning is rare since the plant is not palatable. The toxin volatilizes during drying, so hay containing dried buttercup foliage is harmless. Tall buttercup is a winter annual or short-lived perennial that flowers in early spring; it is best targeted with a fall herbicide application. Bulbous buttercup is a perennial that flowers from May-August; timing should target actively growing plants throughout spring and summer. Most broadleaf herbicides are very effective on buttercups.

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	3 mL (1/10 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	3 mL (1/10 oz) non-ionic surfactant

Poison hemlock (*Conium maculatum*)

Best herbicide timing: fall; late-winter through early spring



Poison hemlock is a biennial weed in the carrot family that flowers in early- to mid-spring, up to 10 feet tall. It is common around pastures, highways and ditches. It is very toxic and can kill livestock quickly, though poisonings are relatively rare.

Since it is a biennial, controlling seed production will be important to stopping its spread. Control with herbicides is best targeted at seedling or first year rosettes, fall through early spring. Herbicide effectiveness goes down quickly once the plant begins to bolt (rapid upright growth) in early spring. Crossbow or an equivalent tankmix of 2,4-D + *Remedy Ultra* is very effective, as is a tankmix of 2,4-D + dicamba. *DuraCor* is very effective and would provide additional residual activity. Other residual herbicides such as *GrazonNext HL* or *Surmount* have only shown around 80% control.

Example applications:

<p><u>Per acre</u> 16 oz DuraCor 8 oz non-ionic surfactant</p>	<p><u>Per gallon of water (spot treatment)</u> 6 mL (2/10 oz) DuraCor 3 mL (1/10 oz) non-ionic surfactant</p>
<p><u>Per acre</u> 1.5 pints Remedy Ultra 3 pints 2, 4-D ester 8 oz non-ionic surfactant</p>	<p><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 3 mL (1/10 oz) non-ionic surfactant</p>
<p><u>Per acre</u> 2.5 pints 2,4-D ester 8 oz dicamba 8 oz non-ionic surfactant</p>	<p><u>Per gallon of water (spot treatment)</u> 16 mL (1/2 oz) 2,4-D ester 3 mL (1/10 oz) dicamba 3 mL (1/10 oz) non-ionic surfactant</p>