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Noxious Weed Control: 2011

Mike Moechnig
South Dakota State University

Leon J. Wrage
South Dakota State University

Darrell L. Deneke
South Dakota State University

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Noxious WEED CONTROL: 2011



Mike Moechnig, Extension Weed Specialist
 Leon J. Wrage, Extension Emeritus, Plant Science
 Darrell L. Deneke, Extension IPM Program

WATCH for NOXIOUS WEED INVADERS

Noxious weeds are non-native plant species that are a concern to South Dakota land owners and managers. They can seriously impact the native plant community by altering or affecting agriculture, recreation, and wildlife.

LOCAL NOXIOUS WEEDS

Several weeds have been designated locally noxious in one or more counties by the South Dakota Weed and Pest Commission. Statute requirements for control are the same as for statewide noxious weeds.

2009 Noxious Weed Statewide

<u>State Noxious</u>	<u>Acres*</u>
Canada thistle	1,573,555
Leafy spurge	314,497
Perennial sow thistle	119,894
Hoary cress	64,141
Salt cedar	3,152
Purple loosestrife	4,938
Russian knapweed	3,796
<u>Locally Noxious</u>	
Biennial thistle (musk & plumeless)	274,954
Absinth wormwood	178,279

*Estimates from 2009 State Noxious Weed Annual Report, SD Department of Agriculture.

- absinth wormwood
- black henbane
- bull thistle
- chicory
- common burdock
- common mullein
- common tansy
- dalmatian toadflax
- diffuse knapweed
- European common reed
- field bindweed
- giant knotweed
- houndstongue
- musk thistle
- plumeless thistle
- poison hemlock
- puncturevine
- Scotch thistle
- spotted knapweed
- St. Johnswort
- yellow toadflax

Noxious Weed of Concern

Purple loosestrife (*Lythrum salicaria*) is a statewide noxious weed that is gradually becoming more abundant in South Dakota. In 2004, purple loosestrife infested approximately 1,000 acres but now it infests approximately 5,000 acres. Purple loosestrife is a perennial weed that invades wetland areas, so managing large infestations can be difficult. Each mature plant can produce more than 2 million seeds, so purple loosestrife patches can spread rapidly and crowd out existing vegetation.

Purple loosestrife produces bright magenta flowers in June through September. It has a square stem with leaves and branches arranged on opposite sides of the stems. It may be found on the edges of ponds, lakes, streams, or in marshy areas.

Small patches may be controlled by hand. Moderate to large infestations may be controlled by herbicides, such as aquatic glyphosate, imazapyr, or triclopyr amine products. Herbicides are often applied while purple loosestrife is flowering. Large infestations may also be controlled by biocontrol insects such as a defoliating beetle (*Galerucella* sp.) or a root weevil (*Hylobius transversovittatus*). Contact the SD Dept. of Ag., local Weed and Pest Supervisors, or local Extension Educators for more information regarding the availability of biocontrol insects in your area.



Purple loosestrife



Purple loosestrife

SOUTH DAKOTA STATE UNIVERSITY
 College of Agriculture & Biological Sciences • Cooperative Extension Service
 U.S. Department of Agriculture

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HERBICIDES for NOXIOUS WEEDS

Noxious Weed Recommendations: Herbicides for pasture, range, and noncrop areas, including roadside and other rights-of-way that may be harvested for hay or grazed, are given a priority.

Noncrop Areas. Noncropland is defined for herbicide purposes as areas not used to produce food or feed crops during the time herbicides residue remains in the soil. Noncrop areas include parking lots, utility storage areas and some rights-of-way. Pasture, range, and hayland are cropland.

Herbicides. Herbicides are listed by tradename except where the active ingredient is available in several products. The common name (in parentheses) follows the first listing of the tradename. Product labels for the same active ingredient vary. Herbicides included are those considered for most situations and those generally available. Rights-of-way are frequently grazed or used for hay, therefore products that allow grazing or harvesting hay are given a priority.

Rates are based on research data available. Treatments include those that (1) provide a high level of eradication with one application for small areas; (2) have lower annual cost but give a high degree of eradication in a four or five year program or (3) have low cost but require repeated application for several years.

Tradenames for herbicides are used in this publication to aid reader recognition. The common name is also listed and is used for herbicides that are available in many labeled products. Examples of other product names are listed where possible based on information available. As patents expire and marketing agreements are formed, additional products may be marketed. Be sure crop use and application directions are followed for the product being used.

Rates for 2,4-D are stated as acid equivalent (ai) per acre. The amount of product for several rates is listed for each formulation.

<u>Lb/A Required</u>	2,4-D RATE Product Per Acre		<u>FORMULATION</u>	
	<u>3.8L*</u>	<u>5.7L*</u>	<u>80% WSP</u>	<u>90% WSP</u>
0.5	1 pt	.66 pt	.66 lb	.6 lb
1.0	2 pt	1.33 pt	1.25 lb	1.1 lb
1.5	3 pt	2 pt	1.9 lb	1.7 lb
2.0	4 pt	2.66 pt	2.5 lb	2.2 lb

*2,4-D showing 3.8 lb/gal is the same as 4 lb/gal; and 5.7 lb/gal is the same as 6 lb/gal acid equivalent.

GLYPHOSATE PRODUCTS Equivalent Rates

Glyphosate is formulated in different salts and different concentrations. Formulation concentration is listed as lb of glyphosate acid/gal (ae); some labels also list lb glyphosate acid plus salt/gal (active ingredient, ai).

<u>Formulation</u>		<u>Amount of Product for lb ae</u>			
		<u>.38 ae</u>	<u>.75 ae</u>	<u>1.5 ae</u>	<u>3 ae</u>
3 lb ae (4 lb ai)	L	1 pt	2 pt	2 qt	4 qt
3.7 lb ae (5 lb ai)	L	.8 pt	1.6 pt	1.6 qt	3.2 qt
4 lb ae (5.4 lb ai)	L	.75 pt	1.5 pt	1.5 qt	3 qt
4.17 lb ae	L	.75 pt	1.5 pt	1.5 qt	3 qt
4.5 lb ae (5.5 lb ai)	L	.7 pt	1.4 pt	1.4 qt	2.8 qt
65% ae (72% ai)	DS	.6 lb	1.1 lb	2.3 lb	4.6 lb

DICAMBA PRODUCTS Formulations

<u>Product</u>	<u>lb a.e/gal</u>	<u>Formulation</u>
Banvel/Sterling	4	dimethylamine salt
Clarity/Vanquish	4	diglycolamine salt

ABBREVIATIONS. Several abbreviations are used in this publication.

pt = pint
qt = quart
gal = gallon
lb = pound
oz = ounce
t = teaspoon
T = Tablespoon

ae = acid equivalent
ai = active ingredient
L = liquid
gpa = gallons per acre
psi = lb per square inch
DF = dry flowable
DS = dry soluble
WDG = water soluble powder or crystals
DG = dispersible granule
NIS = non-ionic surfactant

LEAFY SPURGE

Management: Leafy spurge is a perennial species that develops extensive root systems making it very difficult to control. Management programs typically require several years and can be very costly. Therefore, it is strongly recommended to watch for new patches and control infestations while they are small. Standard herbicide programs include Tordon, Tordon+2,4-D, or Plateau. Apply herbicides in the spring (early June) at flowering or to regrowth in the fall (September-October or while the white sap is still flowing). Plateau may be used around trees, but follow label precautions. For large infestations, consider introducing biocontrol agents such as leafy spurge flea beetles (*Aphthona lacertosa* or *Aphthona nigriscutis*). Contact your local county weed and pest board or the South Dakota Department of Agriculture for more information on flea beetle collection dates and procedures.

Tordon 22K (*picloram*)

1-2 qt Tordon 2L (0.5-1 lb ae) (\$27.85-55.70)

Spring or **Fall.** Primarily for small patches. Use 2 qt/A Tordon as a spot treatment. Rates above 1 qt/A cannot exceed 50% of an acre. Rates above 1 pt/A can be used in fallow cropland if the treated areas are less than 10% of the field. Minimum carrier is 20 gpa. The 2 qt rate will reduce the stand; however, additional Tordon or other follow-up is required. Some regrowth may be noted after application during dry seasons. Make spring treatments before seeds form. Make fall application before soil freeze-up.

Tordon has foliar activity and extended soil residual. It controls topgrowth and translocates into roots. Rainfall is required to move the herbicide into the root zone. Trees, legumes, and broadleaf plants are very sensitive to drift and soil residues.

Tordon is registered for use in grass pasture and range, fallow cropland and noncrop areas. Bromegrass, buffalograss, and wheatgrass may be injured; bluegrass is tolerant.

RESTRICTIONS: Do not use in trees. Avoid drift to trees or sensitive broadleaf crops. For rates above 1 qt/A, do not harvest for hay within 2 weeks after treatment. Do not graze dairy animals for 2 weeks after treatment. Remove animals 3 days before slaughter if grazing within 2 weeks after spraying. Do not apply into water or wetlands or on inner banks of irrigation or drainage ditches. Risk of leaching is greatest where soils have rapid permeability (such as loamy to sand) and where the underlying aquifer is near the surface. **Restricted Use Pesticide.**

Tordon 22K + 2,4-D Ester (*picloram* + 2,4-D)

1.5 pt Tordon 2L + 1 lb ae 2,4-D ester (.38 + 1 lb ae) (\$25.90)

Spring. Tank-mix. Intended as a 4 to 5 year program. Apply in late bud stage. Lower Tordon rates may not provide sufficient residual control into the fall. Amine formulation of 2,4-D may be used if site limitations preclude ester formulations. Minimum carrier is 10 gpa for ground or 2 gpa for air. Intended as one application per year; some regrowth may be noted in wet seasons. Treatment has provided 75 to 80% leafy spurge stand reduction after 4 years.

RESTRICTIONS: Follow restrictions as described for Tordon and for 2,4-D. **Restricted Use Pesticide.**

Plateau (*imazapic*)

8-12 oz Plateau 2L (.12-.18 lb ai)

(\$17.70-26.60)

Fall. Plateau is an imidazolinone herbicide used to control leafy spurge in pasture, range, noncrop areas, and CRP plantings. Plateau is being marketed only through public agencies and organizations. However, it is labeled and may be applied to private as well as public land.

Results have been promising in SDSU tests; 70 to 90% control has been reported the year after application. Fall treatment to active growth has been more effective than spring applications.

Suggested rates are 8 to 12 oz/A of 2L. Use the higher rate for dense infestations that have been established for longer periods of time. The lower rate has been used in most tests. Plateau at 8-12 fl oz/A may suppress growth of cool season grass species, such as smooth brome and wheatgrass, and switchgrass. Field plot data suggest follow-up control programs are required to prevent reinfestation. Add MSO at 2 pt plus 2 pt/A 28% N. Minimum carrier is 10 gpa for conventional ground equipment or 2 gpa for low volume equipment.

Several tree and shrub species listed on the label are known to have acceptable tolerance when applied under the canopy and/or to the foliage. Tolerance is based upon trees with a minimum of 2 inch DBH (diameter at breast height). Some species may exhibit tip chlorosis and minor necrosis. Foliar contact on some species may increase injury, defoliation, and terminal death.

RESTRICTIONS: Treated areas may be grazed. Do not harvest hay for 7 days after treatment.

2,4-D Ester

1.5 lb ae 2,4-D ester 4L (1.5 lb ae)

(\$7.55)

Spring and Fall. Spring and fall application required each year. Selective, foliage applied, translocated herbicide. Uses for 2,4-D include grass pasture, range, and noncrop areas. Apply 2,4-D ester at 1.5 lb ae/A. Suggested carrier is 10 to 40 gpa. This treatment has been popular for large infestations; however, several years are required to achieve significant stand reduction.

Apply in spring at late bud stage when bracts begin to yellow. Retreat in September or early October when new fall growth is 4 to 6 inches. Results can be variable. One treatment per year prevents seed production. Stands have been reduced 50% in 3 years. Complete eradication is difficult even after 10 years. Surfactant or fuel additives increase leaf burn but seldom increase stand reduction.

Spring or Fall. Single application each year. Rates to 2 lb/A may be used in pasture and range; higher rates are allowed in noncrop and fallow. Control is less than for two applications of 1.5 lb/A each. Best for inaccessible areas where the labor cost for a second application is prohibitive.

RESTRICTIONS: Avoid drift to trees and sensitive crops. Not suggested for use in trees. Do not graze lactating dairy animals for 7 days after application. Labels for 2,4-D allow harvesting hay 30 days after application and require a 3 day removal period before slaughter. Note other label precautions. Labels for 2,4-D products vary.

CANADA THISTLE and PERENNIAL SOW THISTLE

Management: Perennial sow thistle and Canada thistle develop extensive root systems which can make them difficult to control. Seeds can spread by wind, making it important to control the plants prior to seed production. Canada thistle seeds may become viable within 10 days after flowering. Standard programs include Tordon+2,4-D, 2,4-D (for maintenance programs), Milestone, or ForeFront. Stinger or Transline may be used for Canada thistle around trees, but follow label precautions. Herbicides may be applied in spring (pre-bud stage in mid to late June) or to regrowth in the fall (September-October or while the leaf tissue is still green). Dense grass may reduce control from fall applications, so consider setting-up the site with mowing or grazing in the summer prior to fall applications. Biocontrol insects can be fairly effective on Canada thistle in some circumstances, but success rates are low. Use a combination of biocontrol insect species such as gall flies, stem mining weevils, and defoliating beetles.

Tordon 22K (*picloram*)

1-2 qt Tordon 2L (.5-1 lb ae)

(\$27.85-55.70)

Spring or Fall. Primarily for small infestations. Apply 2 qt/A Tordon as a spot treatment. Use a minimum of 20 gpa carrier. Rates above 1 qt/A cannot exceed 50% of an acre. Stands have been reduced 85 to 90% in SDSU tests. Make spring treatments before seed forms. Make fall applications while foliage is still green.

The 1 qt/A rate has been promising in recent Canada thistle tests. Use the high rate for maximum stand reduction, especially for fall treating areas such as fence lines. Control one year later is greater than for lower Tordon rates in tank-mixes.

Tordon has foliar activity and extended soil residual. It is absorbed into the leaves and controls topgrowth. It also translocates into roots. Rainfall moves the herbicide into the root zone. Trees, legumes, and broadleaf plants are very sensitive to drift and soil residual.

Tordon is registered for grass pasture and range, fallow cropland, and noncrop areas. At high rates, brome grass, buffalograss, and wheatgrass may be severely injured; bluegrass is tolerant. Tordon is formulated as a liquid containing 2 lb/gal acid equivalent.

RESTRICTIONS: Do not use in trees. Avoid drift to trees or sensitive broadleaf crops. For rates above 1 qt/A, do not harvest for hay within 2 weeks of treatment. Do not graze dairy animals for 2 weeks after treatment. Remove animals 3 days before slaughter if grazing within 2 weeks after spraying. Do not apply into water or wetlands or on inner banks of irrigation or drainage ditches. Risk of leaching is greatest where soils have rapid permeability (such as loamy to sand) and where the underlying aquifer is near the surface. **Restricted Use Pesticide.**

Tordon 22K + 2,4-D (*picloram* + 2,4-D)

1 pt Tordon 2L + 1 lb ae 2,4-D (.25+1 lb ae)

(\$18.95)

4 pt Grazon or Tordon 101 Mixture 2.54L (.27+1 lb ae)

(\$15.05)

Spring. Intended as a multi-year program with sufficient seasonal suppression so only one application per season is required. Apply at bud stage before flowers open. Tank-mix 1 pt Tordon plus 1 lb ae 2,4-D or use 4 pt Grazon premix containing .54 lb picloram (Tordon) plus 2 lb 2,4-D amine per gal. Amines cause less leaf burn and are preferred if growth is lush. Minimum carrier is 10 gpa for ground 2 gpa for air. Some fall regrowth may be noted in wet seasons. Lower rates do not provide sufficient residual control into the fall.

The tank-mix is registered for noncrop, grass pasture, and range. Use Grazon in grass pasture and range or Tordon 101 Mixture for non-crop areas. Grass is usually tolerant to these Tordon rates. Some stunting, especially if applied at boot stage, may be noted.

RESTRICTIONS: Follow restrictions described for Tordon and for 2,4-D. **Restricted Use Pesticide.**

Milestone (*aminopyralid*)**ForeFront (*aminopyralid+2,4-D*)**

3-7 oz Milestone (0.05-0.11 lb ai) (\$8.40-19.60)

2-2.6 pt ForeFront (0.08-0.11 lb ae aminopyralid + 0.67-0.87 lb ae 2,4-D) (\$13.70-17.85)

Spring or Fall. Apply Milestone at 5-7 oz/A for Canada thistle or 3-5 oz/A for perennial sow thistle or ForeFront at 2-2.6 pt/A for either species. Make applications in early summer at the bud stage or early flowering or in fall prior to a killing frost. Use higher rates for advanced weed growth stages, dense stands, or under adverse growing conditions, such as drought. Use a non-ionic surfactant (NIS) at 0.25-0.5% (1-2 qt per 100 gallons spray solution) under adverse growing conditions or advanced weed growth stages. Avoid mowing for 7 days after application to allow for herbicide translocation in the weeds. SDSU studies have demonstrated excellent control that may last two or more years.

Milestone may be applied to non-irrigation ditch banks and seasonally dry wetlands, but may not be applied over water or to areas where surface water is present. Applications may be made on warm and cool season grasses.

RESTRICTIONS: Do not apply Milestone at more than 7 fl oz (0.11 lb ae) per acre per year for broadcast applications or 14 fl oz (0.22 lb ae) for spot treatments (less than ½ acre areas). There are no grazing restrictions for Milestone, but aminopyralid may be transferred in manure from livestock grazing on grass that had been sprayed within 3 days. After grass seeding, wait until perennial grasses are well established with a secondary root system before applying Milestone. Some grasses, such as smooth brome, may be suppressed under adverse growing conditions. For ForeFront, do not harvest forage for hay within 14 days after application and do not apply more than 2.6 pt/A in a growing season.

Stinger or Transline (*clopyralid*)

.66-1.33 pt Stinger 3L or Transline 3L (.25-.5 lb ae) (\$30.30-85.15)

Spring. For Canada thistle. Perennial sow thistle suppression. Apply from rosette to bud stage when plants are actively growing. Stinger is labeled for use in grass pasture, rangeland, fallow, fencerows, and other noncrop areas. Transline is labeled for noncrop areas, rangeland, and rights-of-way. Transline is marketed only to government and public agencies. Use 1 to 1.33 pt/A to achieve maximum stand reduction. Data suggest 90 to 95% reduction can be expected. Minimum carrier is 5 gpa; use at least 10 gpa for most ground applications.

Stinger or Transline has potential in sites where grass cannot be damaged or where trees limit use of herbicides with harmful soil residual.

RESTRICTIONS: Do not contaminate irrigation ditches. No grazing or haying restrictions.

Curtail (*clopyralid + 2,4-D*)

2 qt Curtail 2.38L (.19 + 1 lb ae) (\$24.00)

Spring. Premix. For Canada thistle and perennial sowthistle suppression. Apply before bud stage when plants are actively growing. Reduced rate of 1 qt/A is frequently used for seasonal suppression. The 2 qt/A rate has provided excellent control and 60 to 70% stand reduction. Minimum carrier is 10 gpa for ground and 5 gpa for air for most situations. Curtail is a premix containing .38 lb clopyralid (Stinger) plus 2 lb 2,4-D amine per gallon.

Curtail is labeled for use in noncrop areas, rangeland, grass pasture, and CRP grass seedings and fence lines.

RESTRICTIONS: Do not graze lactating dairy cattle in treated areas for 14 days after application. Remove meat animal 7 days before slaughter if grazing within 2 weeks after application. Do not harvest hay within 30 days after application.

Redeem (*triclopyr + clopyralid*)

4 pt Redeem 3L (1.12 + .38 lb ae)

(\$62.10)

Spring. Premix. Intended for Canada thistle and certain broadleaf weeds not controlled with 2,4-D, such as brush. Apply 4 pt/A from early growth to bud stage. Weeds must be actively growing. Reduced rates provide seasonal suppression. Minimum carrier is 10 gpa for ground or 3 gpa for air. Redeem is a premix containing 2.25 lb triclopyr (Garlon) plus .75 lb clopyralid (Stinger) per gallon. Redeem is labeled for use in rangeland, grass pasture, roadsides, CRP grass seedings, fence lines, and other noncrop areas.

RESTRICTIONS: Do not graze or harvest forage for dairy cattle for 14 days after application. Do not harvest hay until the next growing season for dairy or harvest hay for other livestock for 7 days after treatment. Remove meat animals at least 3 days before slaughter. Do not treat banks or bottom of irrigation ditches.

Dicamba Products (*dicamba*)

1-4 pt dicamba 4L (2 lb ae)

(\$7.60-52.45)

Spring or Fall: Make spring application at early bud stage. Apply in fall before a killing frost while leaves are still green.

Apply 1-2 pt/A for suppression or 2-4 pt/A for greater control (50-70%). Clarity and Vanquish contain a low vapor salt of dicamba. Use at least 3 gpa carrier for ground or 2 gpa for air.

Dicamba is a selective, translocated herbicide. It has foliar activity. Favorable growing conditions improve results. Dicamba products are registered for use in pasture, range, and noncrop areas. At high rates, brome grass may be severely stunted; bluegrass and several other grasses are tolerant. Trees, legumes, and broadleaved plants are sensitive to drift and soil residues.

RESTRICTIONS: Do not graze lactating dairy for 40 days or harvest hay for 70 days after application of more than 1 qt/A. Slaughter animals must be removed for 30 days after last application. Avoid drift to non-target plants. Do not contaminate water.

Dicamba Products + 2,4-D (*dicamba + 2,4-D*)

2 pt dicamba 4L + 1 lb ae 2,4-D (1 + 1 lb ae)

(\$20.25-31.25)

Spring. Tank-mix. Intended as a multi-year program. Apply at bud stage. Mix dicamba 4L at 2 pt plus 2,4-D at 1 lb ae/A. Amines cause less leaf burn and are preferred if growth is lush. Apply in 10 to 20 gpa carrier. Lower dicamba rates may not provide sufficient residual control into the fall, especially in wet seasons. Refer to Dicamba Products table.

Dicamba plus 2,4-D is labeled for use in grass pasture, range, and noncrop areas. Grass is usually tolerant to these rates; some stunting may be noted, especially if applied at boot stage.

RESTRICTIONS: Do not use in trees. Avoid drift to sensitive broadleaved plants. Labels for 2,4-D do not allow grazing lactating dairy for 7 days after application. Labels for 2,4-D allow harvesting hay 30 days after application and require a 3 day removal period before slaughter. Dicamba labeling for 1 to 2 pt/A restricts grazing lactating dairy for 21 days or haying for 51 days after application. Note other label restrictions for higher rates.

Telar (*chlorsulfuron*)

1-3 oz Telar 75XP (.046-.14 lb ai)

(\$23.80-71.45)

Spring or Fall. For Canada thistle. Apply 1-3 oz Telar DF at bud to bloom or in fall at rosette stage. Spring application preferred. Minimum carrier is 10 gpa. Add NIS at 1 qt/100 gal. May be tank-mixed with 2,4-D, dicamba, or glyphosate products.

RESTRICTIONS: There are no grazing restrictions for rates less than 1.3 oz/A. Labeling does not include hay uses. Do not apply to water, such as lakes, streams, or areas where runoff flows into such areas.

2,4-D

2-3 lb ae 2,4-D Amine (2-3 lb ae) (\$9.15-13.75)

Late Fall: Apply a high rate in late fall before leaves are damaged by frost. Rates to 2 lb ae/A may be used in pasture and range; higher rates are allowed in noncrop and fallow. Data indicate 50 to 60% stand reduction if there is considerable new growth and if weeds have been weakened by previous control practices. Light frost before application does not reduce control; temperatures of 60° F after application improve results.

1.5 lb ae 2,4-D Amine or Ester (1.5 lb ae) (\$6.85-7.55)

Spring or Fall: Requires a spring and fall application each year. Make spring applications at bud stage. Retreat in September or early October after new fall growth reaches 6 inches. Suggested carrier is 10 to 20 gpa. Results can be variable. One spraying prevents seed production. Two applications provided 10 to 25% stand reduction the first year in SDSU tests. Reductions of 70 to 80% may be achieved after 3 years.

Uses for 2,4-D include grass pasture, range, and noncrop areas. This is a popular program for large infestations in pasture and roadsides. However, several years are required to reach high levels of eradication. Amine formulations are suggested for spring treatments when growth is lush. Esters may be used for fall spraying or if plants are stressed. Fall retreating is critical.

RESTRICTIONS: Avoid drift to trees and sensitive broadleaved crops. Do not graze lactating dairy on treated areas for 7 days. Labels for 2,4-D allow harvesting hay 30 days after application and require a 3 day removal period before slaughter.

KNAPWEED SPECIES (Russian, Spotted and Diffuse)

Management: Russian knapweed is a persistent perennial species that can develop an extensive root system making it difficult to control. Spotted and diffuse knapweed are biennial or short-lived perennial species and are generally easier to control. Herbicides may be applied to Russian knapweed at the bud-flowering growth stage or in late fall (early to mid October) after the plants appear dormant. Apply herbicides to spotted or diffuse knapweed in the spring or fall while they are in the rosette to early-bolting growth stage. Several biocontrol agents have been released for the knapweed species. The knapweed flower or seed weevil (*Larinus minutus*) has been successful, especially on spotted knapweed.

Tordon 22K (*picloram*)

1-4 pt Tordon 2L (0.25-1 lb a.e.) (\$13.95-55.70)

Spring or Fall. For diffuse or spotted knapweed, apply 1-2 pt/A in the spring to plants in the rosette or mid-bolting growth stage or in the fall to regrowth. Control at the 1 pt/A rate may be improved by tank mixing with 1 qt/A 2,4-D. For Russian knapweed, apply 2-4 pt/A to actively growing plants in the bud to mid-flowering growth stage or in the fall to regrowth. Some studies have demonstrated very good Russian knapweed control after late-fall applications. Note use restrictions mentioned for other weed species.

Milestone (*aminopyralid*)

ForeFront (*aminopyralid+2,4-D*)

Chaparral (*aminopyralid+metsulfuron*)

5-7 oz Milestone (0.06-0.11 lb ae) (\$14.00-19.60)

2-2.6 pt ForeFront (0.08-0.11 lb ae aminopyralid + 0.67-0.87 lb ae 2,4-D) (\$14.45-18.75)

2.5-3.3 oz wt Chaparral (0.08-0.11 + 0.015-0.02 lb ai) (\$13.20-17.45)

Spring or Fall. Apply to diffuse or spotted knapweed that is actively growing in the rosette to bolting stage or in the fall. Apply to Russian knapweed in the spring and summer when plants are in the bud to flower growth stage. For Milestone or Forefront, use a non-ionic surfactant (NIS) at 0.25-0.5% (1-2 qt per 100 gallons spray solution) under adverse growing conditions or advanced weed growth stages. For Chaparral, add NIS (0.25-0.5% v/v), COC (1-2% v/v), or MSO (0.5% v/v). May also add UAN (2-4 qt/A) or AMS (2-4 lb/A). Avoid mowing for 14 days after application to allow for herbicide translocation in the weeds.

Milestone may be applied to non-irrigation ditch banks and seasonally dry wetlands, but may not be applied over water or to areas where surface water is present. Note use restrictions mentioned for other weed species.

2,4-D Ester

2 lb ae 2,4-D ester (2 lb ae)

(\$10.05)

Spring. Apply at rosette stage. Rate of 2 lb ae/A has provided 95 to 99% control in several SDSU tests. Lower rates may be adequate under ideal conditions. Suggested carrier is 10 to 20 gpa. Apply when expected high temperature is to exceed 65° F.

RESTRICTIONS: Avoid drift to trees and non-target broadleaved plants. Do not graze lactating dairy animals on treated areas for 7 days. Labels allow harvesting hay 30 days after application and require a 3 day removal period before slaughter. Product label restrictions vary.

Redeem (*triclopyr + clopyralid*)

1.5-4 pt Redeem 3L (.42-.7 + .07-.12 lb ae)

(\$23.30-62.10)

Spring or Fall. For spotted and diffuse knapweed, apply 1.5-2.5 pt/A from rosette to early bolt stage. Add .5 lb/A 2,4-D if weeds are fully bolted. For Russian knapweed, apply 3-4 pt/A at the bud to mid-flowering growth stage or to fall regrowth. Some studies have demonstrated very good Russian knapweed control after late fall (October) application. Use the higher recommended rates when weeds are in advanced growth stages or are stressed due to drought or low temperatures. Minimum carrier is 10 gpa for ground or 3 gpa for air. Redeem is labeled for range, pasture, CRP grass seeding, fence rows, and noncrop areas. Redeem contains 2.25 lb triclopyr (Garlon) plus .75 lb clopyralid (Stinger) per gallon.

RESTRICTIONS: Do not graze or harvest forage for dairy cattle for 14 days after application. Do not harvest hay until the next growing season for dairy or harvest hay for other livestock for 7 days after treatment. Remove animals at least 3 days before slaughter. Do not treat banks or bottom of irrigation ditches.

Stinger or Transline (*clopyralid*)

.5-1.3 pt Stinger 3L or Transline 3L (0.19-0.49 lb ae)

(\$22.95-85.80)

Spring. Apply from mid bolt to late bud stage. For spotted and diffuse knapweed, apply 0.5-0.67 pt/A. For Russian knapweed, apply 0.67-1.3 pt/A. Stinger is labeled for grass pasture, rangeland, fallow, fence rows, and other non-crop areas. Transline is labeled for non-crop areas and rights-of-way. Transline is marketed only to government and public agencies. Use the high rate for most situations. Minimum carrier is 2 gpa; use at least 10 gpa for most ground applications.

Stinger or Transline have potential in sites where grass cannot be damaged or where trees limit use of herbicides with harmful soil residual.

RESTRICTIONS: Do not contaminate irrigation ditches. No grazing or haying restrictions.

Curtail (*clopyralid + 2,4-D*)

2-4 qt Curtail 2.38L (.19 + 1 lb ae)

(\$24.00-48.00)

Spring. For spotted or diffuse knapweed, apply 2 qt/A. For Russian knapweed, apply 4 qt/A. Apply at rosette stage for spotted or diffuse knapweed. Minimum carrier is 10 gpa for ground or 5 gpa for air.

Curtail is labeled for rangeland, grass pasture, CRP grass seedings, fencerows, and noncrop areas. Note use restriction for clopyralid (Stinger) and 2,4-D.

Plateau (*imazapic*)

12 oz Plateau 2L (0.18 lb ai)

(\$26.60)

Fall. For Russian knapweed only. Apply in the fall after leaves begin to die back (senescence). Control may improve as senescence progresses and may still be obtained after full senescence. Apply with MSO at 1 qt/A. Plateau rates greater than 8 oz/A can cause significant grass injury. Do not harvest treated areas for hay until 7 days after application.

Telar (*chlorsulfuron*)**1-3 oz Telar 75XP****(\$23.80-71.45)**

Spring or Fall: For Russian knapweed only. Apply at the bud to bloom growth stage in early summer or to rosettes in the fall. Registered for use on non-crop, right-of-way, pasture, range, and CRP. However, the maximum rate for pasture/range and CRP is 1.3 oz/A per year. Bluestem, buffalograss, green needlegrass, Indiangrass, and switchgrass may be tolerant to Telar rates up to 0.5 oz/A whereas several wheatgrass varieties, bluegrass, and smooth brome grass may be tolerant to rates over 0.5 oz/A. Minimum carrier is 10 gpa. Add NIS at 0.25% v/v (1 qt per 100 gallons spray solution).

Overdrive (*diflufenzopyr + dicamba*)**6-8 oz Overdrive 70DF (0.075-0.10 +0 .19-0.25 lb ae)****(\$18.90-25.20)**

Spring or Fall. For diffuse and spotted knapweed only. Rate is 6 to 8 ounces per acre based on weed species and maturity. A maximum of 10 oz/A can be applied per season in noncropland sites and a maximum of 8 ounces per acre in pasture, hay, and rangeland. Use 1 qt NIS per 100 gal or MSO at the rate of 1.5 to 2 pt/A. Do not use less than 3 gallons of spray volume per acre. Rainfast 4 hours after application. Overdrive may be tank-mixed with several labeled tank-mix partners to improve control.

Overdrive contains dicamba. Follow drift and vapor movement restrictions as for other dicamba products.

RESTRICTIONS: Supplemental label for aerial application in CRP. Do not plant crops for 30 days after last application. Pasture or rangeland grass treated with Overdrive can be grazed or harvested for livestock feed immediately after application. Do not apply to newly seeded grasses or small grains.

HOARY CRESS

Management: Hoary cress is a perennial species that can develop an extensive root system. Hoary cress may be challenging to control because it flowers in early spring (late April-early May), which is the best time for herbicide applications. SDSU trials indicate metsulfuron products (e.g. Escort) are the most effective. Growth regulator herbicides such as Tordon or 2,4-D are ineffective. Hoary cress may be found in low areas, such as gullies, ditches, dry lakebeds, or near lakes or streams.

Escort (*metsulfuron*)

1-2 oz Escort 60XP (.038-.075 lb ai) (\$26.25-52.50)

Spring. For hoary cress control in grassland. Apply to actively growing weeds at rosette stage. Escort is for western range, rights-of-way, and noncrop areas. Minimum of 10 gpa carrier is suggested. Add NIS at 1 qt/100 gal. Low rate (1 oz/A) has been very effective in SDSU trials.

RESTRICTIONS: Legumes will be injured. No haying or grazing restrictions for rates less than 1.66 oz; delay haying for 3 days for higher rates. Do not apply to water, lakes, streams, or areas that may run off into such areas.

Telar (*chlorsulfuron*)

0.5-1 oz Telar 75XP (.023-.061 lb ai) (\$11.90-23.80)

Spring or Fall. Apply .5 to 1 oz/A of Telar 75DF to hoary cress at bud to bloom stage in spring or in fall at rosette stage. Telar is labeled for use on noncrop, rights-of-way, pasture, range, and CRP. Several wheatgrasses, bluegrass, and smooth brome grass are more tolerant to rates over .5 oz/A; bluestem, buffalograss, green needlegrass, Indiangrass, and switchgrass are tolerant to rates up to .5 oz/A. The low rate (0.5 oz) has been very effective in SDSU trials. Minimum carrier is 10 gpa. Add NIS at 1 qt/100 gal.

RESTRICTIONS: There are no grazing restrictions for rates less than 1.3 oz/A. Labeling does not include hay uses. Do not apply to water, such as lakes, streams, or areas where runoff flows into such areas.

Plateau (*imazapic*)

8-12 oz Plateau 2L (.12-.18 lb ai) (\$17.70-26.60)

Spring. For hoary cress suppression. Add MSO at 2 pt plus 2 pt/A 28% N. Minimum carrier is 10 gpa for conventional ground equipment or 2 gpa for low volume equipment. Plateau may significantly suppress growth of cool season grass species and switchgrass. May apply under trees, but observe label restrictions.

RESTRICTIONS: Treated areas may be grazed. Do not harvest hay for 7 days after treatment.

PURPLE LOOSESTRIFE

Management: Purple loosestrife is often found growing on the edge of lakes or streams, so be sure to use herbicide products that are registered for use on or near water. The best time to apply herbicides is at the beginning of flowering (late June to early July). Alternative control options may include repeated tillage, burning, or biocontrol insects. The *Galerucella* leaf feeding beetles have been effective biocontrol insects for purple loosestrife. Beetles reared in South Dakota are available through the South Dakota Department of Agriculture.

Aquatic Glyphosate Product (*glyphosate*)

4 pt aquatic glyphosate 4L (2 lb ae) (\$26.25)

Aquatic glyphosate is available in several products that are approved for use on aquatic sites. Examples of products include Rodeo, AquaMaster, and AquaNeat. Glyphosate is a non-selective, translocated, foliage-applied herbicide, both grasses and broadleaf plants are affected.

Postemergence. Apply to actively growing plants at full to late flower. Apply as a broadcast treatment at 4 pt/A or as a spot treatment using hand-held equipment with a 1% aquatic glyphosate solution (1 gal/100 gal or 3 tablespoons/gal) to thoroughly wet foliage. Late summer or fall treatments are best. Apply before killing frost. Rate is minimum required for 65 to 85% control. Use NIS (2 qt/100 gal) approved for aquatic use.

This plant is a perennial capable of producing new shoots from buds in the crown areas. Wild types also produce seed. Individual plants can be dug if all small crown pieces are removed. The plant is especially aggressive in wetlands.

Aquatic glyphosate is approved for aquatic uses in lakes, streams, ponds, irrigation ditches, and reservoirs. Allow 7 days before introduction of water into dry ditches. Limit treatment to individual plants if possible.

RESTRICTIONS: Do not apply within ½ mile upstream of potable water intake in flowing streams or within ½ mile of intake in standing water. There are no restrictions for irrigation or recreational uses.

Habitat (*imazapyr*)

1 pt Habitat 2L (.25 lb ai) (\$32.80)

Habitat is an aqueous solution to be mixed with water and surfactant for aquatic use and requires spray adjuvants (NIS, MSO, silicone based). Apply 1 pt/A Habitat to actively growing foliage of purple loosestrife in and around standing and flowing water, including estuarine and marine sites. Do not apply more than 6 pt/A per year. Aerial application is restricted to helicopter only.

RESTRICTIONS: Application of Habitat can only be made by federal or state government entities or applicators who are licensed or certified applicators making applications under a program sponsored by federal or state government entities. There are no restrictions on livestock consumption of water from the treatment area.

Garlon (*triclopyr*)

.33-3 gal Garlon 3A (.1-9 lb ae) (\$31.20-283.50)

Garlon 3A may be used within production forests and industrial noncrop sites to control target vegetation in and around standing water sites, such as marshes, wetlands, and banks of ponds and lakes and transition areas between upland and lowland sites. Use enough water to give uniform and complete coverage for best results. NIS is recommended for all foliar applications.

RESTRICTIONS: Do not apply directly to un-impounded rivers or streams. Do not apply in ditches or canals used to transport irrigation water. Do not apply where runoff water may flow onto agricultural land. Minimize overspray to open water when making applications to banks or shorelines of moving water sites. There are no restrictions on use of water in treatment area for recreational purposes including swimming and fishing or for livestock consumption.

The maximum rate is 3 gal/A per year for all terrestrial use sites other than range, pasture, forestry sites, and grazed areas. Refer to grazing and haying restriction section of this guide for restrictions.

SALTCEDAR

(*Tamarix species*)

Management: Salt cedar is a very persistent tree species as it can reproduce by seed, roots, or stem fragments. It is a prolific seed producer and can spread rapidly. It produces pink, red, or purple flowers in mid-summer and the cedar-like leaves will turn yellow in the fall and fall off in the winter. It can be found along the water line on the edges of streams, lakes, ponds, or dugouts. Habitat may be applied to the foliage whereas triclopyr products, such as Garlon 4, may be applied to the trunk or stems in winter.

Habitat, Stalker, or Polaris (*imazapyr*)

2 qt Habitat 2L or Polaris 2L (1 lb ai)

(\$131.25)

Foliar: Habitat is an aqueous solution to be mixed with water and surfactant approved for aquatic use. For aerial application (helicopter only), apply 2 qt/A Habitat + 0.25% v/v NIS to actively growing foliage during flowering. For spot spraying use 1% solution of Habitat + 0.25% v/v NIS and spray to wet foliage. Wait at least 2 years after application before disturbing treated saltcedar. Earlier disturbance can reduce overall control. Habitat can also be applied as cut stump, cut stem, and frill or girdle treatments.

1-2 pt Stalker 2EC (.25-.5 lb ai)

(\$52.50-105.00)

Basal or Cut Stump: Stalker is an emulsifiable concentrate that can be mixed with water, diesel oil, recommended seed oils, and penetrating oils. Mix 8 to 12 oz Stalker with one gallon water, diesel oil, or penetrating oil. May be applied as a spray to cut stump and frilling cuts, when mixed with water or penetrating oil. Basal treatments should be mixed with penetrating oil. Cut stubble treatments need to be applied within 2 weeks after mowing or cutting.

RESTRICTIONS: Use precautions to minimize or eliminate spray drift. Be sure appropriate buffer zones can be maintained to prevent spray drift out of target area. Special local need labeling (Sec 24(c)) for South Dakota allows grazing treated areas. Remove livestock for slaughter from treated areas for 30 days following treatment. Do not harvest for hay for 30 days after treatment. Follow all label restrictions that apply to aquatic sites.

Garlon 4 or Garlon 4 Ultra (*triclopyr*)

1-8 qt Garlon 4L (1-8 lb ae)

(\$31.50-252.00)

Garlon is recommended for the control of unwanted woody plants and broadleaf weeds. Do not exceed 8 qt/A per year. Basal bark or cut stump treatments are most effective.

Cut Stump: Apply undiluted solution throughout the year. Control may decline during periods of moisture stress. Cut stumps should be treated immediately (less than 1 hour) after cutting. The outer 2 inches of the stump should be sprayed. Coverage is essential for root kill.

Basal Bark: Use a sprayer with the nozzle adjusted to deliver a narrow, cone shaped spray. Apply the Garlon solution lightly but evenly on the plant stem or trunk up to 12 to 15 inches from the ground. Apply to all sides of every stem. Do not apply to the point where runoff causes puddling at the crown or root collar. Older plants with rougher bark may require stems to be treated higher (15 to 18 inches). Mix 1-5% solutions of Garlon Ultra in oil for basal bark treatments, 20-30% solutions for low volume stem bark band applications, or 50-75% solutions for thin line basal bark treatments.

RESTRICTIONS: Refer to grazing and haying restriction section for precautions and restrictions.

BIENNIAL THISTLES (Musk, Plumeless, Bull, and Scotch Thistle)

Management: These species generally emerge as rosettes in the fall and early spring and bolt during the second year of growth. Control is most consistent when herbicides are applied at the rosette stage. Tordon or Milestone may provide some short-term residual control for plants that germinate after the herbicide application. At the rosette stage, 2,4-D may be very effective. After bolting occurs, consider using aminopyralid (Milestone or ForeFront) or metsulfuron (Escort or Cimarron). The musk thistle seed weevil (*Rhinocyllus conicus*) and the rosette weevil (*Trichosiocalus horridus*) have been released in many areas of South Dakota and can be found in most musk thistle infestations.

2,4-D Ester or Amine

1.5-2 lb ae 2,4-D (1.5-2 lb ae) (\$6.85-10.05)

Spring. Apply at rosette stage. May be used in fall or spring; however, other fall treatments with soil residual activity may be more effective. The low rate has been satisfactory under ideal conditions; 2 lb/A is most consistent. Esters are preferred for pastures; use amines when spraying near trees. Minimum carrier is 10 to 20 gpa. Control is reduced after flower stalks elongate (bolt). Apply when expected high temperature is to exceed 65° F. This treatment is registered for use in grass pasture and range.

RESTRICTIONS: Avoid drift to trees and sensitive broadleaf plants. Do not graze lactating dairy on treated areas for 7 days. Labels for 2,4-D allow harvesting hay 30 days after application and require a 3 day removal period before slaughter.

Tordon 22K (*picloram*)

Tordon 22K + 2,4-D (*picloram* + 2,4-D)

.5 pt Tordon 2L (.12 lb ae) (\$6.95)

.38-.5 pt Tordon 2L + 1 lb ae 2,4-D (.1-.12 + 1 lb ae) (\$10.30-12.00)

2-3 pt Grazon or Tordon 101 Mixture 2.54L (.12-.18 + .5-.75 lb ae) (\$7.55-11.30)

Spring or Fall: Apply at the seedling or rosette stage. Use Tordon at .5 pt for fall; use Tordon at .38 to .5 pt plus 2,4-D at 1 lb ae/A for spring application. Minimum carrier is 10 gpa for ground or 2 gpa for air. Provides excellent control under a wide range of growing conditions. Visual effects develop more slowly than for some treatments. Tordon is registered for use in grass pasture and range. Grazon (for pasture) or Tordon 101 Mixture (for non-crop) at 2 pt/A is equivalent to .54 pt Tordon + 2 pt 2,4-D 4L.

RESTRICTIONS: Do not use in trees. Avoid drift to sensitive broadleaved plants. Avoid contaminating water. Note other label precautions. Treated areas may be grazed. Note 2,4-D restrictions when using tank-mix.
Restricted Use Pesticide.

Milestone (*aminopyralid*)

ForeFront (*aminopyralid*+2,4-D)

Chaparral (*aminopyralid*+*metsulfuron*)

3-5 oz Milestone (0.05-0.08 lb ae) (\$8.40-14.00)

1.5-2 pt ForeFront (0.06-0.08 + 0.5-0.67 lb ae) (\$10.30-13.70)

1-2.5 oz wt Chaparral (0.03-0.08 + 0.006-0.01 lb ai) (\$5.30-13.20)

Spring or Fall. Apply Milestone at 3-5 oz/A or ForeFront at 1.5-2 pt/A in the spring or summer to plants in the rosette or bolting stages of growth or in the fall to seedlings or rosettes. Use higher rates when plants are in the late bolting through early flowering growth stages. Milestone control after the late bud stage may be improved by tank-mixing 2,4-D at 1 lb ai/A. For Milestone and Forefront, use a non-ionic surfactant (NIS) at 0.25-0.5% (1-2 qt per 100 gallons spray solution) under adverse growing conditions, advanced weed growth stages, or pubescent plants. For Chaparral, add NIS (0.25% v/v), COC (1% v/v), or MSO (0.5% v/v). May also add either AMS (2-4 lb/A or UAN (2-4 qt/A).

Milestone may be applied to non-irrigation ditch banks and seasonally dry wetlands, but may not be applied over water or to areas where surface water is present.

RESTRICTIONS: There are no grazing restrictions for Milestone, but aminopyralid may be transferred in manure from livestock that have consumed treated grass within the previous 3 days. For ForeFront, do not harvest forage for hay within 14 days after application and do not apply more than 2.6 pt/A per growing season.

Curtail (*clopyralid + 2,4-D*)

1-2 qt Curtail 2.38L (.1-.19 + .5-1 lb ae)

(\$12.00-24.00)

Spring: Apply at rosette to bud stage. Reduced rate of 1 qt/A is frequently used under favorable conditions. Minimum carrier is 10 gpa for ground or 5 gpa for air. Curtail is a premix containing .38 lb clopyralid (Stinger) plus 2 lb 2,4-D amine per gallon. Curtail is labeled for rangeland, grass pasture, CRP grass seedings, fencerows, and other noncrop areas.

RESTRICTIONS: Do not graze dairy cattle in treated areas for 14 days after application. Remove meat animals 7 days before slaughter if grazing treated areas within 2 weeks of application. Do not harvest hay within 30 days after application.

Dicamba Product + 2,4-D (*dicamba + 2,4-D*)

1 pt dicamba 4L + 1 lb ae 2,4-D (.5-1 lb ae)

(\$12.65-18.15)

Spring or Fall: Tank-mix. Apply at the rosette stage. Use dicamba 4L at 1 pt plus 2,4-D at 1 lb ae/A. Rates as low as .5 pt/A dicamba have been successful under ideal conditions. Use the high rate for large rosettes, dense stands, or dry conditions. Use 10 to 20 gpa carrier for ground equipment. May be applied by air using 3 to 10 gpa carrier if there are no sensitive broadleaved crops in the area. This combination is registered for use in grass pasture and range. Refer to Dicamba Product table.

RESTRICTIONS: Avoid drift to trees and sensitive broadleaved plants. Do not graze lactating dairy on treated areas for 7 days after application. Labels for 2,4-D allow harvesting hay 30 days after application and require a 3 day removal period before slaughter. Labeling for rates up to 1 pt/A restricts grazing lactating dairy for 7 days or haying for 37 days after application. Note other restrictions for higher rates and note other label precautions.

Overdrive (*diflufenzopyr + dicamba*)

4-8 oz Overdrive 70DF (.05-.1 + .125-.25 lb ae)

(\$12.60-25.20)

Spring or Fall. Use rate is 4 to 8 oz/A based on weed species and maturity. Best results if applied at rosette stage. Use higher rates if plants are beginning to bolt. A maximum of 10 oz can be applied per season in noncropland sites and a maximum of 8 oz/A in pasture, hay, and rangeland sites. Use 1 qt of NIS per 100 gallons of water or MSO at the rate of 1.5 to 2 pt/A. Do not use less than 3 gpa carrier. Rainfast 4 hours after application. Overdrive may be tank-mixed with several labeled tank-mix partners to improve weed control spectrum.

RESTRICTIONS: Supplemental label for aerial application in CRP. Do not plant crops for 30 days after last application. Pasture or rangeland treated with Overdrive can be grazed or harvested for livestock feed immediately after application. Do not apply to newly seeded grasses.

Escort (*metsulfuron*)

.5-2 oz Escort 60XP (.019-.076 lb ai)

(\$13.15-52.50)

Spring: Apply 0.5-1 oz/A at rosette to bud growth stage to control bull, musk, or plumeless thistle or 1-2 oz/A for Scotch thistle. Control in SDSU tests has been very good with metsulfuron tank-mixed with .5 to 1 lb/A 2,4-D. Cold, dry conditions reduce activity.

Minimum carrier is 10 gpa for ground or 2 gpa for air; use 5 gpa for Escort above .5 oz. Use NIS at 1 qt/100 gal. Legumes will be injured. May tank-mix 1-2 pt/A 2,4-D 3.8L.

RESTRICTIONS: Do not apply on grass grown for seed. No grazing restrictions at listed rate. Hay may be harvested from Escort treated areas. High rates of Escort may suppress grass production.

Cimarron Max (metsulfuron + dicamba + 2,4-D)

20-5 Acres/.5 oz Part A + 2.5 gal Part B (.01-.038 + .12-.5 + .38-1.5 lb ae) (\$6.20-24.85)

Cimarron Max herbicide is a twin-pak combination. Part A contains metsulfuron (Escort). Part B contains 1 lb dicamba (Banvel) plus 2.87 lb ae 2,4-D amine per gallon. The use ratio is .5 oz Part A to 2.5 gal of Part B to treat 5 to 20 acres. Refer to following rate table for acres treated.

Cimarron Max Rate	Part A Rate (oz/A)	Part B Rate (pt/A)	Acres Treated with .5 oz Part A + 2.5 gal Part B
Rate I	0.25	1	20A
Rate II	0.5	2	10A
Rate III	1	4	5A

Use Rate I for musk and Scotch thistle and Rate II for plumeless and bull thistle. The Rate II or 10 acre rate provides equivalent of .5 oz Ally 60DF + .5 pt Banvel 4L + 1.5 pt 2,4-D 3.8L per acre. Rates are based on weed species and weeds less than 4 inches tall. Do not apply more than the equivalent of 1.66 oz/A Cimarron Max Part A per year. Add NIS at 2 to 4 pt/100 gal. May be applied by ground or air. No restrictions or waiting period between treatment and grazing for non-lactating animals. Remove meat animals 30 days prior to slaughter. Do not graze lactating dairy within 7 days of treatment. Do not harvest hay for 37 days after treatment.

Cimarron Plus or Cimarron X-tra (metsulfuron+chlorsulfuron)

0.25-1.25 oz/A Cimarron Plus (0.0075+0.0023 - 0.038+0.012 lb ai) (\$3.30-16.50)

0.5-1 oz/A Cimarron X-tra (0.009+0.012 - 0.018+0.023 lb ai) (\$7.55-15.10)

Spring. For use in pastures, rangeland, or CRP or non-crop land adjacent to these areas. Apply in the spring (preferred) prior to flowering or to fall rosettes. Cimarron Plus contains 48% metsulfuron + 15% chlorsulfuron whereas Cimarron X-tra contains 30% metsulfuron + 37.5% chlorsulfuron. For Cimarron Plus, apply 0.25 oz/A for musk or Scotch thistle, 0.625 oz/A for plumeless thistle, or 1.25 oz/A for bull thistle. For Cimarron X-tra, apply 0.5 oz/A for bull, musk, or Scotch thistle or 1 oz/A for plumeless thistle. Add either a NIS (0.25-0.5% v/v or 1-2 qt per 100 gal. solution) or COC (1-2% v/v or 1-2 gal. per 100 gal. solution). Use higher adjuvant rates during dry conditions. Minimum carrier is 10 gpa for ground applications or 3 gpa for aerial applications. No grazing or haying restrictions. May tank mix growth regulator herbicides such as 2,4-D, dicamba, Tordon, or Remedy.

Telar (chlorsulfuron)

0.5-3 oz Telar 75XP (.023-.061 lb ai) (\$11.90-71.45)

Spring: Apply at rosette stage. Use .5 to 1 oz for musk thistle and 1 to 3 oz/A for bull and Scotch thistle. Minimum carrier is 10 gpa. Add NIS at 1 qt/100 gal. May be tank-mixed with 2,4-D, dicamba, or other labeled tank-mix partners.

RESTRICTIONS: There are no grazing restrictions for rates less than 1.3 oz/A. Labeling does not include hay uses. Do not apply to water, such as lakes, streams, or areas where runoff flows into such areas.

Redeem (triclopyr + clopyralid)

1.5-2.5 pt Redeem 3L (.42-.7 + .07-.12 lb ae) (\$23.30-38.80)

Spring. Premix. Apply from rosette to early bolt stage. Add .5 lb/A 2,4-D if weeds are fully bolted. Minimum carrier is 10 gpa for ground or 3 gpa for air. Redeem is labeled for use in range, pasture, CRP grass seedings, fence rows, and noncrop areas. Redeem contains 2.25 lb triclopyr (Garlon) plus .75 lb clopyralid (Stinger) per gallon.

RESTRICTIONS: Do not graze or harvest forage for dairy cattle for 14 days after application. Do not harvest hay until the next growing season for dairy or harvest hay for other livestock for 7 days after treatment. Remove meat animals at least 3 days before slaughter. Do not treat banks or bottom of irrigation ditches.

Stinger or Transline (*clopyralid*)

.33-1 pt Stinger 3L or Transline 3L (.12-.38 lb ae)

(\$15.15-64.05)

Spring. Apply from rosette to early bolt stage. Stinger is labeled for use in grass pasture, rangeland, fallow, fence rows, and other noncrop areas. Transline is labeled for noncrop areas, rangeland, and rights-of-way. Transline is marketed only to government and public agencies. Results have been very good in SDSU tests. Use the high rate for late bolt stage. Minimum carrier is 5 gpa; use at least 10 gpa for most ground applications. Stinger or Transline have potential in sites where grass cannot be damaged or where trees limit use of herbicides with harmful soil residual.

RESTRICTIONS: Do not contaminate irrigation ditches. No grazing or haying restrictions.

FIELD BINDWEED

Management: Field bindweed is a perennial species that develops an extensive root system making it difficult to control. Management programs may require several years. Apply herbicides at the beginning of flowering or to regrowth in the fall.

Tordon 22K (*picloram*)

1-2 qt Tordon 2L (0.5-1 lb ae)

(\$27.85-55.70)

Spring or Fall. Primarily for small patches. Use 2 qt/A Tordon as a spot treatment. Rates above 1 qt/A cannot exceed 50% of an acre. Rates above 1 pt/A can be used in fallow cropland if the treated areas are less than 10% of the field. Minimum carrier is 20 gpa. The 2 qt rate will reduce the stand; however, additional Tordon or other follow-up is required. Some regrowth may be noted after application during dry seasons. Make spring treatments before seeds form. Make fall application before soil freeze-up.

Tordon has foliar activity and extended soil residual. It controls topgrowth and translocates into roots. Rainfall is required to move the herbicide into the root zone. Trees, legumes, and broadleaf plants are very sensitive to drift and soil residues.

Tordon is registered for use in grass pasture and range, fallow cropland and noncrop areas. Bromegrass, buffalograss, and wheatgrass may be injured; bluegrass is tolerant.

RESTRICTIONS: Do not use in trees. Avoid drift to trees or sensitive broadleaf crops. For rates above 1 qt/A, do not harvest for hay within 2 weeks after treatment. Do not graze dairy animals for 2 weeks after treatment. Remove animals 3 days before slaughter if grazing within 2 weeks after spraying. Do not apply into water or wetlands or on inner banks of irrigation or drainage ditches. Risk of leaching is greatest where soils have rapid permeability (such as loamy to sand) and where the underlying aquifer is near the surface. **Restricted Use Pesticide.**

Tordon 22K + 2,4-D Ester (*picloram* + 2,4-D)

1.5 pt Tordon 2L + 1 lb ae 2,4-D ester (.38 + 1 lb ae)

(\$25.90)

Spring. Amine formulation of 2,4-D may be used if site limitations preclude ester formulations. Minimum carrier is 10 gpa for ground or 2 gpa for air. Intended as one application per year; some regrowth may be noted. Follow-up treatments may be required after 1 year.

RESTRICTIONS: Follow restrictions as described for Tordon and for 2,4-D. **Restricted Use Pesticide.**

2,4-D Ester

1.5-2 lb ae 2,4-D ester 4L (1.5 lb ae)

(\$7.55-10.05)

Spring and Fall. Spring and fall application required each year. Selective, foliage applied, translocated herbicide. Uses for 2,4-D include grass pasture, range, and noncrop areas. Apply 2,4-D ester at 1.5 lb ae/A. Suggested carrier is 10 to 40 gpa. Apply in spring at flowering and retreat in September or early October when new fall growth is 4 to 6 inches. Results can be variable.

Spring or Fall. Single application each year. Rates to 2 lb/A may be used in pasture and range; higher rates are allowed in noncrop and fallow. Control is less than for two applications of 1.5 lb/A each. Best for inaccessible areas where the labor cost for a second application is prohibitive.

RESTRICTIONS: Avoid drift to trees and sensitive crops. Not suggested for use in trees. Do not graze lactating dairy animals for 7 days after application. Labels for 2,4-D allow harvesting hay 30 days after application and require a 3 day removal period before slaughter. Note other label precautions. Labels for 2,4-D products vary.

Dicamba Products (*dicamba*)

1-4 pt dicamba 4L (2 lb ae)

(\$7.60-52.45)

Spring or Fall: Make spring application at flowering or a fall application before a killing frost. Apply 1-2 pt for suppression or 2-4 pt for control. Clarity and Vanquish contain a low vapor salt of dicamba. Use at least 3 gpa carrier for ground or 2 gpa for air.

Dicamba is a selective, translocated herbicide. It has foliar activity. Favorable growing conditions improve results. Dicamba products are registered for use in pasture, range, and noncrop areas. At high rates, bromegrass may be severely stunted; bluegrass and several other grasses are tolerant. Trees, legumes, and broadleaved plants are sensitive to drift and soil residues.

RESTRICTIONS: Do not graze lactating dairy for 40 days or harvest hay for 70 days after application of more than 1 qt/A. Slaughter animals must be removed for 30 days after last application. Avoid drift to non-target plants. Do not contaminate water.

Overdrive (*diflufenzopyr + dicamba*)

4-8 oz Overdrive 70DF (.05-.1 + .125-.25 lb ae)

(\$12.60-25.20)

Spring or Fall. Rate is 4 to 8 ounces per acre based on weed species and maturity. A maximum of 10 oz/A can be applied per season in noncropland sites and a maximum of 8 ounces per acre in pasture, hay, and rangeland. Use 1 qt NIS per 100 gal or MSO at the rate of 1.5 to 2 pt/A. Do not use less than 3 gallons of spray volume per acre. Rainfast 4 hours after application. Overdrive may be tank-mixed with several labeled tank-mix partners to improve control.

Overdrive contains dicamba. Follow drift and vapor movement restrictions as for other dicamba products.

RESTRICTIONS: Supplemental label for aerial application in CRP. Do not plant crops for 30 days after last application. Pasture or rangeland grass treated with Overdrive can be grazed or harvested for livestock feed immediately after application. Do not apply to newly seeded grasses or small grains.

Plateau (*imazapic*)

8-12 oz Plateau 2L (.12-.18 lb ai)

(\$17.70-26.60)

Fall. Plateau is an imidazolinone herbicide used in pasture, range, noncrop areas, and CRP plantings. Plateau is being marketed only through public agencies and organizations. However, it is labeled and may be applied to private or public land.

Suggested rates are 8 to 12 oz/A of 2L. Use the higher rate for dense infestations that have been established for longer periods of time. Plateau at 8-12 fl oz/A may suppress growth of cool season grass species, such as smooth brome and wheatgrass, and switchgrass. Add MSO at 2 pt plus 2 pt/A 28% N. Minimum carrier is 10 gpa for conventional ground equipment or 2 gpa for low volume equipment.

Several tree and shrub species listed on the label are known to have acceptable tolerance when applied under the canopy and/or to the foliage. Tolerance is based upon trees with a minimum of 2 inch DBH (diameter at breast height). Some species may exhibit tip chlorosis and minor necrosis. Foliar contact on some species may increase injury, defoliation, and terminal death.

RESTRICTIONS: Treated areas may be grazed. Do not harvest hay for 7 days after treatment.

Paramount (*quinclorac*)

5.3-8 oz Paramount 75DF (.38 lb ai)

(\$18.45-27.85)

Spring. Primarily for field bindweed. Also suppresses leafy spurge and perennial thistle. Controls annual grass but does not cause permanent damage to most perennial grasses. Most effective if applied in fall to regrowth at least 4 inches long. Make follow-up applications the next year if necessary. Paramount is labeled for use in roadsides, fence lines, rights-of-way, and other noncrop areas and fallow. Apply with ground equipment. Add 2 pt COC or MSO plus .5 to 1 gal 28% N or 2.5 lb AMS per acre. Apply to active weed growth.

RESTRICTIONS: Grass in treated areas cannot be grazed or harvested for forage. Follow crop rotation restrictions for fallow application.

ABSINTH WORMWOOD (Wormwood Sage)

Management: Absinth wormwood is a perennial species that also is a prolific seed producer, so plants may re-establish a few years after control. Just 2,4-D can be effective, but two applications (spring and fall) may be required for control. Herbicides such as Milestone, ForeFront, or Tordon may be effective with one application. Herbicides may be effective in the spring up to the end of June, but may be ineffective after early June during abnormally dry springs. In trees, apply 2,4-D or Redeem after tree leaves turn color and sage is still green.

2,4-D Ester or Amine

2 lb ae 2,4-D (2 lb ae)

(\$9.15-10.05)

Spring or Fall. Apply when wormwood is 8 to 10 inches tall. Rate is 2 lb ae/A. Suggested carrier is 20 gpa. Control is variable. Good coverage and temperature over 65° F improves control. Low-volatile ester formulations are preferred for grass pasture and roadsides. Use amine formulations near trees or where vapor-drift risk is critical for sensitive plants.

RESTRICTIONS: Avoid drift to sensitive plants. Do not graze lactating dairy on treated areas for 7 days. Labels allow harvesting hay 30 days after application and require a 3 day removal period before slaughter. Product label restrictions vary.

Milestone (*aminopyralid*)**ForeFront (*aminopyralid+2,4-D*)**

6-7 oz Milestone (0.09-0.11 lb ae) (\$16.80-19.60)

1.5-2 pt ForeFront (0.06-0.08 lb ae aminopyralid + 0.5-0.67 lb ae 2,4-D) (\$10.30-13.70)

Spring or Fall: Apply Milestone at 6-7 fl oz/A or ForeFront at 1.5-2 pt/A before wormwood is 12 inches tall. May see reduced control with later applications, particularly in drought stressed conditions. Use a non-ionic surfactant (NIS) at 0.25-0.5% (1-2 qt per 100 gallons spray solution) under adverse growing conditions or advanced weed growth stages.

Recommended minimum carrier volume is at least 10 gpa for ground application or at least 3 gpa for aerial application. Greater carrier volumes may improve coverage and control. Removal of old grass litter by mowing or burning may improve coverage and wormwood control. Milestone may be applied to non-irrigation ditch banks and seasonally dry wetlands, but may not be applied over water or to areas where surface water is present. Observe restrictions as described for other species.

Tordon 22K (*picloram*)**Tordon 22K + 2,4-D Ester (*picloram + 2,4-D*)**

1 pt Tordon 2L (.25 lb ae) (\$13.95)

.5-1 pt Tordon 2L + 1 lb ae 2,4-D ester (.12-.25 + 1 lb ae) (\$12.00-18.95)

Spring or Fall. Use Tordon alone or as a tank-mix with 2,4-D ester. Apply in spring before wormwood is over 12 inches. Minimum carrier is 10 gpa for ground or 2 gpa for air. Tordon at 1 pt alone or .5 to 1 pt Tordon plus 1 lb ae/A 2,4-D has provided excellent results in SDSU tests. Results on larger plants have been better than for 2,4-D. Promising as a fall treatment. Tordon is registered for use in grass pasture and range.

RESTRICTIONS: Do not use in trees. Avoid drift to sensitive broadleaved crops. Do not graze lactating dairy on treated areas for 7 days. Labels allow harvesting hay 30 days after application and require a 3 day removal period before slaughter. Note other label precautions. There are no restrictions for lactating dairy if Tordon is used alone at this rate. **Restricted Use Pesticide.**

Redeem (*triclopyr + clopyralid*)

1.5-2 pt Redeem 3L (0.42-0.56 + 0.14-0.19 lb ai) (\$23.30-31.05)

Spring or Fall: Apply in spring when wormwood is less than 12 inches tall or to regrowth in the fall. Add NIS at 0.25% of spray volume.

RESTRICTIONS: Do not graze or harvest forage for dairy cattle for 14 days after application. Do not harvest hay until the next growing season for dairy or harvest hay for other livestock for 7 days after treatment. Remove meat animals at least 3 days before slaughter. Do not treat banks or bottom of irrigation ditches.

SULFUR CINQUEFOIL and CHICORY

Management: Sulfur cinquefoil is a perennial weed that can become invasive in grasslands, particularly in western South Dakota. Chicory may be invasive in pastures and along roadsides in any area throughout South Dakota. For cinquefoil, follow-up applications may be needed 2-3 years after initial applications.

Tordon (*picloram*)

1 pt Tordon 2L (0.25 lb ae) (\$13.95)

Spring or Fall: Apply to actively growing plants in the spring or to regrowth in the fall.

RESTRICTIONS: Do not apply near trees. Avoid drift to sensitive broadleaf plants. Avoid applications near water or on soil with a shallow water table. Treated areas may be grazed. **Restricted Use Pesticide.**

Milestone (aminopyralid)**ForeFront (aminopyralid+2,4-D)****Chaparral (aminopyralid+metsulfuron)**

<u>4-7 fl oz Milestone 2L (0.06-0.11 lb ae)</u>	(\$11.30-19.75)
<u>1.5-2 pt ForeFront (0.06-0.08 + 0.5-0.65 lb ae) for cinquefoil</u>	(\$10.30-13.70)
<u>2-2.6 pt ForeFront (0.08-0.11 + 0.65-0.87 lb ae) for chicory</u>	(\$13.70-17.85)
<u>2-2.5 oz wt Chaparral (0.07-0.08 + 0.012-0.015 lb ai) for cinquefoil</u>	(\$10.60-13.20)
<u>1.5-2 oz wt Chaparral (0.05-0.07 + 0.009-0.012 lb ai) for chicory</u>	(\$7.95-10.60)

Spring. Apply to actively growing chicory plants or cinquefoil plants in the pre-bud growth stage. For Milestone or ForeFront, add NIS at 0.25% v/v (1 qt per 100 gallon spray solution) during adverse growing conditions or to weeds at advanced growth stages. For Chaparral, add NIS (0.25-0.5% v/v), COC (1-2% v/v), or MSO (0.5% v/v). May also add UAN (2-4 qt/A) or AMS (2-4 lb/A).

RESTRICTIONS: There are no grazing restrictions for Milestone, but aminopyralid may be transferred in manure from livestock grazing on grass that had been sprayed within 3 days. For ForeFront, do not harvest hay within 14 days after application.

Remedy Ultra (triclopyr)

<u>1-2 pt Remedy Ultra 4L (0.5-1 lb ae)</u>	(\$12.10-24.20)
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Spring. Apply to young plants in the rosette stage.

RESTRICTIONS: Do not allow lactating dairy animals to graze treated areas until the season following application. Do not harvest hay for 14 days after application. Withdraw livestock from treated areas at least 3 days prior to slaughter.

2,4-D ester or amine

<u>2 qt 2,4-D 4L</u>	(\$9.15-10.05)
<u>1 qt 2,4-D 4L + 1 pt dicamba 4L</u>	(\$12.20-18.15)
<u>1 qt 2,4-D 4L + 1 pt Tordon 2L</u>	(\$18.50-18.95)

Spring. Apply to young and actively growing plants.

RESTRICTIONS: Avoid drift to trees and non-target vegetation. Do not graze lactating dairy animals on treated areas for 7 days. Do not harvest hay until 30 days after application and remove livestock from treated areas at least 3 days prior to slaughter. Observe additional restrictions when tank mixing with dicamba or Tordon (picloram).

Escort (metsulfuron)

<u>1-2 oz wt Escort 60XP (0.038-0.075 lb ai) for cinquefoil</u>	(\$26.25-52.50)
<u>0.33-0.5 oz wt Escort 60XP (0.012-0.019 lb ai) for chicory</u>	(\$8.65-13.15)

Spring. May be applied to cinquefoil up to the flowering growth stage. Add NIS at 0.25% v/v (1 pt per 100 gallons spray solution).

RESTRICTIONS: No grazing or haying restrictions for rates less than 1.66 oz/A, but delay hay harvest for 3 days after application if more than 1.66 oz/A is applied. High rates may suppress grass growth.

COMMON MULLEIN and HOUNDSTONGUE

Management: Common mullein and houndstongue are biennial species that grow rosettes the first year and bolt during the second year of growth. Apply herbicides at the rosette stage during periods of active growth. For common mullein, use a surfactant to help the herbicide penetrate the extremely hairy leaf surface.

Escort (*metsulfuron*)

1-2 oz Escort 60XP (.038-.076 lb ai) (\$26.25-52.50)

Spring. Apply at rosette stage. Full coverage is very important. Escort at .5 to 1 oz/A has been effective in SDSU trials. Add NIS at 1 qt/100 gal.

RESTRICTIONS: Do not apply on grasses grown for seed. No grazing restriction. Allow 3 days after application before harvesting hay if more than 1.66 oz/A Escort is applied. Do not apply to lakes, streams, or sites that may have runoff into such areas. High rates of Escort may suppress grass production.

Cimarron (*metsulfuron*) Premix Products

Cimarron Max (*metsulfuron*+*dicamba*+*2,4-D*) (\$6.20-24.85)

Cimarron Plus (48% *metsulfuron* + 15% *chlorsulfuron*) (\$4.95-16.50)

Cimarron X-tra (30% *metsulfuron* + 37.5% *chlorsulfuron*) (\$7.55-30.15)

Spring. For use in pastures, rangeland, or CRP or non-crop land adjacent to these areas. Cimarron Max is sold as a twin-pack combination containing Part A (*metsulfuron*) and Part B (*dicamba*+*2,4-D*). For Cimarron Max, common mullein may be controlled at the low rate (20 acres per pack) and houndstongue may be controlled at the high rate (5 acres per pack). For Cimarron Plus, apply 0.375-0.625 oz/A for common mullein or 1.25 oz/A for houndstongue. For Cimarron X-tra, apply 0.5 oz/A for common mullein or 2 oz/A for houndstongue. Add either a NIS (0.25-0.5% v/v or 1-2 qt per 100 gal. solution) or COC (1-2% v/v or 1-2 gal. per 100 gal. solution). Use higher adjuvant rates during dry conditions.

Telar (*chlorsulfuron*)

1-3 oz Telar 75XP (.047-.061 lb ai) (\$23.80-71.45)

Spring. For common mullein control. Apply at rosette stage. Full coverage is very important for best results. Minimum carrier is 10 gpa. Add NIS at 1 to 2 qt/100 gal. May be mixed with 2,4-D, dicamba, or other labeled tank-mix partners.

RESTRICTIONS: There are no grazing restrictions for rates less than 1.3 oz/A. Labeling does not include hay uses. Do not apply to water, such as lakes, streams, or areas where runoff flows into such areas.

Plateau (*imazapic*)

8-12 oz Plateau 2L (0.12-0.18 lb ai) (\$17.70-26.60)

Spring. Apply at the rosette stage while plants are actively growing. Plateau may also partially control common mullein, although it is only registered for houndstongue control.

Add MSO (1.5-2 pt/A) or NIS (0.25% v/v or 1 qt/100 gallons of spray solution) plus a nitrogen-based liquid fertilizer such as 28% N at 2-3 pt/A.

RESTRICTIONS: Potential for grass injury, particularly to switchgrass or cool season grasses such as smooth brome or crested wheatgrass. Treated areas may be grazed. Do not harvest for hay until at least 7 days after treatment.

Milestone (aminopyralid)**ForeFront (aminopyralid+2,4-D)****Chaparral (aminopyralid+metsulfuron)**

7 fl oz Milestone (0.11 lb ae)	(\$19.60)
2-2.6 pt ForeFront (0.08-0.11 lb + 0.67-0.87 lb ae)	(\$13.70-17.85)
2-3.3 oz wt Chaparral (0.07-0.11 lb ae + 0.01-0.02 lb ai)	(\$10.60-17.45)

Spring: Apply at the rosette stage. Full coverage and use of a surfactant is necessary for best results (must add NIS, COC, or MSO to Chaparral). Use NIS at 0.25-0.5% v/v (1-2 qt per 100 gallon spray solution). Control has been very good in SDSU trials. Lower Milestone rates have resulted in less control.

RESTRICTIONS: Aminopyralid may be transferred in manure from livestock that have consumed treated forage within the previous 3 days. For ForeFront, do not harvest forage for hay within 14 days after application and do not apply more than 2.6 pt/A in a growing season.

Tordon (picloram)**Tordon + 2,4-D Ester (picloram + 2,4-D)**

1 qt Tordon 2L (.5 lb ae)	(\$27.85)
1 pt Tordon 2L + 1 lb ae 2,4-D ester (.25 + 1 lb ae)	(\$18.95)

Spring. Apply at rosette stage prior to stalk elongation. Use Tordon alone or at a lower rate in a tank-mix with 2,4-D. Treatments have exceeded 90% control in tests in western South Dakota. Surfactant improves penetration through woolly leaf surface. Minimum carrier is 10 gpa for ground and 2 gpa for air. Reduction is apparent for at least 2 years.

RESTRICTIONS: Do not use in trees. Avoid drift to sensitive broadleaved crops. Avoid contaminating water. Note other label precautions. Note 2,4-D restrictions when using tank-mix. Restricted Use Pesticide.

2,4-D Ester

2 lb ae 2,4-D ester (2 lb ae)	(\$10.05)
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Spring. Apply while plants are actively growing but before bloom.

RESTRICTIONS: Avoid drift to trees and sensitive broadleaved plants. Do not graze lactating dairy animals on treated areas for 7 days. Labels allow harvesting hay 30 days after application and require a 3 day removal period before slaughter. Product label restrictions vary.

BURDOCK

Management: Common burdock is a biennial weed that is most often a problem in shelterbelts. Consequently, it can be challenging to use herbicides to control burdock without injuring the trees. Furthermore, burdock often develops a persistent seed bank so plants may appear again within a couple years after control. 2,4-D is commonly used for burdock control, but care must be taken to avoid injury to trees or nearby gardens or crops.

2,4-D amine

1 lb ae 2,4-D amine	(\$4.60)
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Spring or Fall: Apply while burdock is in the rosette stage and actively growing. Consider making applications to rosettes in the fall to avoid tree injury.

RESTRICTIONS: Even products that claim "low volatility" still have the potential to volatilize. Volatilization may be slightly reduced if applied when temperatures are less than 85° F.

Stinger or Transline (*clopyralid*)

0.5-0.66 pt Stinger 3L or Transline 3L (0.19-0.25 lb ae) (\$22.95-42.25)

Spring or Fall: Apply while burdock is in the rosette stage and actively growing. Stinger will not volatilize, but there is risk of tree root uptake if tree roots are exposed or excessive rates used.

RESTRICTIONS: Do not apply over the top of deciduous trees and avoid leaf contact. Risk of tree injury is less for large trees. Avoid spray contact on the bark of young trees.

Chaparral (*aminopyralid + metsulfuron*)

2 oz wt Chaparral (0.7 + 0.01 lb ai) (\$10.60)

Spring or Fall: Apply while burdock is in the rosette stage and actively growing. Chaparral will not volatilize, but there is risk of tree root uptake if tree roots are exposed or excessive rates used. Add NIS (0.25% v/v) or COC (1% v/v).

RESTRICTIONS: Not as safe around trees as Stinger. Do not apply around trees unless unanticipated injury due to root uptake is acceptable. Do not apply over the top of trees and avoid leaf contact. Risk of tree injury is less for large trees. Sensitive trees include some conifers (pine, fir, spruce), legume trees such as locust, birch, lilacs, and possibly hackberry. Do not apply near young trees.

Glyphosate products

22 oz 4.5 lb ae/gallon product or 32 oz of 3 lb ae/gallon product (0.75 lb ae) (\$3.30-7.30)

Spring or Fall. Apply while burdock is in the rosette stage and actively growing.

RESTRICTIONS: Will kill or severely injure all green vegetation contacted by the herbicide. Avoid spray contact on bark of young trees.

BLACK HENBANE

Management: Black henbane is an annual or biennial weed that can invade disturbed areas in pastures, roadsides, or forested areas. Henbane can be toxic to humans and livestock but livestock will generally avoid eating it if other forage is available. It is most common in the Black Hills area, but can also be found in central South Dakota.

Escort (*metsulfuron*)

0.5-1 oz wt Escort 60XP (0.019-0.038 lb ai) (\$13.15-26.25)

Spring. Apply to actively growing plants in the rosette growth stage.

RESTRICTIONS. No grazing or haying restrictions for rates less than 1.66 oz/A.

Chaparral (*aminopyralid + metsulfuron*)

2.5-3 oz wt Chaparral (0.08-0.1 + 0.015-0.018 lb ai) (\$13.20-15.85)

Spring. Apply to actively growing plants in the rosette growth stage.

RESTRICTIONS: No grazing restriction. If possible, do not hay until 14 days after application to allow the herbicide to become active in the weed. Aminopyralid may be transferred in manure from livestock grazing on grass that had been sprayed within the previous 3 days.

Dicamba

1 pt dicamba 4L product (0.5 lb ae) (\$7.60-13.10)

Spring. Apply to actively growing plants in the rosette growth stage.

RESTRICTIONS: Do not graze lactating dairy for 7 days after application and do not harvest hay for lactating dairy animals until 37 days after application. No grazing restriction for non-lactating dairy animals. Do not graze livestock for slaughter on treated areas until 30 days after application.

Tordon (picloram)

1-2 pt Tordon 2L (0.25 lb ae) (\$13.95-27.85)

Spring. Apply to actively growing plants in the rosette growth stage.

RESTRICTIONS: Do not apply near trees. Avoid drift to sensitive broadleaf plants. Avoid applications near water or on soil with a shallow water table. Treated areas may be grazed. **Restricted Use Pesticide.**

COMMON TANSY

Management: Common tansy is a perennial species that seems to be particularly invasive in or near wooded areas, such as the Black Hills. Common tansy may be often found in low areas or near waterways. It mainly spreads by seeds, but will also spread by creeping roots. Metsulfuron products (e.g. Escort) are commonly used for control.

Tordon 22K (picloram)

2-3 pt Tordon 2L (.5-.75 lb ae) (\$27.85-41.80)

Spring. Apply before bloom. Results in SDSU tests show 75 to 90% control. The 2 pt/A rate is minimal; adding 1 lb ae/A 2,4-D ester is suggested with the low rate. Apply in minimum of 10 gpa for ground equipment. Tordon is registered for grass pasture and range.

RESTRICTIONS: Do not use in trees. Avoid drift to sensitive broadleaved crops. For rates above 1 qt/A, do not harvest hay for 2 weeks or graze dairy animals for 2 weeks and remove slaughter animals 3 days before slaughter. Refer to surface and groundwater precautions. Restricted Use Pesticide.

Escort (metsulfuron)

1-2 oz Escort 60XP (.038-.075 lb ai) (\$26.25-52.50)

Postemergence. Apply to actively growing plants. Good spot treatment option. Results have been very good. Add NIS at 1 to 2 qt per 100 gal. Minimum carrier is 10 gpa for ground or 5 gpa for air. May be tank-mixed with 2,4-D or dicamba.

RESTRICTIONS: Do not apply to lakes, streams, or areas where runoff flows into such areas. No grazing or haying restrictions at this rate.

Cimarron (metsulfuron) Premix Products

Cimarron Max (metsulfuron+dicamba+2,4-D) (\$24.85)

Cimarron Plus (48% metsulfuron + 15% chlorsulfuron) (\$16.50)

Cimarron X-tra (30% metsulfuron + 37.5% chlorsulfuron) (\$30.15)

Spring. For use in pasture, rangeland, or CRP or non-crop land adjacent to these areas. Cimarron Max is sold as a twin-pack combination containing Part A (metsulfuron) and Part B (dicamba+2,4-D). Common tansy may be controlled with Cimarron Max at the high rate (5 acres per pack), with Cimarron Plus at 1.25 oz/A, or with Cimarron X-tra at 2 oz/A. Add either a NIS (0.25-0.5% v/v or 1-2 qt per 100 gal. solution) or COC (1-2% v/v or 1-2 gal. per 100 gal. solution). Use higher adjuvant rates during dry conditions.

Telar (*chlorsulfuron*)

1-3 oz Telar 75XP (.047-.061 lb ai) (\$23.80-71.45)

Postemergence. Apply to actively growing plants. Minimum carrier is 10 gpa for ground. Add NIS at 1 qt/100 gal. May be mixed with 2,4-D, dicamba, or other labeled tank-mix partners.

RESTRICTIONS: There are no grazing restrictions for rates less than 1.3 oz/A. Labeling does not include hay uses. Do not apply to water, such as lakes, streams, or areas where runoff flows into such areas.

ST. JOHNSWORT

Management: St. Johnswort spreads by seed and creeping roots. Repeated tillage may suppress populations and repeated mowing may help reduce seed spread. Biocontrol insects have been effective for large infestations in western states.

Tordon (*picloram*)

Tordon + 2,4-D Ester (*picloram* + 2,4-D)

1 pt Tordon 2L (.25 lb ae) (\$13.95)

.5-1 pt Tordon 2L + 1 lb ae 2,4-D (.12-.25 + 1 lb ae) (\$12.00-18.95)

Spring or **Fall:** Use Tordon alone or as a tank-mix with 2,4-D. Has provided excellent control in SDSU tests. Spring application at bud stage gave 95% control for a 2-year period. Reduce the Tordon rate to .5 pt/A when used with 2,4-D if conditions are favorable. Control has averaged 90 to 95% for one year. Minimum carrier is 10 gpa for ground or 2 gpa for air. Tordon may be used in grass pasture, range, and rights-of-way.

RESTRICTIONS: Do not use in trees. Avoid drift to sensitive broadleaved plants. Avoid contaminating water. Note other label precautions. Note 2,4-D restrictions when using tank-mixes. Restricted Use Pesticide.

Milestone (*aminopyralid*)

ForeFront (*aminopyralid*+2,4-D)

Chaparral (*aminopyralid* + *metsulfuron*)

5-7 fl oz Milestone (0.06-0.11 lb ae) (\$14.00-19.60)

2-2.6 pt ForeFront (0.08-0.11 lb ae + 0.67-0.87 lb ae) (\$13.70-17.85)

2.5-3 oz wt Chaparral (0.08-0.1 + 0.015-0.018 lb ai) (\$13.20-15.85)

Spring or **Fall:** Apply in the spring at the bud growth stage or in the fall to regrowth. For Milestone and ForeFront, use NIS at 0.25-0.5% v/v (1-2 qt per 100 gallon spray solution) in adverse growing conditions or to weeds at advanced growth stages. For Chaparral, add NIS (0.25-0.5% v/v), COC (1-2% v/v) or MSO (0.5% v/v). May also add UAN (2-4 qt/A) or AMS (2-4 lb/A). Observe restrictions as described for other species.

RESTRICTIONS: There are no grazing restrictions, but aminopyralid may be transferred in manure from livestock that have consumed treated forage within the previous 3 days.

Escort (*metsulfuron*)

1-2 oz Escort 60XP (.028 lb ai) (\$26.25-52.50)

Postemergence. Apply at the bud to bloom stage; may also be applied to fall regrowth. Results from spot treatments have been excellent. Special 2(ee) labeling for St. Johnswort. Add NIS at 1 qt/100 gal. Minimum carrier is 10 gpa for ground or 4 gpa for air. May be tank-mixed with 2,4-D, dicamba, picloram, triclopyr, and clopyralid.

RESTRICTIONS: Do not apply to water, lakes, streams, or areas that may have runoff. Forage grasses may be cut for hay 3 days after application.

TOADFLAX (Dalmatian and Yellow)

Management: Dalmatian and yellow toadflax spread by seeds and creeping roots. Dalmatian toadflax is generally more sensitive to herbicides than yellow toadflax. Yellow toadflax control requires high herbicide rates and several years of application which can become very costly. Therefore, it is strongly recommended to watch for new infestations and control populations while they are small. For yellow toadflax, SDSU trials indicate that Tordon at 1-2 qt/A may be the most effective herbicide option. Applications of 2,4-D at flowering may defoliate yellow toadflax and help reduce spread by seed, but will only provide approximately 20% control the following year. Biocontrol insects have been effective on large Dalmatian toadflax infestations, but are not effective on yellow toadflax.

Tordon 22K (<i>picloram</i>)	Dalmatian or yellow toadflax
Tordon 22K + 2,4-D ester (<i>picloram</i> + 2,4-D ester)	

1-2 qt Tordon 2L (1 lb ae)	(\$27.85-55.70)
1 qt Tordon 2L + 1.5 lb ae 2,4-D ester (.5+1.5 lb ae)	(\$35.40)

Spring or Fall. For Dalmatian toadflax, apply to actively growing plants through the full bloom stage or in late summer or fall. Use Tordon in tank-mix with 2,4-D in spring before full bloom. For yellow toadflax, Tordon at 2 qt/A may provide 60-70% control the following year. May require annual treatment for 2 to 3 years.

RESTRICTIONS: Do not use in trees. Avoid drift to trees or sensitive broadleaf crops. For rates above 1 qt/A, do not harvest for hay within 2 weeks of treatment. Do not graze lactating dairy animals for 2 weeks after treatment. Remove animals 3 days before slaughter if grazing within 2 weeks after spraying. Do not apply into water or wetlands or on inner banks of irrigation or drainage ditches. Risk of leaching is greatest where soils have rapid permeability (such as loamy to sand) and where the underlying aquifer is near the surface. **Restricted Use Pesticide.**

Telar (<i>chlorsulfuron</i>)	Dalmatian or yellow toadflax
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1-2.5 oz Telar 75XP (.017 + .012 lb ai)	(\$23.80-59.50)
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Postemergence. For dalmatian toadflax, apply 2-3 oz/A and use a high carrier volume (minimum of 24 gallons water/A) if possible. Use NIS at 1 qt/100 gallons. Fall applications may provide more consistent control. For yellow toadflax, apply a minimum of 1.5 oz/A. Telar (1.25 oz/A) is sometimes tank-mixed with Tordon (1 qt/A) as some yellow toadflax populations may be more sensitive to Telar than Tordon (or vice versa) or Telar may be more effective at earlier timings whereas Tordon may be more effective at later timings.

RESTRICTIONS: Do not allow spray drift onto sensitive crops. There are no grazing restrictions for rates less than 1.3 oz/A. Labeling does not include hay uses. Do not apply to water, such as lakes, streams, or areas where runoff flows into such areas. Special 2(ee) label for these weeds. Note label restrictions.

Escort (<i>metsulfuron</i>)	Dalmatian toadflax only
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2 oz Escort 60XP (.070 lb ai)	(\$52.50)
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Postemergence. Apply to actively growing plants. Good spot treatment option; spray to wet entire plant.

RESTRICTIONS: No grazing restrictions at this rate. Allow 3 days after application before harvesting hay if more than 1.66 oz/A Escort is applied. Special 2(ee) label for these weeds.

Plateau (<i>imazapic</i>)	Dalmatian toadflax only
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8-12 oz Plateau 2L (.12-.18 lb ai)	(\$17.70-26.60)
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Fall. Label recommends 12 oz/A of Plateau plus 2 pt/A MSO for control of dalmatian toadflax. For best results apply to the basal growth in the fall, after the first hard frost. The plant can have the top 25% showing necrotic tissue; however, there should be green stem and leaf tissue remaining. Applications made prior to this timing will result in poor control. Grass tolerance is an important issue.

RESTRICTIONS: Treated areas may be grazed. Do not harvest for 7 days after treatment. Plateau is being marketed only through public agencies and organizations. However, it is labeled and may be applied to private as well as public lands.

PUNCTUREVINE

Management: Puncturevine is an annual weed species, but is problematic because it produces large spiny burs that can puncture vehicle tires. It may be found on roadsides or field roads where the soil is dry and compacted. It is very susceptible to 2,4-D, but new seedlings may emerge after application which can make this weed difficult to control.

2,4-D Amine or Ester

2 lb ae 2,4-D (2 lb ae) (\$9.15-10.05)

Postemergence. Apply when new seedlings appear. Tank-mixes with non-selective herbicides in noncrop areas will improve year-long control. Apply in 10 to 20 gpa carrier.

RESTRICTIONS: Note 2,4-D label restrictions. Avoid drift to non-target plants.

Telar (*chlorsulfuron*)

1-3 oz Telar 75XP (.061 lb ai) (\$23.80-71.45)

Preemergence or **Postemergence.** SDSU results have indicated greater control from PRE compared to POST applications. For PRE applications, apply in the late fall or very early spring before spring growth. Moisture is required to activate in soil. For POST applications, add NIS (0.25% v/v) or COC (1% v/v).

May be used with other selective or bareground herbicides.

RESTRICTIONS: Avoid drift to sensitive crops. There are no grazing restrictions for rates less than 1.3 oz/A. Labeling does not include hay uses. Do not apply to water, such as lakes, streams, or areas where runoff flows into such areas.

GIANT KNOTWEED

Management: As the name suggests, giant knotweed is a large plant that can get 6 to 16 ft tall with heart-shaped leaves 6-16 inches long. It has a unique bamboo-like hollow stem. It often grows near streams, so herbicide options may be limited. Aquatic glyphosate is the only herbicide registered for knotweed control. Studies in other states have indicated that foliar applications of imazapyr (e.g. Habitat) or triclopyr (e.g. Garlon) may also be effective. Giant knotweed is generally very difficult to control with herbicides.

Aquatic glyphosate products (*glyphosate*)

AquaMaster, Aquaneat, and Rodeo are examples of glyphosate products registered for use near water.

Stem injection: Inject 5 ml of the glyphosate product into stems between the second and third internodes above the ground.

Cut stem: Cut stems just below the second or third node above the ground. Immediately apply 0.36 fl oz (10 ml) of a 50% solution of the glyphosate product and water into the "well" or the exposed internode. Do not apply more than 8 qt/A, which would be about 1,500 stems if using the 50% solution. Remove the cut giant knotweed stems so that they do not develop roots and grow.

POISON HEMLOCK

Management: Poison hemlock is a biennial species that grows only foliage the first year and bolts and flowers the second year. Poison hemlock may be confused with wild carrot, but poison hemlock often grows taller, has purple blotches on its stems, and will have no hairs whereas wild carrot may be slightly hairy. Poison hemlock is toxic to livestock and humans. It may be found along roadsides, stream banks, waste areas, pasture edges, and occasionally in no-till fields. Control may require a multiple year effort.

2,4-D Ester + Dicamba Product (2,4-D + dicamba)

1 lb ae 2,4-D Ester + .5 to 1 pt dicamba 4L (1 + .25-.5 lb ae) (\$8.85-18.15)

Fall or **Early Spring.** Apply at fall rosette stage or to new growth in early spring. Use 10 to 20 gpa carrier for ground equipment. May be applied by air using 3 to 10 gpa carrier if there are no sensitive broadleaved crops in the area. Refer to Dicamba Product table.

RESTRICTIONS: Avoid drift to trees and sensitive broadleaved plants. Do not graze lactating dairy on treated areas for 7 days after application. Labels for 2,4-D allow harvesting hay 30 days after application and require a 3 day removal period before slaughter. Labeling for rates up to 1 pt/A restricts grazing lactating dairy for 7 days or haying for 37 days after application.

Tordon 22K + 2,4-D (picloram + 2,4-D)

.38 - .5 pt Tordon 2L + 1 lb ae 2,4-D (.1-.12 + 1 lb ae) (\$10.30-12.00)

2-4 pt Grazon or Tordon 101 Mixture 2.54L (.12-.24 + .5-1 lb ae) (\$7.55-15.05)

Spring. Apply in early spring before flower stalks fully elongate. Minimum carrier is 10 gpa for ground or 2 gpa for air. Tordon is registered for use in grass pasture and range. Grazon and Tordon 101 Mixture are premixes containing .54 lb picloram + 2 lb 2,4-D amine per gal; 2 pt Grazon is equivalent to .54 pt Tordon + 1 pt 2,4-D 4L.

RESTRICTIONS: Do not use in trees. Avoid drift to sensitive broadleaved plants. Avoid contaminating water. Note other label precautions. Treated areas may be grazed. Note 2,4-D restrictions when using tank-mix.
Restricted Use Pesticide.

Escort (metsulfuron)

1-2 oz Escort 60XP (0.038-0.075 lb ai) (\$26.25-52.50)

Spring. Apply 1-2 oz/A in spring while plants are actively growing.

RESTRICTIONS: Do not apply to lakes, streams, or areas where runoff flows into such areas. If applying more than 1.67 oz/A, do not harvest grasses for hay or forage until at least 3 days after application.

EUROPEAN COMMON REED (*Phragmites*)

Management: European common reed (*Phragmites australis* subsp. *australis*) is a perennial grass species that looks similar to the native common reed (*Phragmites australis* subsp. *americanus*), which is not a local noxious weed species. The fluffy plume on European common reed may be denser than the native common reed. European common reed stems may be rigid, rough, dull, and slightly ribbed whereas native common reed stems are smooth and shiny. Both reed species may be found in sunny wetland habitats including marshes, streams or lake shores, ponds, wet meadows, and road ditches or in areas where cattails may be found.

Habitat (*imazapyr*)

4-6 pt/A Habitat (1-1.5 lb ai)

(\$131.25-196.90)

Foliar: Apply to actively growing foliage after full leaf elongation. Full spray coverage is important. If old plant residue is inhibiting herbicide interception, consider removing this residue by mowing or burning and wait for approximately 5 foot tall regrowth before applying the herbicide.

Apply with an adjuvant such as NIS (0.25% v/v), MSO (1.5-2 pt/A or 1% v/v), or silicone-based surfactant. Be sure to use adjuvants approved for aquatic use.

RESTRICTIONS: Applications of Habitat can only be made by federal or state government entities or applicators who are licensed or certified applicators making applications under a program sponsored by federal or state government entities. There are no restrictions on livestock consumption of water from the treated area.

Aquatic Glyphosate Product (*glyphosate*)

4-6 pt/A (2-3 lb ae)

(\$26.25-39.40)

Aquatic glyphosate is available in several products that are approved for use on aquatic sites. Examples of products include Rodeo, AquaMaster, AquaNeat, Cinco, Glyfos Aquatic, and several others. Glyphosate is a non-selective, translocated, foliar-applied herbicide. Both grass and broadleaf plants will be injured.

Foliar: For suppression only. Apply in late summer or fall when the plants are actively growing and in full bloom. Complete coverage is important. If old residue is inhibiting coverage, reapplication may be necessary. Visual control symptoms may be slow to develop.

Use water carrier rate of 10-40 gpa. For hand-held sprayers, use 0.75-1.5% solution in water. Add a NIS at 2 qt/100 gallons solution. Be sure to use a surfactant registered for aquatic uses.

RESTRICTIONS: Do not apply within ½ mile upstream of potable water intake in flowing streams or within ½ mile of potable water intake in standing water. There are no restrictions for irrigation or recreational uses.

SHELTERBELTS

(Does not include fruit trees)

Glyphosate Products (*Numerous*)

2-4 qt glyphosate 3 lb ae (1.5-3 lb ae)	(\$6.55-13.15)
1.5-3 qt 4 lb ae (1.5-3 lb ae)	(\$10.35-20.65)
1.4-2.8 qt 4.5 lb ae (1.5-3 lb ae)	(\$14.90-29.80)

Postemergence. Apply when weeds are actively growing and at boot or bud to bloom stage. Fall application is more effective than spring. Canada thistle is reduced 75 to 85%; field bindweed 50 to 75%. Field bindweed control is more variable. Apply in 10 to 40 gpa carrier. Rates are 3 qt for Canada thistle, and 4 qt of 3L ae/A for field bindweed. Adjust rates for other formulations.

Products contain different salts of glyphosate acid, including several "Roundup" products, "Touchdown" products, "Glyphomax" products, Glyphos and others. Rates for formulations are listed according to acid equivalent content. Check specific product labeling. Roundup Pro or Touchdown Pro labeling includes tree plantings and noncrop sites. Other products limit use to trees and noncrop areas associated with agricultural sites. Product concentration also varies. Glyphosate is a nonselective, foliar, translocated herbicide. There is no soil residual activity.

RESTRICTIONS: Avoid spray or drift contact on green leaves, stems, or new bark. Note other label precautions.

2,4-D Amine

1-1.5 lb ae 2,4-D (1-1.5 lb ae)	(\$4.60-6.85)
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Postemergence. Selective, translocated herbicide for broadleaved weeds. This herbicide is useful to reduce stands of perennial weeds including field bindweed, Canada thistle, or leafy spurge. Labeling is for noncrop areas; tree uses are not listed. Apply when weeds are actively growing and at bud stage. Requires retreatment in fall. Apply 1 to 1.5 lb ae 2,4-D amine/A. Suggested carrier is 40 gpa. Use no more than 20 psi pressure to produce coarse droplets and reduce risk of drift. Spray when it's calm and expected high temperature is below 75° F.

RESTRICTIONS: Very small amounts of herbicide from vapor or droplet drift can seriously damage or kill deciduous trees. Some leaf burn may be noted. Conifers are somewhat less sensitive, especially when not actively growing. Avoid heavy application over tree root zone. Suggested use is limited to special situations where risk of exposure to trees can be assumed. Labelers will not be responsible for damage to trees.

Plateau (*imazapic*)

8-12 oz Plateau 2L (.12-.18 lb ai)	(\$17.70-26.60)
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Preemergence and Postemergence. Labeled for use in approved brush and tree species. Not intended for use on nursery, orchard, ornamental plantings, new plantings, or seedling trees. Plateau controls mustard, smartweed, crabgrass, foxtail, pigweed, lambsquarters, leafy spurge, woodsorrel, foxtail barley, bedstraw, and several other grasses and broadleaved weeds. Plateau is being marketed only through public agencies and organizations. However, it is labeled and may be applied to private as well as public lands.

Early postemergence suggested for most weeds; however there is residual activity for preemergence effect. Always add (MSO) at 1.5 to 2 pt when using less than 30 gpa carrier. For carrier over 30 gpa, use MSO or COC at 1 gal/100 gal. AMS may also be added. NIS may be used in place of seed oil in some situations.

Apply Plateau as a directed spray below the foliage for best selectivity. Some chlorosis may be noted. Suggest use on a limited basis to determine tolerance. Labeled species for directed application include green ash, boxelder, red cedar, cottonwood, hackberry, juniper, locust, sugar maple, oak, white pine, serviceberry, and walnut. Plateau may be mixed with Pendulum or other herbicides approved for use.

Stinger (*clopyralid*)

.25-.66 pt Stinger 3L (.2-5 lb ae)	(\$15.40-40.60)
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Postemergence. Labeled for over-the-top application on certain species of Christmas tree plantings, including Douglas, Fraser, grand, balsam and noble fir; blue spruce; and lodgepole, Ponderosa, and white pine. Useful to control emerged broadleaves such as Canada thistle, knapweeds, and some annuals. Very effective on Canada thistle. Use the high rate for perennials. Maximum for blue spruce is .5 pt/A. Reports indicate good tree tolerance. Do not apply to first-year transplants. Do not use additives.

AQUATIC

Aquatic Glyphosate Products (*glyphosate*)

3 to 7.5 pt Aquatic Glyphosate 4L (1.1-2.8 lb ae)

(\$19.70-49.20)

Aquatic glyphosate is available in several products that are approved for use on aquatic sites. Examples of products include Rodeo, Aquamaster, Cinco, AquaNeat, and Glyfos Aquatic. Most aquatic glyphosate products are formulated as a liquid containing 4 lbs glyphosate acid per gallon or 5.4 lb glyphosate, isopropylamine salt per gallon .

Labeled for aquatic and noncrop sites, including lakes, rivers, ponds, reservoirs, drainage ditches, and similar sites. Glyphosate is nonselective, both grasses and broadleaves are affected. There is no soil residual activity.

Aquatic glyphosate controls several species of brush, perennial or annual grasses, and broadleaves. Primary use is to control Canada thistle and other perennials in aquatic sites where other treatments cannot be used.

Rates are 3 to 4.5 pt for Canada thistle or 6 to 7.5 pt/A for field bindweed. Use a 1.5% solution (4 T/gal) for hand-held equipment. Add 2 qt/100 gal solution of labeled surfactant. Apply in 3 to 20 gpa carrier. Rates for other aquatic and noncrop site weeds are based on specific weeds species on the label.

RESTRICTIONS: Do not apply within ½ mile upstream of a potable water intake, in moving water, or within a half mile of a potable water intake in streams, ponds, or reservoirs. Allow a minimum of 7 days after treatment before reintroducing water if applying in dry ditches. There is no restriction on the use of treated water for irrigation, recreation, or domestic purposes.

2,4-D

1-2 lb ae 2,4-D (1-2 lb ae)

(\$4.60-10.05)

Certain amine and ester products are labeled for aquatic sites, including areas around marshes, ponds, irrigation ditches, streams, and lakes. Some products are labeled for aerial application in aquatic sites. Check labels for correct labeling. Do not apply to more than 1/3 to 1/2 of a lake or pond in any one month because excessive decaying vegetation may deplete oxygen control in water and kill fish. Do not contaminate water used for irrigation or domestic purposes. Useful for controlling Canada thistle, perennial sow thistle, leafy spurge, or other broadleaf weeds.

RESTRICTIONS: Refer to label for application guidelines.

Habitat (*imazapyr*)

1-6 pt Habitat 2L (.25-1.5 lb ai)

(\$32.80-196.90)

Habitat is an aqueous solution to be mixed with water and surfactant approved for aquatic use. Applications of 1 to 6 pt/A may only be made to control undesirable emergent and floating aquatic vegetation in or around standing and flowing water, including estuarine and marine sites. Rates are based on aquatic weed species on the label. Do not apply more than 3 qt/A per year. Applications may be made to private waters that are still, such as ponds, lakes, and drainage ditches where there is minimal or no outflow to public waters. Applications may be made to public waters such as ponds, lakes, reservoirs, marshes, drainage ditches, canals, streams, rivers, and other slow-moving or quiescent bodies of water. Applications to public waters can only be made by state or federal agencies or applicators licensed or certified as aquatic pest control applicators.

PRECAUTIONS or RESTRICTIONS: Do not apply directly to water within ½ mile upstream of an active potable water intake in flowing water or within ½ mile of an active potable water intake in a standing body of water such as lakes, ponds, or reservoirs. There are no restrictions on livestock consumption of water from a treated area. Special local need labeling (Sec 24(c)) for South Dakota allows grazing treated areas. Slaughter livestock must be removed from treated areas for 30 days following treatment. Do not cut treated areas for hay for at least 30 days after treatment.

Garlon 3A (*triclopyr*)

.33-3 gal Garlon 3A (.1-9 lb ae)

(\$31.20-283.50)

Garlon 3A may be used within production forests and industrial noncrop sites to control target vegetation in and around standing water sites, such as marshes, wetlands, and banks of ponds and lakes and transition areas between upland and lowland sites. Rates are based on broadleaf and woody plant species on the label.

PRECAUTIONS and RESTRICTIONS: Do not apply directly to un-impounded rivers or streams. Do not apply on ditches or canals used to transport irrigation water. Do not apply where runoff water may flow onto agricultural land. Minimize overspray to open water when making applications to banks or shorelines of moving water sites. There are no restrictions on use of water in treatment area for recreational purposes including swimming and fishing or for livestock consumption.

The maximum rate is 3 gal/A per year for all terrestrial use sites other than range, pasture, forestry sites, and grazed areas. Refer to grazing and haying restriction section of this guide for restrictions.

2,4-D LABEL RESTRICTIONS and NONCROP LABELING

PRODUCT: SD Registration or by Labeler	EPA Reg. #	2,4-D Acid Equiv.	Lbs. acid/gal	Non- crop	Right- of- Way	Aerial Application	Aquatic
<u>Winfield Solutions (1387)</u>							
AgriSolutions 2,4-D Amine 4	1381-103	39.3%	3.8	✓	✓	✓	Y*
2,4-D LV4	1381-102	44.0%	3.8	✓	✓	✓	N
2,4-D LV6	1381-101	59.1%	5.6	✓	✓	✓	N
<u>Albaugh (42750)</u>							
AgriStar 2,4-D Amine 4	42750-19	38.9%	3.8	✓	✓	✓	Y*
Albaugh 2,4-D LV4	42750-15	42.5%	3.8	✓	✓	✓	N
Albaugh 2,4-D LV6	42750-20	57.4%	5.5	✓	✓	✓	N
AgriStar Solve 2,4-D	42750-22	40.9%	3.76	✓	✓	✓	N
AgriStar D-638	42750-36	30.8%	2.8	✓	✓	✓	N
AgriStar Five Star	42750-49	54.2%	5.0	✓	✓	✓	N
<u>Helena Chemical Co. (5905)</u>							
2,4-D LV6	42750-20-5905	57.4%	5.5	✓	✓	✓	N
2,4-D LV4	42750-15-5905	42.5%	3.8	✓	✓	✓	N
Barrage H.F. (ester)	5905-529	51.8%	4.7	✓	✓	✓	N
Opti-Amine	5905-501	38.8%	3.8	✓	✓	✓	Y*
Hardball	5905-549	19.6%	1.7	✓	✓	✓	Y*
Unison/2010	5905-542	19.6%	1.7	✓	✓	✓	N
<u>NuFarm America's & NuFarm Turf and Specialty (71368)</u>							
Esteron 99 Concentrate	62719-9-71368	44.1%	3.8	✓	✓	✓	N
Weedar 64	71368-1	38.9%	3.8	✓	✓	✓	Y*
Weedone 638	71368-3	30.8%	2.8	✓	✓	✓	N
Weedone 650 Solventless	35935-6-71368	88.8%	5.6	✓	✓	✓	N
Weedone LV4 EC	228-139-71368	44.6%	3.8	✓	✓	✓	N
Weedone LV4 Solventless	71368-14	41.5%	3.8	✓	✓	✓	N
Weedone LV6 EC	71368-11	57.5%	5.4	✓	✓	✓	N
Riverdale Weeddestroy AM-40 Amine Salt	228-145	39.3%	3.8	✓	✓	✓	Y
Riverdale 2,4-D LV6 ester	228-95	87.3%	5.5	✓	✓	✓	N
Riverdale 2,4-D LV4 ester	228-139	44.6%	3.8	✓	✓	✓	N
Turret Solventless	228-95-71368	57.9%	5.5	✓	✓	✓	N
<u>PBI Gordon (2217)</u>							
Hi-Dep Broadleaf Herbicide	2217-703	38.6%	3.8	✓	✓	✓	N
<u>TenKoz (55467)</u>							
Tenkoz 638	42750-36-55467	30.8%	2.8	✓	✓	✓	N
Tenkoz 2,4-D Amine 4	42750-19-55467	38.9%	3.8	✓	✓	✓	Y*
Lo-Vol 4 2,4-D Low Volatile	42750-15-55467	42.5%	3.8	✓	✓	✓	N
Lo-Vol 6 2,4-D Low Volatile	42750-20-55467	57.5%	5.5	✓	✓	✓	N
Lo-Vol 4 Solventless	71368-14-55467	41.5%	3.8	✓	✓	✓	N
<u>UAP/Loveland Chemical (34704)</u>							
Clean Amine 4 2,4-D	34704-120	38.6%	3.74	✓	✓	✓	Y*
Low Vol 4 Ester	34704-124	43.4%	3.8	✓	✓	✓	N
Low Vol 6 Ester	34704-125	58.9%	5.6	✓	✓	✓	N
Saber	34704-803	38.7%	3.8	✓	✓	✓	N
Salvo Low Volatile Weed Killer	34704-609	54.2%	5.0	✓	✓	✓	N
Savage Dry Soluble	34704-606	78.9%	DS	✓	✓	✓	Y*
<u>Van Diest Supply (11773)</u>							
Cornbelt 4# Amine	11773-2	38.4%	3.8	✓	✓	✓	Y*
Cornbelt 4# LV Ester	11773-3	43.9%	3.8	✓	✓	✓	N
Cornbelt 6# LV Ester	11773-4	58.3%	5.6	✓	✓	✓	N
Cornbelt Solvan	11773-16	54.2%	5.0	✓	✓	✓	N
<u>Wilber-Ellis (2935)</u>							
Amine 4A Selective Herbicide	2935-512	39.3%	3.8	✓	✓	✓	Y*
LV 4	2935-511	44.3%	3.8	✓	✓	✓	N
LV 6	228-95-2935	87.3%	5.5	✓	✓	✓	N
LV 6 Low Volatile Herbicide	42750-20-2935	57.4%	5.5	✓	✓	✓	N

Summary SITE and USE RESTRICTIONS

	Grazing Restriction	Haying Restriction	Non-Agricultural Use	Right-of-Way	Aquatic Use	Aerial Application
Tordon (picloram)	1 qt/A or more Lactating dairy-14 d Non-lactating dairy & beef - none ^{2/} Slaughter interval-3 d	1 qt/A or more - 14 d	Yes	Yes	No	Yes
Milestone (aminopyralid)	None	14 d	Yes	Yes	No	Yes
ForeFront (aminopyralid+ 2,4-D)	None	7-14 d	Yes	Yes	No	Yes
2,4-D ester	Lactating dairy-7 d Slaughter interval-3 d	30 d	Yes	Yes	No	Yes
2,4-D amine	Lactating dairy-7 d Slaughter interval-3 d	30 d	Yes	Yes	Some ^{2/}	Yes
Grazon P+D (picloram+ 2,4-D amine)	Lactating dairy-14 d Other livestock: no restrictions	30 d	No	No	No	Yes
Tordon 101 Mixture (picloram+2,4-D)	Lactating dairy-14 d Other livestock: no restrictions	30d	Yes	Yes	No	Yes
Plateau (imazapic)	None	Do not harvest-7 d	Yes	Yes	No	Yes
Banvel, Clarity, Sterling (dicamba)	Lactating dairy: 1 pt/A-7 d 1 qt/A-21 d 2 qt/A-40 d Non-lactating dairy & beef-none Slaughter interval-30 d	Lactating dairy: 1 pt/A-37 d 1 qt/A-51 d 2 qt/A-70 d	Yes	Yes	No	Yes
Overdrive (diflufenzopyr+ dicamba)	None	None	Yes	Yes	No	CRP only
Stinger (clopyralid)	None	None	Yes	* ^{2/}	No	No
Transline (clopyralid)	None	None	Yes	Yes	No	Yes
Curtail (clopyralid+2,4-D)	Lactating dairy-14d Non-lactating dairy- none Slaughter interval-7 d ^{2/}	30 d	Yes	No	No	Yes
Cimarron Max (metsulfuron+ dicamba+2,4-D)	Lactating dairy-7 d Slaughter interval-30 d	37 d	No	No	No	Yes

	Grazing Restriction	Haying Restriction	Non-Agricultural Use	Right-of-Way	Aquatic Use	Aerial Application
Cimarron X-tra/ Cimarron Plus (metsulfuron+ chlorsulfuron)	None	None	No	Yes	No	Yes
Escort XP (metsulfuron)	>1.66 oz-3 d	>1.66 oz-3 d	Yes	Yes	No	Yes
Arsenal (imazapyr)	Do not graze	Do not harvest	Yes	Yes	No	Yes
Habitat, Stalker (imazapyr)	Slaughter interval - 30 d	30 d	Yes	No	Yes	Helicopter Only
Krenite (fosamine)	Do not graze-1 yr	Do not harvest-1 yr	Yes	Yes	No ^{4/}	Yes
Garlon 4L (triclopyr)	Slaughter interval-3 d Do not graze lactating dairy until next growing season	Do not harvest-14 d	Yes	Yes	No	Yes
Garlon 3A (triclopyr)			Yes	Yes	Labeled restricted areas	Yes
Krenite (fosamine)	Do not graze-1 yr	Do not harvest-1 yr	Yes	Yes	No ^{4/}	Yes
Crossbow (triclopyr+2,4-D)	Lactating dairy: <2 gal/A-14 d >2 gal/A-next year Other livestock: <2 gal/A-none 2-4 gal/A-14 d ^{5/} Slaughter interval-3 d	Lactating dairy: next year Other livestock: <2 gal/A-7 d >2 gal/A-14 d Removal before slaughter-3 d	Yes	Yes	No	Yes
Redeem (triclopyr+ clopyralid)	Lactating dairy: 14 d Other livestock: No restriction	Lactating dairy: Do not harvest until next growing season. Other livestock: 7 d	Yes	No (fence- lines, road- sides)	No	Yes
Paramount (quinclorac)	Do not graze	Do not harvest for 20 days	Yes	Yes	No	Yes
Glyphosate Products	Slaughter interval-3 d Spot treatment ^{6/} -14 d Broadcast treatment-8 weeks Do not graze	Spot treatment-14 d Broadcast treatment-8 wks Do not harvest	No Yes	No Yes	No No	Yes Yes
Roundup Pro						
Rodeo (glyphosate)	----	----	Yes	Yes	Yes	Yes
Touchdown Pro (glyphosate)	Do not graze	Do not harvest	Yes	Yes	No	Yes

^{1/} Remove livestock to untreated grass pasture for 7 days before transferring livestock to broadleaf or broadleaf-mixed pasture areas. Otherwise, urine may contain enough product to cause injury to sensitive broadleaf plants.

^{2/} Refer to specific label for aquatic use products.

^{3/} Withdrawal not needed if 2 weeks or more time elapsed since application.

^{4/} Apply only to water's edge.

^{5/} If less than 25% of grazed area is treated, there is no grazing restrictions.

^{6/} Do not treat more than 1/10 of any given acre at one time with spot or wiper applications. Remove livestock before application.

^{7/} Fence rows, around farm buildings, and equipment pathways.

CHEMICAL, PHYSICAL and SAFETY CHARACTERISTICS of HERBICIDES

Properties of the most commonly used herbicides to control noxious weeds are listed in the table below. Formulation and other local conditions will affect values for most properties. Solubility is affected by formulation, temperature and soil pH.

Half-life refers to the days required for the herbicide level in the soil to be reduced to half the original amount applied. Rainfall, temperature, and soil pH are important factors affecting half life.

Toxicity for oral ingestion and dermal exposure are expressed as the quantity required for a lethal dose for 50% of a population. The LD₅₀ value may be multiplied by .003 to determine ounces of active ingredient that would be lethal for half a population of 180 lb subjects.

Leaching (LE) rating refers to risk of herbicide movement through the soil profile into groundwater. Chemical properties of the herbicide, soil properties and rainfall are important factors affecting leaching potential. Herbicide movement in runoff solution (SL) is a rating for risk of movement in surface water. Rainfall amount and intensity, soil properties, surface characteristics, and herbicide rate are important variables affecting runoff solution.

Special safety equipment is based on label statements. All herbicides should be handled according to label safety guidelines using equipment and precautions that minimize risk of exposure.

<u>Herbicide</u>	<u>Solubility (ppm)</u>	<u>Half Life (days)</u>	<u>Surface and Groundwater Risk</u>		<u>LD₅₀ (mg/kg)</u>	
			<u>Leaching (LE)</u>	<u>Runoff Sol. (SL)</u>	<u>Oral</u>	<u>Dermal</u>
Tordon 22K (picloram)	200,000	90	High	High	8200	>2000
Milestone (aminopyralid)	2,480	35	Low	Low	>5000	>5000
2,4-D ester	8	7	Low	Low	375	800
2,4-D amine	796,000	10	Low	Low	375	800
Banvel (dicamba)	400,000	14	Low to Medium	Low	1707	>2000
Stinger (clopyralid)	300,000	30	Moderate Potential	Low	>5000	>2000
Roundup (glyphosate)	400,000	47	Low	Low	4300	>940
Arsenal (imazapyr)	11,000	90	Low	Low	>5000	>2148
Krenite (fosamine)	1,790,000	8	Low	Low	>5000	>5000
Garlon (triclopyr ester)	23	46	Medium	Medium	630	2140
Escort/Ally (metsulfuron)	9500	120	Moderate@high pH	Medium	>5000	<2000
Telar (chlorsulfuron)	7000	160	Moderate@high pH	Medium	5545	>3400
Plateau (imazapic)	2232	120	Low	Low	>5000	>5000

Data base: National Water Quality Technology Staff and other references.

BIOCONTROL of NOXIOUS WEEDS in SOUTH DAKOTA

Biocontrol offers another IPM tool for noxious weed control. The basic idea behind biocontrol is utilizing the weed's natural enemies as a means of weakening or killing the host plant. The natural enemies may include several options; however insects have been the more common choice. Insects used as biological agents for noxious weeds include: 1) seed attackers; 2) gall formers; 3) defoliators; 4) sapsuckers; 5) stem miners; 6) crown and root borers; and 7) root feeders.

Biocontrol of noxious weeds may not be the best choice in all situations. If the noxious weed infestation can be controlled by a more efficient means, such as chemical control, then that should be the option of choice. Biocontrol can work well when combined with other control tactics for an integrated approach to controlling a noxious weed. There are potential economic benefits as well as advantages where environmental situations or site restrictions limit or preclude other control options.

Biocontrol usually requires at least 3 to 5 years investment for significant results. It is important to realize that a biological control program will not eradicate noxious weeds. A residual level of the weed population is to be expected even under the best conditions.

Survival of the biocontrol agent is dependent on the density of the host noxious weeds. This is a natural cycle and should be expected so a resurgence of the weed population may occur from 1) seed bank in the soil; 2) missed plants; or 3) lagging populations of the biocontrol agent.

South Dakota continues to consider the use of new biological control agents on noxious weeds. Prior to the initial release by USDA-APHIS biocontrol agents go through a rigorous testing program to ensure they are host specific for the weed targeted. USDA-APHIS and the South Dakota Department of Agriculture are involved with the initial introductions and monitoring of the releases. These release sites are monitored for a period of time to determine that the agents will establish in the state, and will provide acceptable control of the target weed. Then the oversight responsibility for future collection and redistribution is typically passed on to the affected agencies. These may include county weed and pest boards, or state and federal land managing agencies.

Approved biological control agents are available through several reputable insectory businesses located in neighboring states. Prices and availability for specific biocontrol agents may vary from year to year. Many of the biological control agents released in South Dakota may be available for collection and redistribution at no cost. Please contact your county weed and pest control board for more information.

Common noxious weed biocontrol options in South Dakota:

Leafy spurge: Several insects were evaluated as a potential biocontrol agent in South Dakota. Of these, the leafy spurge flea beetle became the agent of choice over time. Of the flea beetle group, the black leaf beetles (*Aphthona lacertosa* and *Aphthona czwalinae*) and the brown flea beetle (*Aphthona nigricutis*) have shown the best results. This insect is quite adaptable to much of the state's diverse climate and environmental conditions. Flea beetles are sun-loving insects that prefer day sites; however *A. lacertosa* can tolerate cooler, shadier, and wetter sites.

Another approved bioagent for leafy spurge that shows limited success is a stem boring larvae (*Oberea erythrocephala*). This insect feeds on the leafy spurge leaves, bracts, and girdles the stems.

Currently, the South Dakota Department of Agriculture coordinates the redistribution program for the leafy spurge flea beetles. The county weed and pest boards is the local contact point for landowners or land managers considering the use of flea beetles in the leafy spurge management program. South Dakota landowners can collect the flea beetles, free of charge, at state supervised collection days in mid to late June. Many county weed and pest programs also have their own organized flea beetle collections as well.

Musk thistle: The musk thistle seedhead weevil (*Rhinocyllus conicus*) was the first major biocontrol program for noxious weeds in South Dakota. Introductions were made in the late 1970's to early 1980's. Currently this seed weevil can be found throughout the state in musk thistle infestations as well as the native thistle. Further releases are not recommended. A rosette weevil (*Trichosirocalus horridus*) has been released in some counties of the state and has shown some success.

Canada thistle: Two insect biocontrol agents currently being used in the state include a stem mining weevil (*Hadroplatus litura*) and a thistle stem gall fly (*Urophora cardui*). Damage from the developing stem mining weevil larvae to the plant comes from the mining of the thistle stem as the shoot elongates. The thistle stem gall fly adult lays eggs and when they hatch the developing larvae stimulate the plant to form a hard woody stem gall. The gall directs the nutrients away from the plant's metabolic and reproductive functions thus affecting seed production.

Purple loosestrife: A leaf feeding beetle (*Galerucella californiensis* and *Galerucella pusilla*) has been introduced in wetland sites invaded by this noxious weed. The *Galerucella* species has been used in South Dakota and Nebraska in a special project coordinated by these two states. An insectory was developed to rear this biocontrol agent for use in this special project and has yielded thousands of insects that have led to the decline of purple loosestrife in the release areas. A root boring insect, *Hylobius transversovittatus*, has also been released. Larvae feed on the root hairs and mine into roots and crown affecting the plant's ability to move nutrients and water throughout the plant.

Spotted knapweed: The primary bioagent released for the control of spotted knapweed is the knapweed flowerhead weevil (*Larinus minutus*). A root boring weevil (*Cyphocleonus achates*) has also been released and an insectory is being set up by the South Dakota Department of Agriculture to rear this insect for distribution through a special weed management project involving South Dakota and Nebraska.

Dalmatian toadflax: A stem boring weevil (*Mecinus janthinus*) has been a successful option for controlling Dalmatian toadflax. Adult weevils feed externally on the foliage and the larvae feed on the plants vascular tissue reducing or eliminating flower and seed production.

Common Biocontrol Agents for Noxious Weeds in South Dakota

LEAFY SPURGE BIOAGENTS



Fig. 1 *Aphthona nigriscutis* adult (brown flea beetle)



Fig. 2 *Aphthona lacertosa* adult (black flea beetle)



Fig. 3 *Aphthona lacertosa* flea beetles on leafy spurge



Fig. 4 South Dakota flea beetle collection/beetle sorter



Fig. 5 *Oberea erythrocephala* adult on leafy spurge

CANADA THISTLE BIOAGENTS



Fig. 6 *Hadroplactus litura* adult (Canada thistle stem mining weevil)



Fig. 7 *Hadroplactus litura* larvae in Canada thistle stem



Fig. 8 Mined Canada thistle stem—Hand County



Fig. 9 *Urophora cardui* (Canada thistle gall fly)



Fig. 10 Gall on Canada thistle stem—Beadle County

MUSK THISTLE BIOAGENTS



Fig. 11 *Rhinocyllus conicus* adult (musk thistle seed weevil)



Fig. 12 Left: Normal (musk thistle seedhead); Right: infested musk thistle seedhead



Fig. 13 *Trichosivocalus horridus* adult (musk thistle rosette weevil)

DALMATION TOADFLAX BIOAGENTS



Fig. 14 Stem boring weevil *Mecinus janthinus* on Dalmation Toadflax

SPOTTED KNAPWEED BIOAGENTS



Fig. 15 *Larinus minutus* adult (flowerhead weevil)



Fig. 16 Knapweed seedhead with emergence hole—Pennington County

PURPLE LOOSESTRIFE BIOAGENTS



Fig. 17 *Galerucella Sp.* defoliating purple loosestrife



Fig. 18 Rearing buckets and tents for *Galerucella Sp.*