Maximum use rates of aminopyralid for control of invasive species. Rodney G. Lym. (Plant Sciences Department, North Dakota State University, Fargo, ND 58105). Aminopyralid controls several noxious weed species and is generally applied at 0.75 to 1.75 oz ae/A. Aminopyralid is labeled for spot treatments at 3.5 oz /A and may provide better long-term control and/or a wider spectrum of weed control than the general application rate. The purpose of this research was to evaluate various timing and use rates of aminopyralid for control of Canada thistle, leafy spurge, and yellow toadflax.

For all studies, herbicides were applied using a hand-held boom sprayer delivering 17 gpa at 35 psi. Experimental plots were 10 by 30 feet and replicated four times in a randomized complete block design. Control of each species was evaluated visually using percent stand reduction compared to the untreated control. Results were compared to picloram applied at the general use rate for each weed species.

The first study evaluated the control of Canada thistle with aminopyralid applied alone or with diflufenzopyr in the spring or fall. The experiment was established near Eckelson and Fargo, ND and treatments were applied June 19 or September 20, 2007 at Eckelson and June 12 or October 2 in Fargo. Spring treatments were applied to actively growing Canada thistle in the bolt to bud stage and fall treatments were applied to Canada thistle rosettes.

Canada thistle control with aminopyralid at Eckelson and Fargo was similar regardless of application rate and averaged 94 and 99% in September 2006 when spring or fall applied, respectively (Table 1). No grass injury was observed from any treatment. Canada thistle control with aminopyralid was similar when applied alone or with diflufenzopyr.

A second study was established near Walcott, ND to evaluate aminopyralid applied alone or with picloram for leafy spurge control. Herbicides were applied as previously described on June 1 or September 6, 2006 when leafy spurge was in the true-flower or fall regrowth stage, respectively.

Aminopyralid provided short-term leafy spurge control when fall-applied at 3.5 oz/A (Table 2). Control averaged 79% in May 2007 but declined to 40% by September 2006. Aminopyralid did not control leafy spurge when spring-applied. Aminopyralid plus picloram at 3.5 + 8 oz/A tended to provided better leafy spurge control than picloram at 16 oz/A when spring- but not when fall-applied.

A third experiment was established to evaluate yellow toadflax control with aminopyralid applied alone or with picloram. The experiment was established on a wildlife production area near Valley City, ND which contained a dense stand of yellow toadflax and smooth bromegrass. Treatments were applied as previously described on July 5 or September 20, 2007 when yellow toadflax was in the vegetative to flowering or seed-set growth stage, respectively.

Aminopyralid applied alone or with picloram did not adequately control yellow toadflax regardless of application date or rate (Table 3). Smooth bromegrass was injured with treatments that contained picloram, especially when fall-applied. Grass injury exceeded 50% when picloram was applied in the fall at 16 oz/A alone or at 8 oz/A with aminopyralid at 3.5 oz/A.

In summary, Canada thistle control was similar when aminopyralid was applied at 1.75 or 3.5 oz/A, the year after treatment. Aminopyralid did not provide satisfactory control of leafy spurge or yellow toadflax when applied alone or with picloram regardless of application date or rate. Smooth bromegrass was injured when aminopyralid was applied with picloram.

Table 1. Aminopyralid applied at the maximum use rate in the spring or fall in for spot treatment of Canada thistle at two locations in North Dakota.

		Evaluation date		
Treatment[1]	Rate	Aug 06	June 07	Sept 07
Spring applied	– oz/A –			
Aminopyralid	1.75	99	96	96
Aminopyralid	3.5	99	96	92
Picloram	8	98	96	93
Aminopyralid + diflufenzopyr	1.75 + 0.7	99	96	93
Fall applied				
Aminopyralid	1.75		99	99
Aminopyralid	3.5		100	99
Picloram	8		99	91
Aminopyralid + diflufenzopyr	1.75 + 0.7		100	99
LSD (0.05)		NS	2.5	4.5

[1] Activator 90 was applied at 0.25% with all treatments, Loveland Products, Inc., Greeley CO 80632-1286. Treatments were applied in mid-June or following a light frost in late-Sept or early Oct 06.

Table 2. Aminopyralid applied at the maximum use rate in the spring or fall for spot treatment of leafy spurge near Walcott, ND.

Treatment[1]	Rate	Evaluation date		
		6 Sept 06	31 May 07	5 Sept 07
Spring applied	– oz/A –		%	
Aminopyralid	1.75	3	8	0
Aminopyralid	3.5	18	8	3
Aminopyralid + picloram	1.75 + 8	92	53	31
Aminopyralid + picloram	3.5 + 8	98	80	64
Picloram	16	95	58	44
Fall applied				
Aminopyralid	1.75		26	0
Aminopyralid	3.5		79	40
Aminopyralid + picloram	1.75 + 8		99	52
Aminopyralid + picloram	3.5 + 8		99	64
Picloram	16		100	76
LSD (0.05)		6	22	32

[1] Activator 90 was applied at 0.25% with all treatments, Loveland Products, Inc., Greeley CO 80632-1286. Treatments were applied on 1 June 06 (spring) or 6 Sept 06 (fall).

Table 3. Aminopyralid applied at the maximum use rate in mid-summer or fall for spot treatment of yellow toadflax in Barnes County, ND.

		31 Aug 06		8 June 07	
Treatment[1]	Rate	Control	Grass injury	Control	Grass injury
Mid-summer applied	— oz/A —		%		
Aminopyralid	1.75	8	0	0	0
Aminopyralid	3.5	10	0	5	0
Aminopyralid + picloram	1.75 + 8	23	3	46	6
Aminopyralid + picloram	3.5 + 8	25	7	76	8
Picloram	16	26	13	46	18
Fall applied					
Aminopyralid	1.75			0	0
Aminopyralid	3.5			22	5
Aminopyralid + picloram	1.75 + 8			38	26
Aminopyralid + picloram	3.5 + 8			20	51
Picloram	16			15	55
LSD (0.05)		NS	5	22	11

[1] Activator 90 was applied at 0.25% with all treatments, Loveland Products, Inc., Greeley CO 80632-1286. Treatments were applied on 5 July 06 (mid-summer) or 20 Sept 06 (fall).

Canada thistle control with aminopyralid plus diflufenzopyr. Rodney G. Lym. (Department of Plant Sciences, North Dakota State University, Fargo, ND 58105). Aminopyralid is a member of the pyridinecarboxylic acid family of herbicides and controls several noxious weed species at lower use rates than other auxin-type herbicides. Diflufenzopyr is a semicarbazone herbicide which inhibits auxin transport in susceptible plants. The addition of diflufenzopyr has improved weed control of some species with certain herbicides. The purpose of this research was to evaluate aminopyralid alone or with diflufenzopyr for Canada thistle control.

Aminopyralid at 0.75 or 1.5 oz ae/A was applied alone or with diflufenzopyr at a 2.5:1 or 5:1 ratio (herbicide:diflufenzopyr) on Canada thistle at two locations in North Dakota. Picloram at 6 oz ae/A was included as a standard comparison. Treatments were applied June 12, 2006 near Fargo, ND on former crop-land and June 19, 2006 near Eckelson near a wind-break with a dense stand of perennial grasses using a hand-held boom sprayer delivering 17 gpa at 35 psi. Experimental plots were 10 by 30 feet with four replicates in a randomized complete block design. Canada thistle was in the bolt to early bud growth stage at both locations and varied in height from 6 to 24 inches at Fargo and 6 to 40 inches at Eckelson. Canada thistle stem density averaged 15 and 12 stems/m^2 at the Fargo and Eckelson locations, respectively. Control was visually evaluated using percent stand reduction compared to the untreated control.

Canada thistle control averaged 96% across all treatments and both locations 3 MAT (Table). However, long-term control declined rapidly at Fargo and only averaged 37% 12 MAT compared to 97% at Eckelson. Similarly, control with picloram averaged 92% 15 MAT at Eckelson but only 22% at Fargo. The increased long-term control at Eckelson compared to Fargo was likely due to the dense grass cover which competed with Canada thistle compared to little competition in the relatively bare ground at Fargo. Canada thistle control was similar whether aminopyralid was applied alone or with diflufenzopyr regardless of application rate at both locations. In summary, Canada thistle control with aminopyralid was similar whether applied at 0.75 or 1.5 oz/A and with or without diflufenzopyr. Long-term control was better when the site contained perennial grasses compared to generally bare ground.

Table. Aminopyralid plus diflufenzopyr applied for Canada thistle control in June 2006 at two locations in North Dakota.

		Fargo			Eckelson		
Treatment[1]	Rate	3[2]	12	15	3	12	15
	— oz/A —	% control					
Aminopyralid	0.75	92	29	19	90	96	70
Aminopyralid	1.5	96	31	24	98	97	88
Aminopyralid + diflufenzopyr	0.75 + 0.3	93	36	29	95	96	84
Aminopyralid + diflufenzopyr	0.75 + 0.15	92	41	28	98	97	88
Aminopyralid + diflufenzopyr	1.5 + 0.6	97	47	24	98	97	83
Aminopyralid + diflufenzopyr	1.5 + 0.3	97	33	26	98	99	86
Aminopyralid	1.75	96	43	35	98	99	93
Picloram	6	96	38	22	97	96	92
LSD (0.05)		NS	NS	NS	NS	NS	NS

[1]Surfactant Activator 90 at 0.25% was applied with all treatments, Loveland Products, Inc., Greeley, CO 80632-1286.
[2]Months after treatment.

Cut-stump treatment for Russian olive control. Rodney G. Lym. (Plant Sciences Department, North Dakota State University, Fargo, ND 58105). Russian olive (*Elaeagnus angustifolia* L.) was originally planted in farm shelterbelts, wildlife production areas, and along highways, rivers, and streams in North Dakota in the early 1900s. It is one of the most hardy woody species introduced into the state, but spreads rapidly by seed, and can become invasive. Russian olive can displace native species such as plains cottonwood *(Populus deltoides* var. *occidentalis*) and reduce forage production in pasture and rangeland. Russian olive can grow to 20 to 25 feet in height and is often removed by cutting. However, this species regrows by producing multiple stems from the cut-stump and root crown area, resulting in a denser Russian olive infestation than found prior to removal. The purpose of this study was to evaluate a variety of auxinic herbicides as a cut-stump treatment for control of Russian olive regrowth.

The study was established on the Sheyenne National Grassland in cooperation with the U.S. Forest Service and was located near McLeod, ND. Russian olive originally had been planted as part of a shelter belt but had spread into an adjacent pasture. The trees were 15 to 25 feet tall and ranged in age from approximately 10 to over 50 years old. The trees were cut by Forest Service personnel on April 28, 2006 and herbicides were applied to the stumps on May 26, 2006. Each treatment was applied to 10 trees (reps) and each replicate consisted of similar size tree stumps. The first replicate contained the smallest tree stumps which were 7.5 to 8 inches in diameter while replicate 10 contained the largest diameter stumps which averaged 18.5 to 20 inches.

Herbicides were applied on a percent solution basis in a petroleum based oil (herbicide:oil v:v) with a single nozzle hand-held pump sprayer. Stumps were thoroughly covered to the point of run-off. Control was evaluated by counting the number of shoots arising from the stump and root collar of treated compared to non-treated stumps 2, 12, and 14 months after treatment.

All cut-stump treatments provided excellent control of Russian olive regrowth (Table). An average of 33 stems/stump grew from untreated trees compared to no regrowth from any of the treated stumps except triclopyr at 13.5% (v:v) which averaged 2 stems/stump in August 2006. No regrowth was observed on any treated stump in 2007, compared to an average of 5 and 2 stems/stump in the untreated control in June and August 2007, respectively. Control was similar with 2,4-D ester, triclopyr alone or triclopyr plus aminopyralid or 2,4-D. In conclusion, auxinic herbicides applied in oil provided excellent control of Russian olive regrowth from cut-stumps and can be applied at least 30 days after the tree has been cut.

Control of Russian olive regrowth from stumps and root collar with various auxinic herbicides applied in an oil carrier on May 26, 2006, approximately 30 days after the trees were cut.

Treatment[1]	Rate	Evaluation date		
		8 Aug 06	11 June 07	7 Aug 07
	— % sol'n —	— Stems/stump[2] —		
2,4-D ester	21%	0	0	0
Aminopyralid + triclopyr	2 + 10%	0	0	0
Triclopyr	25%	0	0	0
Triclopyr/2,4-D[3]	11 + 22%	0	0	0
Triclopyr[4]	13.6%	2	0	0
Untreated check	• • •	33	5	2
LSD (0.05)		13	4	NS

[1] Herbicide treatments applied in bark oil solution, Bark oil by Dow AgroSciences LLC, 9330 Zionsville Road, Indianapolis, IN 46268-1189 on May 26, 2006.

[2] Number of stems regrowing from stump is an average of 10 trees (reps).

[3] Commercial formulation - Crossbow and [4]commercial formulation - Pathfinder II RTU product of triclopyr and oil. Both by Dow AgroSciences LLC, 9330 Zionsville Road, Indianapolis, IN 46268-1189.

Purple loosestrife control with aminopyralid applied alone or with 2,4-D or triclopyr. Rodney G. Lym. (Department of Plant Sciences, North Dakota State University, Fargo, ND 58105). Purple loosestrife (lythrum) was introduced as an ornamental into North America in the early 1800s. Although slow to spread in the relatively dry climate of North Dakota, the plant was added to the state noxious weed list in 1999 and currently infests approximately 250 A in 22 counties. Nearly all infestations are located in aquatic sites such as rivers, streams, and drainage areas where most herbicides cannot be used. The purpose of this research was to evaluate aminopyralid applied alone or with 2,4-D or triclopyr for purple loosestrife control.

The experiment was located in a green area along a drainage ditch within the city limits of Fargo, ND. Purple loosestrife had invaded the area which otherwise had a near complete cover of cattails. Herbicides were applied with a single nozzle back-pack sprayer and plants were sprayed until wet (approximately 75 gpa). Herbicides were applied on July 6, 2006 when purple loosestrife was in the bloom growth stage and ranged from 3 to 5 feet tall. Purple loosestrife and associated vegetation was sprayed until wet but run-off was avoided. The experimental design was a randomized complete block with three replicates. Plots were 30 feet long and 5 feet wide in the first rep and 30 by 10 feet wide in the second and third reps. Control was visually evaluated using percent stand reduction compared to the untreated control. Glyphosate at 1.5% (herbicide:water v:v) and triclopyr at 1% (v:v) were included as standard treatments for comparison.

In general, aminopyralid provided long-term purple loosestrife control at lower rates than the standard treatments of glyphosate or triclopyr (Table). For instance, aminopyralid applied at 0.2% (v:v) provided 86% purple loosestrife control 13 MAT compared to only 56 and 23% with glyphosate or triclopyr, respectively. Purple loosestrife control increased as the aminopyralid rate increased and averaged 36, 54, and 86% control 13 MAT when applied at 0.05, 0.1, and 0.2% (v:v), respectively. Purple loosestrife control increased when 2,4-D but not triclopyr was applied with aminopyralid compared to aminopyralid alone at comparable use rates. Cattails were killed by glyphosate but unaffected by any other treatment in the study (data not shown).

Aminopyralid provided very good purple loosestrife control at much lower use rates than currently used herbicide treatments. Also, aminopyralid is safe to use under or near many tree species commonly found in areas infested by purple loosestrife.

Purple loosestrife control with aminopyralid compared to triclopyr or glyphosate applied during the full bloom growth stage on July 6, 2006 in Fargo, ND.

Treatment	Rate		Evaluation/months after treatment			
			1	2	11	13
	— % solution —	–oz/A[1] -	— % control —			
Aminopyralid + X-77	0.05 + 0.25	1.2	91	83	72	36
Aminopyralid + X-77	0.1 + 0.25	2.4	97	90	85	54
Aminopyralid + X-77	0.2 + 0.75	4.8	99	97	97	86
2,4-D/aminopyralid[2] + X-77	0.223 + 0.027 + 0.75	1.8 + 0.9	99	97	97	77
Triclopyr/aminopyralid[3] + X-77	0.435 + 0.075 + 0.75	5.2 + 0.9	76	73	66	28
Triclopyr/aminopyralid[3] + X-77	0.66 + 0.09 + 0.75	7.9 + 0.11	91	88	82	63
Glyphosate + X-77	1.5 + 0.75	72	95	98	88	56
Triclopyr + X-77	1 + 0.75	48	84	82	63	23
LSD (0.05)			13	17	21	29

[1] Herbicide rate estimation was based on an average of 75 gpa applied, but actual rate was dependent on purple loosestrife and associated vegetation height.
[2] Commercial formulation - Forefront by Dow AgroSciences LLC, 9330 Zionsville Road, Indianapolis, IN 46268-1189.
[3] Experimental formulation - GF-1883 by Dow AgroSciences LLC, 9330 Zionsville Road, Indianapolis, IN 46268-1189.

Biological control of yellow toadflax with *Mecinus janthinus* (Germar) in North Dakota. Chelsea J. Juricek, Travis L. Almquist, and Rodney G. Lym. (Department of Plant Sciences, North Dakota State University, Fargo, ND 58105)._Yellow toadflax (*Linaria vulgaris* L. [Mill]) is an increasing problem in North Dakota. Currently, there are no herbicide treatments available that provide adequate long-term control of yellow toadflax. Potential biological control agents could improve yellow toadflax management. *Mecinus janthinus* is a stem-boring weevil which is native to Eurasia and was found to feed on Dalmatian toadflax (*Linaria dalmatica* [L.] P. Mill), yellow toadflax, and other related species in greenhouse trials. *M. janthinus* was originally released in North America for the control of Dalmatian toadflax. The objectives of this research were to determine if *M. janthinus* would establish and control yellow toadflax in North Dakota.

Approximately 600 *M. janthinus* adults were released in May 2005 at a yellow toadflax infested USFWS Waterfowl Production Area in Barnes County, North Dakota. The number of adult *M. janthinus* and the density of yellow toadflax were determined in June 2006 and 2007 at the release points, and 5, 10, and 15 m. away in the cardinal directions. No *M. janthinus* were found after release during any evaluation date. The density of yellow toadflax remained unchanged. It is unlikely that *M. janthinus* established on yellow toadflax in this study.

Yellow toadflax control in non-cropland with various herbicides and application timings. (Jenks, Willoughby, Mazurek). Yellow toadflax has taken over areas that were previously infested by leafy spurge west of Burlington, ND. Several herbicides were evaluated for yellow toadflax control. These herbicides were applied at the vegetative stage (mid-summer), flowering stage (late summer), and post-flowering stage (fall). The results shown below represent yellow toadflax control following herbicide applications in both 2005 and 2006 to the same experimental plots each year. Each experimental plot was 10 by 30 feet and replicated three times. For example, in Treatment 1, Tordon + 2,4-D amine was applied at the vegetative stage in 2005 and again in 2006. Thus, the yellow toadflax control ratings on July 7, 2007 represent control as a result of the two herbicide applications in 2005 and 2006.

Tordon was the only herbicide in the study that provided some level of yellow toadflax control at all application timings. Yellow toadflax control was higher with later application timings. Higher Tordon rates provided better yellow toadflax control. Plateau at 8 oz/A caused 23% grass injury when applied in Fall 2006, but little injury applied at the vegetative or flowering stages. However, in 2007, Plateau at 8 oz/A caused 30-65% grass injury across application timings. Plateau applied at 4 oz with Tordon caused 0-3% grass injury in 2006, but caused 8-27% grass injury in 2007. Tordon alone at any rate caused very little grass injury.

			Grass		Yellow toadflax	
			-----% injury-----		-----% control-----	
Treatment	Rate	Timing	Jun 27 2006	Jul 7 2007	Jun 27 2006	Jul 7 2007
Tordon + 2,4-D amine	2 pt + 1 qt	VEG	0	0	15	48
Plateau + MSO + 28% N	8 oz + 1 qt + 1 qt	VEG	0	30	0	5
Tordon + Plateau + 2,4-D amine + MSO	2 pt + 4 oz + 1 qt + 1 qt	VEG	0	8	17	42
Ally + Weedmaster + COC	0.5 oz + 2 pt + 1%	VEG	0	3	0	0
Tordon + 2,4-D amine	2 pt + 1 qt	FLWR	0	0	49	57
Plateau + MSO + 28% N	8 oz + 1 qt + 1 qt	FLWR	4	50	0	30
Tordon + Plateau + 2,4-D amine + MSO	2 pt + 4 oz + 1 qt + 1 qt	FLWR	0	20	45	50
Ally + Weedmaster + COC	0.5 oz + 2 pt + 1%	FLWR	0	0	0	0
Tordon + 2,4-D amine	2 pt + 1 qt	FALL	0	3	62	75
Plateau + MSO + 28% N	8 oz + 1 qt + 1 qt	FALL	23	65	0	28
Tordon + Plateau + 2,4-D amine + MSO	2 pt + 4 oz + 1 qt + 1 qt	FALL	3	27	71	68
Ally + Weedmaster + COC	0.5 oz + 2 pt + 1%	FALL	0	5	0	0
Tordon	4 pt	FLWR	3	3	84	98
Untreated Check			0	0	0	0
LSD (0.05)			14	3.4	21	11
CV			36	86	34	43