Pink Section **Perennial and Noxious Weed Control** Page

Leafy spurge control with quinclorac applied alone or with aminopyralid. Rodney G. Lym. (Department of Plant Sciences, North Dakota State University, Fargo, ND 58108-6050). Previous research at North Dakota State University has found that both quinclorac and aminopyralid applied with 2,4-D will control leafy spurge. Quinclorac and aminopyralid can be used in areas with shallow groundwater or near trees and other desirable vegetation unlike commonly used leafy spurge control herbicides such as picloram, aminocyclopyrachlor, and dicamba. The purpose of this research was to evaluate mixtures of quinclorac with aminopyralid for control of leafy spurge as either a spring or fall applied treatment.

The quinclorac plus aminopyralid study was established at two sites. The first site was on abandoned farmland near Fargo, ND, while the second was on the Sheyenne National Grassland (SNG) near Anslem, ND. Treatments were applied on June 10 or 12, 2015 at Fargo or the SNG, respectively, to leafy spurge in the flowering growth stage or on September 25, 2015 at both locations to leafy spurge in the fall regrowth stage with 1 to 3 inch new stem growth. All treatments were applied using a hand-held boom sprayer delivering 17 gpa at 35 psi. Experimental plots were 10 by 25 feet and replicated four times in a randomized complete block design. Leafy spurge control was evaluated visually using percent stand reduction compared to the untreated control.

Long-term leafy spurge control was better at the SNG than Fargo, so the results will be discussed by location. Leafy spurge control from treatments applied in June averaged only 67% or less 3 months after treatment (MAT) at Fargo (Table 1). Control with quinclorac at 6 oz/A applied alone was similar to when applied with aminopyralid or aminopyralid plus 2,4-D and averaged 44%. The same treatments applied in September provided an average of 98% leafy spurge control 9 MAT but control declined rapidly to an average of 50% 12 MAT. Leafy spurge control was similar when aminopyralid was applied alone or with 2,4-D regardless of application date.

Leafy spurge control with quinclorac applied at 6 oz/A plus aminopyralid or aminopyralid plus 2,4-D averaged 76% control compared to only 46% control with quinclorac applied alone 3 MAT at the SNG (Table 2). Control was also improved when quinclorac was applied with aminopyralid or aminopyralid plus 2,4-D in the fall and averaged 89% compared to 71%, respectively, 9 MAT. However, control was similar when quinclorac was applied alone or with aminopyralid by 15 and 12 MAT, for the spring and fall applied treatments, respectively. No treatment provided satisfactory control 12 MAT. Leafy spurge control with aminopyralid generally was improved when 2,4-D was included compared to aminopyralid applied alone.

In summary, leafy spurge control with quinclorac generally was not improved with the addition of aminopyralid or aminopyralid plus 2,4-D and the combination treatment would not be cost-effective. Aminopyralid plus 2,4-D provided better leafy spurge control than aminopyralid applied alone at the SNG but not the Fargo location.

Table 1. Leafy spurge control with quinclorac applied alone or with aminopyralid and 2,4-D in June or September near Fargo, ND.

Treatment	Rate	Evaluation (MAT S/F)		
		3	12/9	15/12
	oz/A	% control		
Spring application (June 10, 2015)				
Quinclorac[a] + MSO[b]	6 + 1 qt	46	33	13
Quinclorac + aminopyralid + 2,4-D[c] + MSO	6 + 1.72 + 14 + 1 qt	43	27	8
Quinclorac + aminopyralid[d] + MSO	6 + 1.75 + 1 qt	46	31	14
Quinclorac + MSO	12 + 1 qt	67	52	35
Aminopyralid + 2,4-D + MSO	1.72 + 14 + 1 qt	30	14	3
Aminopyralid + HSMOC[e]	1.75 + 1 qt	8	15	9
Fall application (Sept. 25, 2015)				
Quinclorac + MSO	6 + 1 qt		96	46
Quinclorac + aminopyralid + 2,4-D + MSO	6 + 1.72 + 14 + 1 qt		98	44
Quinclorac + aminopyralid + MSO	6 + 1.75 + 1 qt		97	61
Quinclorac + MSO	12 + 1 qt		95	63
Aminopyralid + 2,4-D + MSO	1.72 + 14 + 1 qt		77	28
Aminopyralid + HSMOC	1.75 + 1 qt		88	33
LSD (0.05)		33	23	28

[a]Commercial formulation - Facet L by BASF Corporation, 26 Davis Drive, Research Triangle Park, NC 27709.
[b]Upland MSO by West Central Inc., 2700 Trott Ave SW, P.O. Box 897, Willmar, MN 56201.
[c]Commercial formulations - Forefront HL and [d]Milestone by Dow AgroSciences LLC, 9330 Zionsville Road, Indianapolis, IN 46268-1189.
[e]Destiny HC by Winfield Solutions, LLC, P.O. Box 64589, St. Paul, MN 55164-0089.

Table 2. Leafy spurge control with quinclorac applied alone or with aminopyralid and 2,4-D in June or September on the Sheyenne National Grassland near Anselm, ND.

Treatment	Rate	Evaluation (MAT S/F)		
		3	12/9	15/12
	oz/A	% control		
Spring application (June 12, 2015)				
Quinclorac[a] + MSO[b]	6 + 1 qt	46	54	41
Quinclorac + aminopyralid + 2,4-D[c] + MSO	6 + 1.72 + 14 + 1 qt	79	69	70
Quinclorac + aminopyralid[d] + MSO	6 + 1.75 + 1 qt	74	74	69
Quinclorac + MSO	12 + 1 qt	86	93	79
Aminopyralid + 2,4-D + MSO	1.72 + 14 + 1 qt	55	68	60
Aminopyralid + HSMOC[e]	1.75 + 1 qt	19	31	24
Fall application (Sept. 25, 2015)				
Quinclorac + MSO	6 + 1 qt		71	58
Quinclorac + aminopyralid + 2,4-D + MSO	6 + 1.72 + 14 + 1 qt		86	43
Quinclorac + aminopyralid + MSO	6 + 1.75 + 1 qt		92	50
Quinclorac + MSO	12 + 1 qt		97	72
Aminopyralid + 2,4-D + MSO	1.72 + 14 + 1 qt		71	29
Aminopyralid + HSMOC	1.75 + 1 qt		29	26
LSD (0.05)		22	23	35

[a]Commercial formulation - Facet L by BASF Corporation, 26 Davis Drive, Research Triangle Park, NC 27709.
[b]Upland MSO by West Central Inc., 2700 Trott Ave SW, P.O. Box 897, Willmar, MN 56201.
[c]Commercial formulations - Forefront HL and [d]Milestone by Dow AgroSciences LLC, 9330 Zionsville Road, Indianapolis, IN 46268-1189.
[e]Destiny HC by Winfield Solutions, LLC, P.O. Box 64589, St. Paul, MN 55164-0089.

Evaluation of quinclorac applied in the spring or fall for optimum leafy spurge control. Rodney G. Lym. (Department of Plant Sciences, North Dakota State University, Fargo, ND 58108-6050). The use of quinclorac to control leafy spurge was largely developed in the 1990s but the herbicide was little used until a full grazing label was obtained in 2010. While control of leafy spurge with quinclorac has been well documented, initial publications indicated optimum leafy spurge control was obtained when quinclorac was applied in the spring compared to fall applications. Observations made since 2010 have indicated quinclorac applied in the fall will provide leafy spurge control similar to spring applications. The purpose of this research was to evaluate quinclorac applied in the spring or fall for leafy spurge control.

The experiment was established at two locations in North Dakota. The first site was located on the Sheyenne National Grassland (SNG) near Anselm, while the second location was on the Albert Ekre Grassland Perserve near Walcott. Both locations were within grazed pastures with a dense stand of leafy spurge. Treatments were applied on June 3, or September 8, 2014 at the SNG and June 23 or September 8, 2014 at the Walcott location. Leafy spurge was in the true-flower growth stage and 6 to 24 inches tall in June and was in the fall regrowth stage with 4 to 6 inch long branches growing from the main stem in September at application. Quinclorac applied at 6, 9, or 12 oz/A was compared to aminocyclopyrachlor plus chlorsulfuron at the Walcott location and with 2,4-D on the SNG where aminocyclopyrachlor use is prohibited. Herbicides were applied using a hand-held boom sprayer delivering 17 gpa at 35 psi. All quinclorac treatments were applied with a methylated seed oil at 1 qt/A. Experimental plots were 10 by 30 feet and replicated four times in a randomized complete block design. Leafy spurge control was evaluated visually using percent stand reduction compared to the untreated control.

In general, quinclorac tended to provide slightly better leafy spurge control at the Walcott location than at the SNG and also as a spring compared to fall applied treatment (Tables 1 and 2). For instance, leafy spurge control in the fall of 2014 [3 months after treatment (MAT)] averaged across all quinclorac application rates was 88 and 97% at the SNG and Walcott locations, respectively. Quinclorac applied in September 2014 provided excellent leafy spurge control at both locations when evaluated in June 2015 (96% average) but control dropped rapidly thereafter. Leafy spurge control at the SNG averaged over all quinclorac application rates was 82% and 62% when applied in June or September 12 MAT. The decrease in control was even more dramatic at the Walcott location as leafy spurge control averaged 95% and 71% when spring and fall applied 12 MAT. Control continued to decline in 2016 and treatments applied in June 2014 averaged 78 and 59% at the Walcott and SNG locations, respectively.

Leafy spurge control tended to increase as the quinclorac application rate increased with 9 oz/A the most likely cost-effective application rate considering both long-term control and chemical cost (approximately $5 per oz ai) (Tables 1 and 2). Quinclorac applied at 9 to 12 oz/A provided similar control to aminocyclopyrachlor plus chlorsulfuron (Table 2) but is more expensive ($45 to $60/A for quinclorac compared to $11/A for aminocyclopyrachlor). However, quinclorac can be used in areas with high ground water, near trees, or in other environmental sensitive areas which makes the treatment most cost-effective from an environmental standpoint.

The increased leafy spurge control at Walcott compared to the SNG may be due to the presence of the biological control agent *Aphthona* spp. flea beetles which were present but in very low numbers with no visible reduction in non herbicide treated areas. Research conducted at North Dakota State University has shown that herbicides applied on leafy spurge with *Aphthona* spp. present provided better long-term control than either method used alone.

In summary, quinclorac applied in June tended to provide slightly better long-term control than September applications at the Walcott but not SNG location. Thus, the optimum timing for quinclorac use to control leafy spurge could not be determined and is likely not critical. However, regardless of application timing, quinclorac applied at 9 oz/A was the most cost-effective application rate.

Table 1. Leafy spurge control with quinclorac applied in June or September on the Sheyenne National Grasslands near Anselm, ND.

		Evaluation date					
		2014		2015		2016	
Treatment	Rate	25 Aug	8 Sept	5 June	26 Aug	26 May	13 Sept
	oz/A	% control					
June application							
Quinclorac[a] + MSO[b]	6 + 1 qt	81	78	86	68	51	46
Quinclorac + MSO	9 + 1 qt	89	86	81	55	40	36
Quinclorac + MSO	12 + 1 qt	95	84	79	87	85	77
2,4-D	16	40	35	30	10	18	13
September application							
Quinclorac + MSO	6 + 1 qt			87	49	31	29
Quinclorac + MSO	9 + 1 qt			98	68	61	58
Quinclorac + MSO	12 + 1 qt			98	71	63	56
2,4-D	16			24	8	8	14
LSD (0.05)		36	11	12	27	37	38

[a]Commercial formulation - Facet L by BASF Corporation, 26 Davis Drive, Research Triangle Park, NC 27709.

[b]Upland MSO by West Central Inc., 2700 Trott Ave. SW, P.O. Box 897, Willmar, MN 56201.

Table 2. Leafy spurge control with quinclorac applied in June or September at the Albert Ekre research station near Walcott, ND.

		Evaluation date				
		2014	2015		2016	
Treatment	Rate	4 Sept	4 June	26 Aug	24 May	8 Sept
	— oz/A —			% control		
June application						
Quinclorac[a] + MSO[b]	6 + 1 qt	96	92	78	59	46
Quinclorac + MSO	9 + 1 qt	96	94	91	87	71
Quinclorac + MSO	12 + 1 qt	99	95	93	89	76
Aminocyclopyrachlor + chlorsulfuron[c]	1.4 + 0.6	97	97	98	91	75
September application						
Quinclorac + MSO	6 + 1 qt		97	56	39	31
Quinclorac + MSO	9 + 1 qt		99	68	43	21
Quinclorac + MSO	12 + 1 qt		99	89	55	25
Aminocyclopyrachlor + chlorsulfuron	1.4 + 0.6		99	93	77	33
LSD (0.05)		NS	4	22	24	33

[a]Commercial formulation - Facet L by BASF Corporation, 26 Davis Drive, Research Triangle Park, NC 27709.

[b]Upland MSO by West Central Inc., 2700 Trott Ave. SW, P.O. Box 897, Willmar, MN 56201.

[c]Commercial formulation - Perspective by E.I. duPont de Nemours and Company, 1007 Market Street, Wilmington, DE 19898.

Leafy spurge control with quinclorac mixtures applied in June or September. Rodney G. Lym. (Department of Plant Sciences, North Dakota State University, Fargo, ND 58108-6050). Quinclorac can be used to control leafy spurge in pasture, rangeland, and wildlands and is very safe on most native and cultivated grass species. Quinclorac is generally applied at 12 oz/A but at that rate is more expensive than other commonly used herbicides such as picloram and aminocyclopyrachlor. Combinations of herbicides such as picloram plus 2,4-D are often used in place of picloram alone for leafy spurge control because the combination treatment provides better long-term control than picloram used alone at similar or higher rates. The purpose of this research was to evaluate quinclorac applied alone or with 2,4-D or dicamba plus diflufenzopyr for leafy spurge control.

A study to evaluate quinclorac applied alone or combined with dicamba plus diflufenzopyr for leafy spurge control was established at the Albert Ekre Grassland Preserve, near Walcott, ND. Treatments were applied on June 23 or September 8, 2014. Leafy spurge was in the true-flower growth stage in June and had fall regrowth and was 22 to 26 inches tall in September. All treatments in these studies 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. Leafy spurge control was evaluated visually using percent stand reduction compared to the untreated control.

Long-term leafy spurge control with quinclorac was generally better when applied in June compared to September and at 12 compared to 6 oz/A (Table 1). For instance, leafy spurge control with quinclorac at 12 oz/A applied in June was 98% 12 months after treatment (12 MAT) compared to 70% 11 MAT (Aug 2015) when applied in September. Control was similar whether quinclorac was applied alone, with 2,4-D, or with dicamba plus diflufenzopyr.

The second experiment was established on the Sheyenne National Grassland near Anselm, ND and treatments were applied on June 3 or September 8, 2014. Leafy spurge was in the true-flower growth stage in June and had 6 inch vegetative regrowth on the main stems in September. In contrast to the first study, quinclorac applied in June or September provided similar leafy spurge control. For instance, quinclorac applied at 6 or 12 oz/A in June provided an average of 89% leafy spurge control 12 MAT (June 5, 2015) compared to 83% 12 MAT when applied in the fall (September 8, 2015) (Table 2). Leafy spurge control was similar wether quinclorac was applied alone or with 2,4-D.

In summary, leafy spurge control with quinclorac was not improved with the addition of dicamba plus diflufenzopyr or 2,4-D. Leafy spurge control tended to be better when quinclorac was applied in June compared to September at the one of the two locations. Thus, the optimum application timing for quinclorac to control leafy spurge could not be determined.

Table 1. Quinclorac applied in June or September alone or with various herbicide mixtures for leafy spurge control near Walcott, ND.

		Evaluation date				
		2014	2015		2016	
Treatment[a]	Rate	4 Sept	4 June	26 Aug	24 May	4 Sept
	— oz/A —			% control		
Spring application (June 23, 2014)						
Quinclorac[b]	6	98	90	67	35	24
Quinclorac	12	99	98	88	34	10
Quinclorac + dicamba + diflufenzopyr	6 + 3 + 1.2	98	96	78	65	51
Quinclorac + 2,4-D	6 + 16	96	80	60	90	83
Dicamba + diflufenzopyr[c]	3 + 1.2	68	54	32	73	56
Dicamba + diflufenzopyr + 2,4-D	3 + 1.2 + 16	84	64	38	49	30
2,4-D	16	68	42	16	8	10
Fall application (Sept. 8, 2014)						
Quinclorac	6		78	42	15	5
Quinclorac	12		98	70	35	13
Quinclorac + dicamba + diflufenzopyr	6 + 3 + 1.2		99	68	29	18
Quinclorac + 2,4-D	6 + 16		52	28	40	24
Dicamba + diflufenzopyr	3 + 1.2		75	36	54	28
Dicamba + diflufenzopyr + 2,4-D	3 + 1.2 + 16		83	39	3	0
2,4-D	16		23	9	6	0
LSD (0.05)		13	33	31	32	35

[a]All treatments were applied with 1 qt/A of Upland MSO by West Central Inc., 2700 Trott Ave SW, P.O. Box 897, Willmar, MN 56201.
Commercial formulation - [b]Facet L, [c]Overdrive by BASF Corporation, 26 Davis Drive, Research Triangle Park, NC 27709.

Table 2. Quinclorac applied alone or with 2,4-D in June or September for leafy spurge control on the Sheyenne National Grasslands near Anselm, ND.

		Evaluation date					
		2014		2015		2016	
Treatment[a]	Rate	5 Aug	8 Sept	5 June	26 Aug	26 May	13 Sept
	— oz/A —	% control					
Spring application (June 23, 2014)							
Quinclorac[b]	6	71	82	88	44	46	30
Quinclorac	12	94	97	90	71	20	16
Quinclorac + 2,4-D	6 +16	83	86	76	58	69	54
Quinclorac + 2,4-D	12 + 16	93	91	84	82	75	64
2,4-D	16	32	50	20	18	15	8
Fall application (Sept 8, 2014)							
Quinclorac	6			95	77	41	36
Quinclorac	12			97	88	63	44
Quinclorac + 2,4-D	6 + 16			92	63	81	66
Quinclorac + 2,4-D	12 + 16			91	75	58	48
2,4-D	16			56	42	43	31
LSD (0.05)		23	20	19	33	36	NS

[a]All treatments applied with 1 qt/A of Upland MSO by West Central Inc., 2700 Trott Ave SW, P.O. Box 897, Willmar, MN 56201.
[b]Commercial formulation - Facet L by BASF Corporation, 26 Davis Drive, Research Triangle Park, NC 27709.

Reed canarygrass control in wetlands. Rodney G. Lym. (Department of Plant Sciences, North Dakota State University, Fargo, ND 58108-6050). Reed canarygrass (*Phalaris arundinacea* L.) is considered a major invasive weed threat to wetlands as the plant out competes most native species. Reed canarygrass is a perennial that can grow up to 6 ft tall, has 0.25 to 0.4 inch wide leaves, and spreads by rhizomes. The plant was introduced into the US as a forage crop in the 1800s and is still planted because of high biomass production and greater tolerance to cold temperatures than many other cool-season grass species. Glyphosate has provided short-term top-growth reed canarygrass control, but the plant rapidly reestablishes from rhizomes a few months after treatment. The purpose of this study was to evaluate a variety of herbicides for efficacy on reed canarygrass to increase long-term control of the plant.

Two studies were established on the Albert Ekre Grassland Preserve near Walcott, ND on June 2 or September 25, 2015. All treatments were applied using a hand-held boom sprayer delivering 17 gpa at 35 psi. Experimental plots were 10 by 30 feet and with two replications in a randomized complete block design. In June, 18 herbicides were applied to reed canarygrass which was 6 to 16 inches tall. Plants were mowed in August to facilitate the fall study. Herbicides that showed the highest efficacy from the spring study were applied to reed canarygrass that had regrown to 2 to 3 inches tall. Reed canarygrass control was evaluated visually using percent stand reduction compared to the untreated control.

Clethodim and glyphosate were the only herbicides to provide greater than 90% reed canarygrass control 1 month after treatment (MAT) in June (Table 1). Reed canarygrass control averaged 94% 2 MAT with clethodim, but only 70% with glyphosate. Control gradually increased over time with imazapic, metsulfuron, sulfometuron, and tebuthiuron and averaged 97, 73, 74, and 68% 2 MAT, respectively. Only 3 herbicides provided satsifactory control the following spring; imazapic, sulfometuron, and tebuthiuron provided 85, 94, and 73% control 11 MAT. No treatment provided satisfactory control by September 2016, 15 MAT. Based on the 2 MAT evaluation data, glyphosate, imazapic, sulfometuron, and metsulfuron were chosen to be further evaluated in the fall study.

All fall-applied herbicides except metsulfuron provided 88% or greater reed canarygrass when evaluated in May 2016, 8 MAT (Table 2). However, control declined rapidly during the growing season. Reed canarygrass control 11 MAT with sulfometuron applied at 6 oz/A averaged 90% and 75% with glyphosate at 24 oz/A. Metsulfuron and imazapic did not provide satisfactory reed canarygrass control 11 MAT.

Imazapic, sulfometuron, and tebuthiuron provided season long reed canarygrass control when applied in June. Clethodim and glyphosate provide rapid, but short-term control. Sulfometuron also provided long-term reed canarygrass control as a fall applied treatment. Clethodim was the only herbicide evaluated that provided at least temporary reed canarygrass control and could be used if desirable forbs are present or to be seeded. Sulfometuron is a wide-spectrum herbicide that would inhibit establishment of native species but could be used if bare ground could be tolerated for a few months. Glyphosate provided better long-term reed canarygrass control when applied in the fall compared to spring.

Table 1. Evaluation of various herbicides for reed canarygrass control with treatments applied on June 2, 2015 at the Ekre ranch near Walcott, ND.

		Evaluation/months after treatment			
		2015		2016	
Treatment	Rate	1	2	11	15
	oz/A	% control			
Aminocyclopyrachlor + chlorsulfuron + NIS[a]	2.4 + 0.95 0.25%	28	33	10	0
Atrazine + MSO[b]	24 + 1 qt	45	25	0	0
Chlorsulfuron + MSO	1.5 + 1 qt	6	14	0	0
Clethodim + MSO	16 + 1 qt	93	94	38	0
Fenoxaprop	1.75 + 1.5 pt	10	3	0	0
Flucarbazone + MSO	0.88 + 1 qt	53	12	0	0
Glyphosate + AMS	24 + 24	97	70	0	0
Imazamox + MSO	0.75 + 1 qt	39	19	6	0
Imazapic + MSO	2 + 1 qt	38	97	85	13
Imazaquin + MSO	2.1 + 1 qt	3	0	0	0
Metsulfuron + MSO	0.9 + 1 qt	47	73	15	0
Nicosulfuron + MSO	0.75 + 1.5 pt	23	31	8	0
Primsulfuron + NIS	0.57 + 0.25%	18	4	0	0
Quinclorac + MSO	16 + 1 qt	13	38	0	0
Quizalofop + MSO	1.32 + 1 qt	20	19	0	0
Sethoxydim + MSO	7.5 + 1 qt	28	10	0	0
Sulfometuron + MSO	2.5 + 1.5 pt	58	74	94	30
Tebuthiuron + NIS	19 + 0.25%	50	68	73	10
LSD (0.05)		37	39	27	12

[a]Activator 90 by Loveland Products, 3005 Rocky Mountain Ave., Loveland, CO 80538.
[b]WCS Crop Oil by West Central Inc., 2700 Trott Avenue SW, PO Box 897, Willmar, MN 56201.

Table 2. Evaluation of various herbicides for reed canarygrass control applied on September 25, 2015 at the Ekre ranch near Walcott, ND.

Treatment	Rate	Evaluation/months after treatment	
		8	12
	oz/A	% control	
Glyphosate + MSO[a]	4 + 1 qt	88	0
Glyphosate + MSO	8 + 1 qt	96	5
Glyphosate + MSO	16 + 1 qt	99	0
Glyphosate + MSO	24 + 1 qt	99	75
Imazapic + MSO	2 + 1 qt	95	13
Imazapic + MSO	3 + 1 qt	99	45
Metsulfuron + MSO	2 + 1 qt	69	13
Sulfometuron + MSO	6 + 1 qt	100	90
LSD (0.05)		18	38

[a]WCS Crop Oil by West Central Inc., 2700 Trott Avenue SW, PO Box 897, Willmar, MN 56201.

Canada thistle control using the rosette technique, Carrington, 2015-16. Greg Endres and Mike Ostlie. A field study was conducted during 2015-16 at the NDSU Carrington Research Extension Center to re-examine control of Canada thistle using the rosette technique. Experimental design was a randomized complete block with three replications. Selected summer 2015 tillage treatments involved roto-tilling on June 12 to 1- to 24-inch tall (rosette to bud stage) Canada thistle followed by a second tillage on July 13. Selected summer 2015 mowing treatments were on June 12 followed by mowing on July 3 (rosette to bud stage) and August 4. Herbicides were applied with a CO_2-pressurized plot sprayer delivering 17 gal/A at 35 psi through 8002 flat fan nozzles to the center 6.67 ft of 10- by 30-ft plots. Herbicides were applied during summer 2015 on June 20 at 76 F, 61% RH and 9 mph wind to 2- to 30-inch tall (rosette to bud stage) Canada thistle. Herbicides were applied during fall 2015 on September 29 at 69 F, 26% RH and 11 mph wind to 1- to 24-inch tall (rosette to bud stage) Canada thistle. Following fall-applied herbicides, selected treatments were roto-tilled on October 9. Barley was planted in the trial on April 8, 2016. No herbicides were used during the growing season but the trial was mowed August 3.

Summer-applied Roundup PowerMax or WideMatch and summer- plus fall-applied Roundup PowerMax provided 76-81% Canada thistle control when evaluated on September 24, 2015 (before fall tillage to selected treatments) (Table). Canada thistle control when evaluated in May 2016 generally was good to excellent (77-97%) with all treatments except the summer herbicide treatments (numbers 3 and 4). However, only suppression (66-73% control) of Canada thistle was achieved when evaluated in September 2016 with mowing followed by fall-applied Roundup PowerMax; summer plus fall application of Roundup PowerMax; mowing followed by fall-applied Roundup PowerMax plus fall tillage; and summer application of WideMatch followed by fall-applied Stinger plus fall tillage (treatments 2, and 6-8). In summary, the data indicate mowing followed by fall herbicide or summer- followed by fall-applied herbicide provided the highest level of Canada thistle suppression at the close of the second year of the trial.

Table.

Number	Treatment Description[1]	Timing[2]	Herbicide rate	Canada thistle control				
				24-Sep-15	16-May-16	18-Jun-16	15-Jul-16	21-Sep-16
			fl oz/A			%		
	Tillage	Summer 2015	x					
1	Roundup PowerMax	29-Sep-15	32	35	92	75	77	56
	Mow	Summer 2015	x					
2	Roundup PowerMax	29-Sep-15	32	63	83	74	78	72
3	Roundup PowerMax	20-Jun-15	32	76	13	15	10	0
4	WideMatch	20-Jun-15	28.4	76	33	13	8	0
	Tillage	Summer 2015	x					
5	Roundup PowerMax	29-Sep-15	32	42	77	72	76	29
	Tillage	9-Oct-15	x					
	Roundup PowerMax	20-Jun-15	32					
6	Roundup PowerMax	29-Sep-15	32	81	84	76	77	66
	Mow	Summer 2015	x					
7	Roundup PowerMax	29-Sep-15	32	59	80	75	79	69
	Tillage	9-Oct-15	x					
	WideMatch	20-Jun-15	28.4					
8	Stinger	29-Sep-15	10.7	71	97	79	84	73
	Tillage	9-Oct-15	x					
CV (%)				6.1	18.6	20.3	14.3	31.1
LSD (0.05)				9	23	21	15	25

[1]Roundup PowerMax includes Class Act NG at 2.5% v/v (Winfield).

[2]Summer 2015: Tillage (roto-till)=June 12 and July 13; Mow=June 12, July 3 and August 4.