Rush skeletonweed control in winter wheat fallow.

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Rush skeletonweed (*Chondrilla juncea* L.) established on thousands of acres of rangeland in eastern Washington during the mid-1900s, and then spread into adjacent farmland after the land was enrolled in the Conservation Reserve Program (CRP). When CRP contracts expired, the land was returned to winter wheat production, but the rush skeletonweed persisted. Soil moisture is depleted by rush skeletonweed in the fallow phase of the winter wheat/fallow rotation, which results in poor winter wheat establishment in the fall and reduced yields at harvest.

Rush skeletonweed rosette 4 weeks after autumn Stinger application.

An herbicide trial was initiated near LaCrosse, WA in October 2017 to evaluate fall-, spring-, and summer-applied herbicides for control of rush skeletonweed in the fallow phase of a winter wheat/fallow rotation. The study area produced spring wheat in 2017 and the stubble remained standing through the fall and winter. The initial rush skeletonweed density averaged 6 plants/yd^2. By October 2017, most plants had bolted during the summer and the flowering stems were still present; however, some plants consisted of only rosettes. The 2017 spring wheat crop followed winter wheat in 2016, therefore, soil moisture was depleted and signs of drought, including dull leaf color and few leaves were visible on the rush skeletonweed plants at the fall application. During the 2018 fallow period, the plot area was cross cultivated, fertilized, and rod-weeded in late spring, and then rod-weeded in August prior to winter wheat seeding on September 1.

Plots measured 10 by 30 ft and were arranged in a randomized complete block design with four replications per treatment. Herbicides were applied with a hand-held spray boom with six TeeJet® XR11002 nozzles on 20-inch spacing and pressurized with a CO_2 backpack at 3 mph. Spray output was 15 gpa at 25 psi. Fall treatments were applied October 9, 2017, 7 days after the first frost. Spring treatments were applied on April 9, 2018 to coincide with normal spring fallow aid-to-tillage herbicide applications. Summer treatments were applied June 26, 2018 when rush skeletonweed plants were bolting (Table 1). Herbicide efficacy was assessed by counting all rush skeletonweed plants in a 6.5 by 28 ft strip through the middle of each 10 by 30 ft plot at several times throughout the year.

Table 1. Application and soil data.

Location	LaCrosse, WA		
Application date	October 9, 2017	April 9, 2018	June 26, 2018
Growth stage	bolted stems and rosettes	rosettes, only	rosettes and bolted stems
Air temperature	65	61	75
Relative humidity (%)	27	29	24
Wind (mph, direction)	2-4, E	0-4, SSW	2-4, WSW
Cloud cover (%)	10	10	10
Soil temperature at 3 inches (F)	60	62	80
Soil texture	sandy loam		
Soil pH	6.3		

Rush skeletonweed density at the time of the fall applications averaged 84 plants/plot and ranged from 66 to 97 plants/plot. By the following spring, all fall-applied treatments had substantially reduced rush skeletonweed density. At the April 25, 2018 census, rush skeletonweed were not yet present in plots treated with Stinger®, Milestone®, Curtail® at 64 oz/A, or Tordon® (Table 2). Plots treated with Curtail + Finesse® averaged 0.3 plants/plot and RT 3® + 2,4-D LV6® treated plots averaged 2.5 plants/plot, but these densities were not different from zero.

Spring applications on April 9, 2018 included a 24 oz/A application of RT 3 to all fall-applied treatments and the glyphosate check plots. This application was to control volunteer crop and winter annual weeds that had emerged through the winter. Spring-applied treatments of Stinger and Milestone were tank mixed with RT 3 at the 24 oz/A rate to combine the normal spring aid-to-tillage application with treatments for rush skeletonweed control during the fallow phase. Fallow tillage operations followed the spring herbicide applications during May and early June. The May/June tillage would have eliminated all above-ground plant material. Regrowth occurred in all plots, except those treated with Tordon, by the June 21 census; however, there were no differences between the fall-applied treatments except for fall-applied RT 3 + 2,4-D, which averaged 13 plants/plot and was not different from the glyphosate check, which averaged 23 plants/plot (Table 2). The greatest amount of regrowth occurred with spring-applied Stinger + RT 3, spring-applied Milestone + RT 3, fall- and spring-applied RT 3, and the glyphosate check.

On June 26, 2,4-D LV6 was applied to plots previously treated with Stinger, Milestone, and RT 3 (Table 2). This was intended as a rescue treatment for re-establishing rush skeletonweed beginning to bolt. At the mid-summer census on August 2, it was evident that the 2,4-D LV6 treatment only slightly checked an increasing density in the Milestone fall-treated plots, but it did not benefit fall-applied Stinger plots, which were already relatively low in density (Table 2). At the August 2 census, fall-applied Tordon was the most effective treatment averaging only 5 plants/plot.

A final census occurred on November 8, after the winter wheat had been seeded and had emerged. Fall treatments that were not different from the glyphosate check included Milestone, Curtail + Finesse, and fall-applied RT 3 + 2,4-D LV6 (Table 2). In previous research, Milestone applied at 1.2 oz/A controlled rush skeletonweed in the winter wheat crop; however, in the current trial it had lost control by mid-summer. Milestone is not yet labeled for use in winter wheat or fallow, but the rate used in this trial may be too low for effective fallow control. In addition, the June application of 2,4-D LV6 had not reduced rush skeletonweed density in the Stinger or Milestone treatments where it was included as a rescue treatment (Table 2). Furthermore, spring-applied Stinger + RT 3 or Milestone + RT 3 were not different from the glyphosate check. The lack of rush skeletonweed control with these two treatments is not fully understood. It is not clear if there is potential antagonism between glyphosate and the two synthetic auxins, or if the lack of control is simply a timing issue. This is being researched further.

The best year-long control was with either Tordon or Curtail at the 64 oz/A rate. At the November census, plots with these treatments averaged 11 and 16 plants/plot, respectively (Table 2). A concern with Tordon is reduced yield in the following crop; however, no visible crop injury was observed at this census (data not shown). Yield will be evaluated at crop harvest in 2019. Control with Curtail at 64 oz/A was more effective than Curtail at 32 0z/A + Finesse at 0.4 oz/A, and more effective than the fall-applied Stinger at 12 oz/A + summer-applied 2,4-D LV6 (Table 2). The 64 oz/A Curtail treatment applied 0.l9 lb ae/A clopyralid + 0.5 lb ae/A 2,4-D while the 12 oz/A Stinger treatment applied 0.28 lb ae/A. This would suggest there may be benefit or synergism from the combination of clopyralid and 2,4-D, both being synthetic auxin herbicides.

Glyphosate has been the standard fallow herbicide treatment in this region. In this trial, the aid-to-tillage application of 24 oz/A RT 3 in April controlled winter annual weeds and volunteer growth in the fall-treated plots and the glyphosate check plots. However, from grower communication it was reported that the aid-to-tillage rate does not reduce rush skeletonweed pressure in the fallow. By the August 2 census, density of rush skeletonweed in the glyphosate check plots was 50% greater than either the fall or spring glyphosate treatments of 64 oz/A (Table 2). By the November 8 census, the spring-applied 64 oz/A RT 3 plots still averaged 50% less rush skeletonweed than the glyphosate check. Density in the fall-applied RT 3 plots had increased and was not different from the glyphosate check, and averaged 1.6 times greater density than the spring-applied RT 3 treatment (Table 2). This would suggest that if glyphosate is the primary herbicide used for rush skeletonweed control, a spring high-rate application would give better control through the fallow phase than the fall application

From previous research, we have reported good control of rush skeletonweed with Stinger at 8 oz/A applied either in the fall or spring in the winter wheat crop. However, control during the crop phase does not guarantee control through the following fallow year. This trial finds good, but not complete, control with either Tordon or Curtail, each applied at the maximum labeled rate for fallow. Long-term control will require use of effective herbicides in both the fallow and crop phases.

Table 2. Rush skeletonweed density in winter wheat fallow in relation to fall, spring, and summer-applied herbicides.[1]

Trt	Herbicide[2]	Rate	Time[3]	Spring 3/29/18	Early Summer 6/21/18	Mid-Summer 8/2/18	Fall 11/8/18
		(oz/A)		------- plants per plot (6.5 by 28 ft)[4] -------			
1	Stinger	12	F	0 b	3 d	14 cd	28 cd
	RT 3	24	Sp				
2	Milestone	1.2	F	0 b	9 d	48 a	59 ab
	RT 3	24	Sp				
3	Stinger	12	F	0 b	5 d	14 cd	30 c
	RT 3	24	Sp				
	2,4-D	43	Su				
4	Milestone	1.2	F	0 b	7 d	30 b	46 abc
	RT 3	24	Sp				
	2,4-D	43	Su				
5	Curtail	64	F	0 b	5 d	13 d	16 de
	RT 3	24	Sp				
6	Curtail + Finesse	32 + 0.4	F	0.3 b	6 d	23 bc	41 bc
	RT 3	24	Sp				
7	Tordon	16	F	0 b	0 d	5 e	11 e
	RT 3	24	Sp				
8	RT 3 + 2,4-D	64 + 43	F	2.5 b	13 c	25 b	44 bc
	2,4-D	43	Su				
9	Stinger + RT 3	12 + 24	Sp	76 a	39 a	64 a	76 a
10	Milestone + RT 3	1.2 + 24	Sp	81 a	21 bc	49 a	69 ab
11	RT 3	64	Sp	75 a	13 bc	21 bcd	28 cd
	2,4-D	43	Su				
12	Glyphosate check[4]	24	Sp	75 a	23 b	54 a	57 ab

[1] Initial spring tillage and fertilization occurred in May/June 2018; Field was rod-weeded August 22, 2018; Field was seeded September 1, 2018

[2] Milestone and Curtail + Finesse treatments included non-ionic surfactant at 0.25% v/v; all RT 3 treatments included ammonium sulfate at 18 lb/gal. Glyphosate check plots were sprayed with an aid-to-tillage rate of glyphosate for control of winter annual weeds and volunteer crop.

[3] Time of application F = October 9, 2017, Sp = April 9, 2018, Su = June 26, 2018.

[4] Numbers in each column followed by the same letter are not statistically different (α=0.05)

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