Rush skeletonweed control in winter wheat.

Mark Thorne, John Spring, Henry Wetzel, Ian Burke, and Drew Lyon

Rush skeletonweed (*Chondrilla juncea* L.) is a deep-rooted perennial plant that has persisted on farmland across eastern Washington since the land was taken out of the Conservation Reserve Program (CRP) and put back into winter wheat production. Wheat yield is reduced where dense stands of rush skeletonweed deplete seed zone moisture during the fallow phase of the winter wheat/fallow rotation resulting in failed emergence of fall-seeded winter wheat (Figure 1). During the crop phase, rush skeletonweed flourishes and proliferates in areas where the wheat stand is thin or absent. Herbicide control in the crop phase is one part of an overall strategy to reduce or eradicate skeletonweed from these production areas.

Figure 1. Failed emergence of winter wheat in areas where rush skeletonweed depleted seed zone moisture.

We repeated an herbicide trial initially conducted in 2015-16 on land near LaCrosse, WA evaluating five different synthetic auxin herbicides for control of rush skeletonweed in winter wheat. Milestone® contains the active ingredient aminopyralid, Stinger® contains the active ingredient clopyralid, DPX-MAT28-128 is an experimental product containing the herbicide aminocyclopyrachlor, Clarity® contains dicamba as the active ingredient, and 2,4-D LV6 is a low-volatile ester formulation of 2,4-D. Herbicides were applied on October 29, 2016 when the wheat was tillering, and on April 5, 2017 when the wheat was well tillered with nodes present 1 inch above the crown. Rush skeletonweed was in the rosette stage at both application times and ranged from 1 to 9 inches in diameter in October, and 2-8 inches in diameter in April. The land had been in CRP until October 2013 and the first post-CRP crop was harvested in 2014. In 2016, the field was in summer fallow and was seeded to 'ORCF-102' winter wheat at 60 lb/A on September 2 with a John Deere HZ616® grain drill. The field had been fertilized prior to seeding with 85 lb nitrogen, 10 lb phosphorus, 10 lb sulfur, and 10 lb chloride per acre. At both treatment dates, herbicides were applied with a CO_2 pressurized backpack sprayer and 10-foot spray boom delivering 15 gpa spray volume. Boom pressure was 25 psi and ground speed was 3 mph. For maintenance of the plot area, a blanket treatment of 1.0 oz/A of Affinity® BroadSpec was applied on April 11, 2017 to control a dense population of tumble mustard. On May 8, 2017, the plot area was sprayed with 4.0 oz/A of Propi-Star® fungicide to control stripe rust. Experimental design was a randomized complete block with four replicated blocks and a factorial arrangement of herbicides and timing. Plot dimension was 10 by 30 feet.

Figure 2. Rush skeletonweed in winter wheat

Rush skeletonweed density was somewhat variable across the plot site where dense patches coincided with thin wheat stands (Figure 2). For consistency with the 2015/16 trial, two one-meter quadrats per plot were flagged on October 19, 2016 and all rush skeletonweed plants in each quadrat were counted to establish baseline initial densities in which to monitor until harvest. Rush skeletonweed densities were recounted in all quadrats on April 4, just prior to the spring herbicide applications, on April 20, two weeks following spring applications, June 12, when the wheat was in the soft-dough stage and again on July 19, prior to crop harvest. Additionally, herbicide control was evaluated visually on a whole-plot basis as percent of the non-treated check plots. Visual ratings on April 4, 2016 evaluated fall-applied herbicides and were prior to the spring-applied treatments. April 20 ratings evaluated control two weeks following spring applications as well as a second evaluation of the fall applications. Follow-up ratings were also made on June 12 and July 19. The plots were harvested on July 26 with a Kincaid® plot combine and grain samples were bagged from each plot and sub-sampled for grain moisture and test weight. In about 50% of the plots, blank or thin patches of wheat existed where fall emergence was poor. Visual estimations of the percent area affected in each plot were made prior to harvest (data not shown) and were used to standardize wheat yield to reduce variability from initial stand density. Standardized wheat yield was converted to bu/A and reported on a 12% moisture basis.

Rush skeletonweed densities prior to fall applications were similar across plots and averaged between 7 to 13 plants/m^2 (Table 1). By the April 4 census, fall-applied Milestone and Stinger had reduced rush skeletonweed density to less than 1 plant/m^2, but no reduction was seen with the other herbicides tested. At this census, the spring treatments had not yet been applied. At the June 12 census, fall-applied Stinger was most effective in controlling rush skeletonweed with only 0.4 plants/m^2 remaining. Spring-applied Stinger and Milestone were equally effective with densities of 1.3 and 1.4 plants/m^2. Results were mixed for DPX-MAT28-128, Clarity, and 2,4-D LV6. Fall-applied DPX-MAT28-128 resulted in 2.8 plants/m^2 and was not different from Milestone; however, spring-applied DPX-MAT28-128 was less effective than Milestone and not different than the non-treated check (Table 1). Clarity, and 2,4-D LV6 were the least effective fall-applied treatments, but spring-applied Clarity was better than the non-treated check. By the

July 19 pre-harvest census, no differences in density was found between any of the treatments (Table 1). By harvest, the dense wheat canopy was up to 52 inches tall and had shaded out many of the rush skeletonweed plants. This reduced the number of plants in denser colonized plots, including the non-treated checks, and diminished differences between all treatments.

Table 1. Rush skeletonweed density in winter wheat in response to herbicide applications.

		Rush skeletonweed census dates[2]			
Treatments[1]	Rate	19 Oct	4 Apr	12 Jun	19 Jul
	(oz/A)	-------------------------(plants/m^2)----------------------			
Fall-applied herbicides					
Non-treated	-	9.1 a	14.2 a	12.2 a	1.6 a
Milestone	0.6	11.3 a	0.8 b	2.4 d	1.3 a
Stinger	8.0	7.4 a	0.6 b	0.4 e	0.3 a
DPX-MAT28-128	1.7	9.4 a	9.4 a	2.8 cd	0.7 a
Clarity	4.0	7.6 a	8.3 a	5.5 bc	2.1 a
2,4-D LV6	8.7	11.1 a	12.2 a	6.0 b	1.3 a
Spring-applied herbicides					
Non-treated	-	12.8 a	15.5 a	17.3 a	2.5 a
Milestone	0.6	9.0 a	12.7 a	1.4 c	0.5 a
Stinger	8.0	9.5 a	12.5 a	1.3 c	0.8 a
DPX-MAT28-128	1.7	9.1 a	9.5 a	7.9 ab	0.8 a
Clarity	4.0	10.3 a	11.0 a	4.4 b	0.6 a
2,4-D LV6	8.7	8.1 a	10.0 a	9.0 ab	1.0 a

[1]All herbicide applications included a non-ionic surfactant (R-11®) at 0.25% v/v rate. Fall treatments were applied on October 29, 2016; spring treatments were applied on April 5, 2017. DPX-MAT28-128 is an experimental product containing the synthetic auxin aminocyclopyrachlor as the active ingredient.

[2] Means in each column, within each application time, followed by the same letter are not different at $p \leq 0.05$. The October 19, 2016 census established baseline densities and was prior to herbicide applications.

Visual control ratings were made over the whole plot area and gave similar results to the density measurements. Fall-applied Milestone and Stinger resulted in the greatest control, between 90 and 100%, at the April 4 and April 20 ratings (Table 2). By the June 12 rating, control with Milestone had declined to 80% compared with 97% control with Stinger. At this time, Milestone control was not different than DPX-MAT28-128, but control was greater than with Clarity or 2,4-D LV6. The decline in control from Milestone was due to plants bolting that had previously appeared dead. Injury or control from the spring-applied herbicides was only slightly evident two weeks after application on April 20 as only minor curling or burning could be seen on the rush skeletonweed leaves (Table 2). By June 12, within the spring-applied treatments, Milestone and Stinger had resulted in the greatest injury. For plants treated with DPX-MAT28-128, Clarity, or 2,4-D LV6, only slight suppression of bolting plants was the most common injury. At the July 19 pre-harvest rating, nearly all remaining plants had bolted and were nearing flowering, and heavy competition by the wheat crop made these ratings more variable than earlier ratings. No difference in control was found between fall-applied Milestone, Stinger, or DPX-MAT28-128; however, control with Stinger was still greater than 90%. Clarity and 2,4-D LV6 gave the least amount of control at 48 and 55%, respectively. No difference was found between any of the spring-applied treatments.

Table 2. Rush skeletonweed visual control ratings in winter wheat.

Treatments[1]	Rate	Visual control ratings[2]			
		04 Apr	20 Apr	12 Jun	19 Jul
	(oz/A)	----------------------------(%)----------------------------			
Fall-applied herbicides					
Non-treated	-	0 -	0 -	0 -	0 -
Milestone	0.6	95 a	96 ab	80 b	82 abc
Stinger	8.0	97 a	100 a	97 a	96 a
DPX-MAT28-128	1.7	72 b	63 c	67 bc	85 ab
Clarity	4.0	79 b	81 bc	35 d	48 c
2,4-D LV6	8.7	81 b	80 bc	55 cd	55 bc
Spring-applied herbicides					
Non-treated	-	0 -	0 -	0 -	0 -
Milestone	0.6	0 -	4 a	88 a	91 a
Stinger	8.0	0 -	6 a	85 a	90 a
DPX-MAT28-128	1.7	0 -	4 a	40 b	81 a
Clarity	4.0	0 -	7 a	57 b	80 a
2,4-D LV6	8.7	0 -	6 a	40 b	68 a

[1] See Table 1 for application details.
[2] April 4 ratings were prior to spring applications; April 20 ratings were 2 weeks following spring applications; June 12 ratings were at wheat soft dough stage; July 19 ratings were just prior to harvest. Means in each column, within each application time, followed by the same letter are not different at $p \leq 0.05$.

The wheat stand was exceptionally heavy across most of the plot area with the highest yields averaging 40 bu/A more than the long-term average for this area. Fall-applied herbicides had no effect on test weight; however, spring-applied DPX-MAT28-128 reduced test weight nearly 1.5 lb/bu compared with all other treatments (Table 3). Both fall and spring applications of DPX-MAT28-128 reduced crop yield with the spring application causing a substantial amount of kernel abortion that reduced yield up to 75%. Wheat yield was also reduced by 2,4-D LV6 applied in the fall, but not in the spring (Table 3). Stinger applied in the spring had lower yield than the highest yielding treatments, but was not different than Milestone or the non-treated check. Clarity had no apparent effect on yield applied in either fall or spring.

Overall, Milestone or Stinger applied in fall or spring were superior in controlling rush skeletonweed in winter wheat compared with DPX-MAT28-128, 2,4-D LV6, or Clarity. Stinger is currently labeled for winter wheat at 5.3 oz/A; however, 8 oz/A is consistent with rates for control of perennial weeds. Milestone is not yet labeled in the U.S. The experimental herbicide DPX-MAT28-128 can injure wheat and reduce yield, especially when applied in the spring. These results are similar to results from the 2015-16 trial.

Table 3. Winter wheat test weight and yield following fall- and spring-applied herbicides applications to control rush skeletonweed.

Treatments[1]	Rate	Test weight	Crop yield
	(oz/A)	lb/bu	bu/A
Fall-applied herbicides			
Non-treated	-	62.9 a	106 a
Milestone	0.6	62.9 a	93 ab
Stinger	8.0	62.8 a	105 a
DPX-MAT28-128	1.7	62.8 a	77 b
Clarity	4.0	62.8 a	101 a
2,4-D LV6	8.7	63.0 a	79 b
Spring-applied herbicides			
Non-treated	-	62.8 a	91 bc
Milestone	0.6	62.8 a	91 bc
Stinger	8.0	62.8 a	88 c
DPX-MAT28-128	1.7	61.3 b	28 d
Clarity	4.0	62.6 a	104 ab
2,4-D LV6	8.7	62.7 a	109 a

[1] See Table 1 for application details.

[2] Means in each column, within each application time, followed by the same letter are not different at $p \leq 0.05$.

Disclaimer

Some of the pesticides discussed in this presentation were tested under an experimental use permit granted by WSDA. Application of a pesticide to a crop or site that is not on the label is a violation of pesticide law and may subject the applicator to civil penalties up to $7,500. In addition, such an application may also result in illegal residues that could subject the crop to seizure or embargo action by WSDA and/or the U.S. Food and Drug Administration. It is your responsibility to check the label before using the product to ensure lawful use and obtain all necessary permits in advance.