

## **Control of Perennial Invasive Weeds with Repeated Applications of Herbicides**

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It is a well known fact that herbicides have potential for managing perennial invasive weed species; however, it is also well known that a single application of most herbicides provide only a short-term efficacy (one or two year suppression). We believe that this short-term assessment is not sufficient, as perennial species can propagate by multiple means, including seeds and perennial roots (rhizomes, stolons and crowns), which all contain secondary buds that can sprout new shoots after an initial damage by herbicide.

Therefore, we have conducted a 10-year herbicide efficacy study with a pilot species, purple loosestrife (*Lythrum salicaria* L.). Purple loosestrife is an invasive weed introduced from Eurasian to North America in early 1880's, and has become widespread in the United States. The spread of purple loosestrife is reducing the biodiversity of riparian areas across Nebraska and elsewhere in United States. As of 2001, purple loosestrife was declared a noxious species in Nebraska, as it poses a serious threat to the economic, social, or aesthetic well-being of Nebraska's landscape. Thus, we have evaluated the effectiveness of 14 herbicide treatments for purple loosestrife control over a 10-year period. Total of four studies were conducted at four sites. First site was along Missouri River near Newcastle, northeast Nebraska, with about 10 years old stand (according to landowners). Buffalo site, established along Plate River near Kearney had a 3-years old stands; Brown site, established along the Niobrara River north of Johnstown with 5-years old stands; and Holt site, along the local private lake north of Atkinson with the 3-years old stands.

The evaluated 14 herbicide treatments were: glyphosate (4 and 6 pt/acre); 2,4-D amine (2.5 and 5 pt/acre); triclopyr (3 and 5 pt/acre); imazapyr (4 and 6 pt/acre); metsulfuron (2 and 4oz/acre); fosamine (3 and 5 gal/acre); triclopyr (3 pt/acre)+2,4-D amine (2.5 pt/acre); and metsulfuron (1 oz/acre) + 2,4-D amine (2.5 pt/acre). Herbicides were applied when purple loosestrife was blooming, which was approximately the last two weeks of June each year. Herbicide efficacy rating was conducted at 60 and 360 days after treatment (DAT) utilizing a scale of 0-100% (where 0 = no control and 100% = plant death). It is important to note that not all treatments were applied every year. For example, during the initial years of the experiments all herbicide treatments were applied every year, but the decision whether to respray a particular treatment was based at the rating from 360 DAT, hence all treatments with ratings lower than 100% were resprayed.

### **Purple Loosestrife Control:**

Our data showed that the age of purple loosestrife stand was critical for effective control. The younger the stand the faster the control was achieved. For example, the 3 yr old stands from Buffalo and Holt required 2-3 years of consecutive spraying to provide complete control of the purple loosestrife (Table 1). At Holt site, the 3-year old stands were completely controlled by glyphosate, imazapyr, and metsulfuron after two consecutive years of spraying, while 2,4-D, triclopyr and fosamine required 3-years.

The 5-year-old stands at Brown site, required 2-5 years of consecutive spraying to achieve complete (100%) control, depending on the herbicide (Table 1). For example, the earliest complete control was achieved with metsulfuron sprayed yearly for 2 consecutive years, while the 3 years of consecutive spraying of glyphosate, imazapyr, and a mix of 2,4-D dimethylamine plus triclopyr was needed to provide complete control. Yearly spraying of 2,4-D dimethylamine, triclopyr, and fosamine for 5 yr was required to completely control the 5 year old stand at Brown site.

The 10 yr old stand at Dixon site required 3-9 yr of spraying to achieve complete control, which varied across herbicides (Table 2). For example, imazapyr required 3 years of consecutive spraying to achieve complete control, while it required yearly applications of 2,4-D, triclopyr and fosamine for a period of 9 years to provide complete control of the 10 yr old stands (see Table 2 for details). This is suggesting that herbicide selection is critical for faster control.

All treatments at all four sites were also rated and monitored for an extra 3 year after last spraying, and all ratings showed 100% control (data not shown in this article).

### **Practical implications:**

In general, our study had clearly shown that repeated spray of the tested herbicides could provide effective control of purple loosestrife over time, it will just require persistence and the use of most effective herbicide. The most effective herbicides for purple loosestrife control were glyphosate, imazapyr and metsulfuron, as they provided the fastest control of purple loosestrife (eg. within the first 2-3 years of spraying).

In addition, our assessment of the negative impacts on beneficial vegetation, suggested that metsulfuron appears to be the most desirable choice, as it has no detrimental effects on the grassy vegetation. Presence of grasses along the edges of waterways is promoted by land managers because grasses provide habitat and food for various bird species (including migratory birds) and feed for grazing animals (deer, livestock).

Finally, early detection of purple loosestrife stands followed by immediate control is critical, as it will increase the chance of managing this invasive species below the threshold level, and reduce the time and costs required for desirable control of purple loosestrife.

Table 1. Number of herbicide treatment application (or year) until complete control was achieved for each age group of purple loosestrife (*Lythrum salicaria*) stands (or locations)

Treatment	Rate (kg ae [ai] ha <sup>-1</sup> )	3-yr (Buffalo)	3-yr (Holt)	5-yr (Brown)	10-yr (Dixon)
Glyphosate	2.2	2 (2) <sup>a</sup>	2 (2)	3 (3)	4 (6)
Glyphosate	3.4	2 (2)	2 (2)	3 (3)	4 (6)
2,4-D dimethylamine	1.4	2 (2)	3 (3)	5 (5)	7 (8)
2,4-D dimethylamine	2.8	2 (2)	3 (3)	5 (5)	7 (8)
Triclopyr	1.3	2 (2)	3 (3)	5 (5)	7 (8)
Triclopyr	2.1	2 (2)	3 (3)	5 (5)	7 (8)
Imazapyr	1.1	2 (2)	2 (2)	3 (3)	3 (3)
Imazapyr	1.7	2 (2)	2 (2)	3 (3)	3 (3)
Metsulfuron	0.042	2 (2)	2 (2)	2 (2)	4 (5)
Metsulfuron	0.084	2 (2)	2 (2)	2 (2)	4 (5)
Fosamine	13.5	2 (2)	3 (3)	5 (5)	7 (8)
Fosamine	22.4	2 (2)	3 (3)	5 (5)	7 (8)
Triclopyr + 2,4-D	1.3 + 1.4	2 (2)	3 (3)	3 (4)	6 (7)
Metsulfuron + 2,4-D	0.042 + 1.4	2 (2)	2 (2)	3 (4)	6 (7)
Mean		2 (2)	2 (2)	4 (4)	6 (6)

<sup>a</sup> number of application (years of application)

Table 2. A 10-year-old purple loosestrife (*Lythrum salicaria*) stand control over time from selected herbicide treatments at Dixon.

Treatment	Rate (pt, oz or gal/acre)	Year 1 <sup>a</sup>		Year 2		Year 3		Year 4		Year 5		Year 6		Year 7		Year 8		Year 9	
		60 <sup>b</sup>	360	60	360	60	360	60	360	60	360	60	360	60	360	60	360	60	360
		% control																	
Glyphosate	4	90	84	97	94	95	93	100	100	-	-	100	100	-	-	-	-	-	-
Glyphosate	6	98	97	97	96	97	95	100	100	-	-	100	100	-	-	-	-	-	-
2,4-D amine	2.5	61	32	94	50	76	32	57	54	57	62	65	78	81	76	91	97	100	100
2,4-D amine	5	96	28	97	79	95	72	82	78	71	72	81	80	78	82	90	94	100	100
Triclopyr	3	64	25	86	41	79	32	64	63	47	72	72	74	55	76	83	77	100	100
Triclopyr	5	85	29	97	50	92	70	90	87	54	90	-	-	78	76	84	83	100	100
Imazapyr	4	84	83	97	98	100	100	-	-	-	-	-	-	-	-	-	-	-	-
Imazapyr	6	87	89	95	98	100	100	-	-	-	-	-	-	-	-	-	-	-	-
Metsulfuron	2	79	30	94	89	100	100	-	-	94	97	-	-	-	-	-	-	-	-
Metsulfuron	4	85	30	90	92	100	100	-	-	96	95	-	-	-	-	-	-	-	-
Fosamine	3	50	43	94	67	80	89	76	71	66	73	77	85	87	85	87	88	100	100
Fosamine	5	76	66	99	75	83	87	69	76	59	90	90	82	83	83	87	87	100	100
Triclopyr + 2,4-D	3 + 2.5	85	30	88	52	78	100	-	-	70	85	77	98	100	100	-	-	-	-
Metsulfuron + 2,4-D	1 + 2.5	91	30	86	74	95	97	-	-	86	97	99	97	100	100	-	-	-	-
LSD (0.05)		5.3	10.4	6.0	17	10.0	15.2	13.4		17.0	15.1	14.9	13.5	10.2	21.1	12.8	16.7	0.0	0.0

<sup>a</sup> Herbicides were sprayed once in each year.

<sup>b</sup> Days after treatment (DAT)

-: Not sprayed because there was no regrowth