

## 2014 / 2016 Kudzu Control Trial

### *Introduction*

Kudzu (*Pueraria montana*) is an invasive deciduous twining, trailing, mat-forming, woody leguminous vine that forms dense infestations along forest edges, rights-of-way, old homesteads, and stream banks. It colonizes by vines rooting at nodes and spreads by seed dispersal. The plants have extensive root systems with large tuberous roots that can be 3 to 10 feet deep. Kudzu can dominate a site to the exclusion of other vegetation. Repeated herbicide applications, along with other management measures, are required to reduce the kudzu infestations. Vegetation managers in many states use picloram for kudzu control but it has not been used extensively in KY in recent years (W. Witt, personal communication). This trial evaluated the efficacy of some potential alternate herbicide options to picloram for kudzu control.

### *Materials and Methods*

This study was initiated on June 24, 2014 by mowing a kudzu-infested abandoned tobacco field near Beattyville KY. The field had been burned in March, 2014 and the dominant vegetation was a mix of kudzu and giant ragweed at the time of mowing. Plots were 30 feet by 30 feet with 10 foot alleys separating them and were arranged in a 10 treatment randomized complete block design with three replications. On July 25, 2014, after kudzu regrowth, 9 herbicide treatments were applied in 30 gallons per acre carrier. The average kudzu canopy height was 14 inches with a range of 9 to 18 inches. Two of the treatments (Garlon 1.5 gal/A and Rodeo 4 qt/A) were reapplied on September 25, 2014. These same treatments were reapplied on July 23 and September 24 in 2015. Alleyways were mowed and Milestone was applied to minimize encroachment of kudzu from outside the trial area and from outside the plots in 2014 and 2015 but not in 2016, as described by Minogue et al (2011). Encroachment seemed to be “under control” early in 2016 but we were only able to complete the mid season assessment as kudzu had encroached on the trial area and no end of season assessment was done.

Table 1 lists the treatments, active ingredients and application rates. All the treatments were applied at the maximum annual amount specified on the herbicide product label. Garlon 3A and Rodeo can be applied more than once per year so one treatment of each (Treatments 4 and 6) received half the maximum rate in July and again in September. Most treatments included a non-ionic surfactant (Activator 90) at 0.5% v/v except for the Streamline treatment that included methylated seed oil (MSO) at 1% v/v. Visual assessments of percent kudzu control and green vegetative cover (0-100%) were done 32 (8/26/2014) and 62 (9/25/2014) days after initial treatment (DAIT) in 2014. Visual assessments of percent green vegetative cover by kudzu, grasses, and other broadleaves, as well as percent bare ground, were done 363 (7/23/2015) and 426 (9/24/2015) DAIT in 2015. Visual assessments of percent green vegetative cover by kudzu, grasses, giant ragweed, and broadleaves other than kudzu were done 689 (6/13/2016) and 760 (8/23/2016) DAIT in 2016. Data were analyzed using ARM software and treatment means were compared using Fisher's LSD at  $p = 0.05$ .

### *Results and Discussion*

In 2014, all the treatments, with the exceptions of Transline and Patron 170, controlled kudzu 98% or better 32 DAIT (Table 2). Control with Transline and Patron 170 was still good 32 DAIT, but only 92%. However, by 62 DAIT, control with Patron 170 declined to 72% while control with Transline was 96% (Table 2). Streamline, Garlon 3A (either as a single or split application), and Opensight all resulted in better control (99-100%) than Transline or Patron 170 62 DAIT. Control with Rodeo (either as a single or split application, 99 and 98%, respectively) and BK 800 (98%) 62 DAIT was higher than Patron 170 but not significantly different than the other treatments.

Transline and Patron 170 allowed for more regrowth of vegetation than the other treatments, 83 and 70% green vegetation cover, respectively, 32 DAIT (Table 2). However, by 62 DAIT, these treatments, as well as the split Garlon treatment, both Rodeo treatments, and BK 800, had green vegetation cover equal to that of the untreated plots (Table 2). Streamline was the most injurious to other vegetation (13% green cover) followed by Opensight (63% green cover) and the single application (1.5 gal/A) of Garlon (80% green cover).

At the time of the first assessment and reapplication of the treatments in 2015 (363 DAIT), Patron 170 had 83% kudzu cover (Table 3) while the other treatments ranged from 28 to 4% cover. Annual grasses and other broadleaf species covered the areas not dominated by kudzu. Streamline had the most bare ground (21%).

Sixty-three days after the 2015 applications and 426 days after the initial treatments in 2014, the kudzu cover was 67% in plots treated with Patron 170, 8% with Transline and 0-3% for the other herbicide treatments (Table 4). There was 77-93% annual grass cover in the Garlon 3A, Opensight, and BK 800 treatments. Broadleaf cover was highest (73-77%) in plots with either of the two Rodeo treatments. Streamline resulted in higher bare ground than with Transline, Garlon 3A, Opensight, BK800, the split Rodeo treatment or Patron 170 but not the Rodeo at 8 qt/A.

At the first assessment in 2016 (689 DAIT and 200 days after 2015 applications), the kudzu cover was 47% in plots treated with Patron 170 and 0-5% for the other herbicide treatments (Table 5). This same group of herbicide treatments had 57-83% grass cover, which was predominantly cheatgrass and large foxtail. Most of the plots included giant ragweed and a mix of other broadleaf species, such as large poison hemlock plants, except for the control, which only had kudzu (37%) and giant ragweed (63%) visible.

The site looked quite different at the last rating on August 25, 2016 (760 DAIT and 271 days after 2015 applications) with tall giant ragweed plants and encroaching kudzu plants as the dominant vegetation. We rated the plots from the back of the truck to view them. We had not seen this amount of growth in 2015. Looking at the monthly precipitation for the region (Climate Division 4), the long term average for May is 5 inches. In 2014, we had 3.4 inches, in 2015 1.8 inches, and in 2016 6.4 inches (Figure 1). Perhaps these differences in rainfall distribution played a role in the extent of kudzu and giant ragweed growth.

The kudzu cover was 70% for the Patron 170 plots and 0-10% for the other herbicide treatments 271 days after 2015 applications 760 DAIT (Table 6). The amount of grass cover decreased from the previous assessment (10-65%) for these herbicide treatments with no grass visible in the Patron 170 and control plots. The amount of giant ragweed cover increased from the previous assessment and it was the predominant vegetation in many of the treatments.

In summary, Transline, Streamline, Garlon 3A, Rodeo, Opensight, and BK 800 provided excellent kudzu control after two applications spaced one year apart. Patron 170 would not be a recommended treatment for kudzu control. However, a sustained effort is required to keep the kudzu from encroaching on the cleared areas again.

Minogue, P.J., S.F. Enloe, A. Osiecka, and D.K. Lauer. 2011 Comparison of aminocyclopyrachlor to common herbicides for kudzu (*Pueraria montana*) management. *Invasive Plant Sci. Management*. 4: 419-426.

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**Table 1. Treatments and Active Ingredients for Kudzu Control Trial**

Treatment	Product Names	Rate	Rate Unit	2014/15 Application Dates	Active Ingredient(s)	ai Rate (per acre)
1	Transline Activator 90	21 0.5	FL OZ/A % V/V	7/25/2014 7/23/2015	clopyralid	7.9 oz ae
2	Streamline COC	11.5 1	OZ/A % V/V	7/25/2014 7/23/2015	aminocyclopyrachlor + metsulfuron	4.5 oz + 1.4 oz
3	Garlon 3A Activator 90	3 0.5	GAL/A % V/V	7/25/2014 7/23/2015	triclopyr	9 lb ae
4	Garlon 3A Activator 90	1.5 0.5	GAL/A % V/V	7/25/2014 7/23/2015	triclopyr	4.5 lb ae
	Garlon 3A Activator 90	1.5 0.5	GAL/A % V/V	9/25/2014 9/24/2015	triclopyr	4.5 lb ae
5	Rodeo Activator 90	8 0.5	QT/A % V/V	7/25/2014 7/23/2015	glyphosate	8 lb ae
6	Rodeo Activator 90	4 0.5	QT/A % V/V	7/25/2014 7/23/2015	glyphosate	4 lb ae
	Rodeo Activator 90	4 0.5	QT/A % V/V	9/25/2014 9/24/2015	glyphosate	4 lb ae
7	Opensight Activator 90	3.3 0.5	OZ/A % V/V	7/25/2014 7/23/2015	aminopyralid + metsulfuron	1.7 oz ae + 0.3 oz
8	BK 800 Activator 90	2 0.5	GAL/A % V/V	7/25/2014 7/23/2015	2,4-D + 2,4-DP + dicamba	3.78 lb ae + 1.88 lb ae + 0.94 lb ae
9	Patron 170 Activator 90	6.9 0.5	PT/A % V/V	7/25/2014 7/23/2015	2,4-D + 2,4-DP	1.47 lb ae + 0.75 lb ae
10	Untreated Check					

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**Table 2: Results for Kudzu Control Trial (2014)**

Treatment	Product Names	Rate	Rate Unit	2014 Application Date	% Kudzu Control		% Green Vegetation Cover	
					32 DAT <sup>1</sup>	62 DAT	32 DAT	62 DAT
1	Transline Activator 90	21 0.5	FL OZ/A % V/V	7/25	92 b <sup>2</sup>	96 b	83 ab	100 a
2	Streamline COC	11.5 1	OZ/A % V/V	7/25	100 a	100 a	2 e	13 d
3	Garlon 3A Activator 90	3 0.5	GAL/A % V/V	7/25	100 a	100 a	10 de	80 b
4	Garlon 3A Activator 90	1.5 0.5	GAL/A % V/V	7/25	98 a	100 a	38 c	97 a
	Garlon 3A Activator 90	1.5 0.5	GAL/A % V/V	9/25				
5	Rodeo Activator 90	8 0.5	QT/A % V/V	7/25	100 a	99 ab	25 cde	97 a
6	Rodeo Activator 90	4 0.5	QT/A % V/V	7/25	98 a	98 ab	30 cd	96 a
	Rodeo Activator 90	4 0.5	QT/A % V/V	9/25				
7	Opensight Activator 90	3.3 0.5	OZ/A % V/V	7/25	98 a	99 a	18 cde	63 c
8	BK 800 Activator 90	2 0.5	GAL/A % V/V	7/25	99 a	98 ab	28 cd	98 a
9	Patron 170 Activator 90	6.9 0.5	PT/A % V/V	7/25	92 b	72 c	70 b	100 a
10	Untreated Check				0 c	0 d	100 a	100 a

<sup>1</sup> DAT = Days after treatment

<sup>2</sup> Means within a column followed by the same letter are not different according to Fisher's Protected LSD at  $P < 0.05$ .

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**Table 3: Results for Kudzu Control Trial (2015) (before 2015 applications 363 DAIT<sup>1</sup>)**

Treatment	Product Names	Rate	Rate Unit	% Vegetation Cover			
				% Kudzu	% Grass	% Other Broadleaves	% Bare Ground
1	Transline Activator 90	21 0.5	FL OZ/A % V/V	28 <i>b</i> <sup>2</sup>	38 <i>abc</i>	33 <i>abcd</i>	0 <i>b</i>
2	Streamline COC	11.5 1	OZ/A % V/V	4 <i>c</i>	36 <i>abc</i>	40 <i>abc</i>	21 <i>a</i>
3	Garlon 3A Activator 90	3 0.5	GAL/A % V/V	5 <i>c</i>	52 <i>ab</i>	30 <i>bcd</i>	13 <i>ab</i>
4	Garlon 3A Activator 90 Garlon 3A Activator 90	1.5 0.5 1.5 0.5	GAL/A % V/V GAL/A % V/V	17 <i>bc</i>	65 <i>a</i>	15 <i>cd</i>	3 <i>ab</i>
5	Rodeo Activator 90	8 0.5	QT/A % V/V	17 <i>bc</i>	15 <i>bc</i>	65 <i>a</i>	3 <i>ab</i>
6	Rodeo Activator 90 Rodeo Activator 90	4 0.5 4 0.5	QT/A % V/V QT/A % V/V	8 <i>bc</i>	30 <i>abc</i>	62 <i>ab</i>	0 <i>b</i>
7	Opensight Activator 90	3.3 0.5	OZ/A % V/V	20 <i>bc</i>	53 <i>ab</i>	17 <i>cd</i>	10 <i>ab</i>
8	BK 800 Activator 90	2 0.5	GAL/A % V/V	20 <i>bc</i>	68 <i>a</i>	10 <i>cd</i>	2 <i>ab</i>
9	Patron 170 Activator 90	6.9 0.5	PT/A % V/V	83 <i>a</i>	3 <i>c</i>	13 <i>cd</i>	0 <i>b</i>
10	Untreated Check			98 <i>a</i>	0 <i>c</i>	2 <i>d</i>	0 <i>b</i>

<sup>1</sup> DAIT = Days after initial treatment

<sup>2</sup> Means within a column followed by the same letter are not different according to Fisher's LSD at  $P < 0.05$ .

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**Table 4: Results for Kudzu Control Trial (2015) (63 days after 2015 applications 426 DAIT<sup>1</sup>)**

Treatment	Product Names	Rate	Rate Unit	2015 Application Date	% Vegetation Cover			
					% Kudzu	% Grass	% Other Broadleaves	% Bare Ground
1	Transline Activator 90	21 0.5	FL OZ/A % V/V	7/23	8 c <sup>2</sup>	65 b	23 b	3 b
2	Streamline COC	11.5 1	OZ/A % V/V	7/23	0 d	35 c	3 c	44 a
3	Garlon 3A Activator 90	3 0.5	GAL/A % V/V	7/23	0 d	77ab	10 bc	13 b
4	Garlon 3A Activator 90 Garlon 3A Activator 90	1.5 0.5 1.5 0.5	GAL/A % V/V GAL/A % V/V	7/23 9/24	0 d	88 ab	7 bc	3 b
5	Rodeo Activator 90	8 0.5	QT/A % V/V	7/23	3 cd	2 d	73 a	22 ab
6	Rodeo Activator 90 Rodeo Activator 90	4 0.5 4 0.5	QT/A % V/V QT/A % V/V	7/23 9/24	2 cd	7 d	77 a	13 b
7	Opensight Activator 90	3.3 0.5	OZ/A % V/V	7/23	0 d	93 a	2 c	5 b
8	BK 800 Activator 90	2 0.5	GAL/A % V/V	7/23	2 cd	80 ab	9 bc	8 b
9	Patron 170 Activator 90	6.9 0.5	PT/A % V/V	7/23	67 b	20 cd	13 bc	0 b
10	Untreated Check				95 a	0 d	5 bc	0 b

<sup>1</sup> DAIT = Days after initial treatment

<sup>2</sup> Means within a column followed by the same letter are not different according to Fisher's Protected LSD at P < 0.05.

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**Table 5: Results for Kudzu Control Trial (2016) (200 days after 2015 applications 689 DAIT<sup>1</sup>)**

Treatment	Product Names	Rate	Rate Unit	2015 Application Date	% Vegetation Cover			
					% Kudzu	% Grass	% Giant Ragweed	% Broadleaves other than Kudzu
1	Transline Activator 90	21 0.5	FL OZ/A % V/V	7/23	5 b <sup>2</sup>	58 a	5 bc	50 ab
2	Streamline COC	11.5 1	OZ/A % V/V	7/23	0.3 b	82 a	16 b	18 c
3	Garlon 3A Activator 90	3 0.5	GAL/A % V/V	7/23	0 b	70 a	2 bc	30 bc
4	Garlon 3A Activator 90 Garlon 3A Activator 90	1.5 0.5 1.5 0.5	GAL/A % V/V GAL/A % V/V	7/23  9/24	0 b	83 a	7 bc	17 c
5	Rodeo Activator 90	8 0.5	QT/A % V/V	7/23	0.3 b	58 a	13 bc	41 abc
6	Rodeo Activator 90 Rodeo Activator 90	4 0.5 4 0.5	QT/A % V/V QT/A % V/V	7/23  9/24	0 b	80 a	9 bc	20 c
7	Opensight Activator 90	3.3 0.5	OZ/A % V/V	7/23	0 b	73 a	12 bc	27 bc
8	BK 800 Activator 90	2 0.5	GAL/A % V/V	7/23	2 b	57 a	0 c	42 abc
9	Patron 170 Activator 90	6.9 0.5	PT/A % V/V	7/23	47 a	13 b	0 c	40 abc
10	Untreated Check				37 a	0 b	63 a	63 a

<sup>1</sup> DAIT = Days after initial treatment

<sup>2</sup> Means within a column followed by the same letter are not different according to Fisher's Protected LSD at P < 0.05.



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**Table 6: Results for Kudzu Control Trial (2016) (271 days after 2015 applications 760 DAIT<sup>1</sup>)**

Treatment	Product Names	Rate	Rate Unit	2015 Application Date	% Vegetation Cover			
					% Kudzu	% Grass	% Giant Ragweed	% Broadleaves other than Kudzu
1	Transline Activator 90	21 0.5	FL OZ/A % V/V	7/23	8 b <sup>2</sup>	10 bc	37 ab	82 a
2	Streamline COC	11.5 1	OZ/A % V/V	7/23	0 b	62 a	38 ab	38 abc
3	Garlon 3A Activator 90	3 0.5	GAL/A % V/V	7/23	1 b	65 a	33 ab	34 abc
4	Garlon 3A Activator 90 Garlon 3A Activator 90	1.5 0.5 1.5 0.5	GAL/A % V/V GAL/A % V/V	7/23 9/24	0 b	47 abc	53 ab	53 abc
5	Rodeo Activator 90	8 0.5	QT/A % V/V	7/23	0 b	30 abc	68 a	70 ab
6	Rodeo Activator 90 Rodeo Activator 90	4 0.5 4 0.5	QT/A % V/V QT/A % V/V	7/23 9/24	0 b	52 ab	45 ab	48 abc
7	Opensight Activator 90	3.3 0.5	OZ/A % V/V	7/23	0 b	33 abc	67 a	67 ab
8	BK 800 Activator 90	2 0.5	GAL/A % V/V	7/23	10 b	43 abc	25 ab	45 abc
9	Patron 170 Activator 90	6.9 0.5	PT/A % V/V	7/23	70 a	0 c	3 b	30 bc
10	Untreated Check				92 a	0 c	8 b	8 c

<sup>1</sup> DAIT = Days after initial treatment

<sup>2</sup> Means within a column followed by the same letter are not different according to Fisher's LSD at  $P < 0.05$ .

**Figure 1: Monthly Precipitation (inches) for 2014 – 2016 for Climate Division 4**

