WOODY VEGETATION CONTROL ON UTILITY RIGHTS-OF-WAY IN EASTERN KANSAS: I. MANAGEMENT TECHNIQUES

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Abstract. Various management methods for controlling woody vegetation on rights-of-way of electric utility, high voltage, transmission lines were investigated. Three-year results showed that the Tordon and Tordon + Garlon treatments provided about 50% mortality in the approximately 7-year-old sapling stands. Height of surviving stump sprouts was not affected. Krenite S was less effective when applied in the fall at the time of the first frost than when applied earlier. Arsenal was not effective, but the application rate was 1/2 that suggested. Problem species appear to be ash, oak, pecan, persimmon, and plum. A vegetation management system that includes herbicide treatments along with cutting should nearly eliminate the woody plants within a few cutting cycles.

Rights-of-way (ROWs) for electric transmission lines are strips of land where electric utilities provide a corridor for the safe and reliable transmission of electricity. Trees can disrupt the security zone of a transmission line. The principal objective of vegetation management is to replace the undesirable tall trees with low-growing plant communities. A variety of herbicides has been used to remove undesirable plants. Background information on ROW management concepts, costs, and alternative values can be found in recent texts (1-4,6,7,9,12).

In eastern Kansas, transmission line ROWs often cross wooded areas. Eventual natural regrowth of trees in the cleared ROW's creates a hazard to the lines. Even in less productive soils, natural forest vegetation often exceeds 50 feet in height in Kansas. This study evaluated various mechanical cutting and chemical management methods for controlling trees and shrubs on the ROWS of electric utility transmission lines. Test plots were established on selected sites in eastern Kansas to account for variations in soils, climate, and plant species. Mechanical cutting, where trees are sheared close to the ground (cut-stubble), can be used with or without chemicals (11). Although cutting had been used extensively in northeastern Kansas, a combined treatment with chemicals had not been tested locally.

Materials & Methods

Study area description. Two geographical areas were selected for the investigation. Both northeastern and southeastern Kansas have needs for brush and tree control. The study was established at three sites in the springs of 1987 and 1988. All sites had been cut previously within the past 10 years and were covered with tree and shrub regrowth.

The Rock Creek Site (NEK-1) study area was established on a level upland site having disturbed loamy soil and covered with densely mixed, sapling-sized, hardwood tree species. The Branch Creek Site (NEK-2) study area was established on a rolling hill upland site that was level to a 25% northerly slope, had shallow rocky silty clay loam soil, and also was covered with a dense stand of upland hardwood tree species. And finally, the SEK-1 (Strauss Site) study area was located on a level bottomland site with silty clay soil and was covered with a dense stand of bottomland hardwood tree species.

Experimental design and treatments. The field layout employed in all the studies was the Randomized Complete Block design, which usually had two to six replications with each herbicide treatment represented once in each replicate. Individual research plots were 2000, 1000, or 750 sq. ft. for each herbicide treatment; every plot in an individual replicate was of the same size.

In April, all sites were cut mechanically with a Hydro-Ax 550 brush hog, and most plots were broadcast-sprayed within three days in two directions with a Birchmeier backpack sprayer at a 50 gal/acre rate. Herbicide treatments were either Tordon K (picloram) at 4, Arsenal (imazapyr) at 1/2, Garlon 4 (triclopyr) + Tordon K at 6 + 2, or Tordon 101M (picloram + 2, 4-D) at 12 qts/acre. In early fall, an aqueous solution of Krenite S (fosamine) was sprayed on foliage in cut-only plots at 2 to 3 gals/acre in a 2% solution in water at a 125 gal/acre rate with a hand directed power spray unit. In addition, a water softener (4 oz/100 gal. sodium glucinate) and 1/4% of Cido-kick II were added to the solution. All herbicides but Krenite have ground/root activity. Dormancy may have begun, because an early fall frost probably occurred at two of the three sites. Some cut-only control plots were left unsprayed for comparison. Treated species included American plum, black cherry, black locust, black walnut, boxelder, cottonwood, dogwood, elms, green ash, hackberry, hawthorn, hickory, mulberry, osage orange, pecan, persimmon, redbud, red oak, and white oaks.

Data collection and analysis. A final evaluation was made in early November 1990. Species counts and average heights were taken of living trees. Vegetation survival differences between herbicide treatments after three growing seasons were tested by statistical analyses (ANOVA) using the SAS statistical package (10).

To assist in selecting the appropriate management technique, natural vegetation growing on the sites after treatments was evaluated.

Results

Herbicide treatments. Evaluation after the third growing season showed that three of the herbicide treatments (Tordon K, Tordon 101M, and Garlon 4 +Tordon K) provided about 50% tree control (Table 1). Resprouting of cut trees was reduced 42% by all the ground-applied herbicide treatments (counting only original trees before treatment) as compared to the cut-only control. Total tree numbers were increased by the inclusion of newly seeded trees from the adjacent woodlands, thus the change was -35% (counting all live trees after three years on herbicide-treated plots only). The Tordon and Garlon plus Tordon treatments gave better control (about 50%) of the woody vegetation (Figure 1).

Krenite S applied in the fall at the time of the first frost (NEK-1 and SEK-1) did not reduce the number of living stems, but showed a 58% reduction when applied earlier (NEK-2). Arsenal was not effective.

Only 9% of the living trees had a single living stem, whereas the other 91% had multiple stems. Single stems were considered to reflect volunteer seedlings. No difference in the number of stems was found among the herbicide treatments.

Table 1. Final evaluation (3 years) of the herbicide treatment effects on hardwood tree species at three sites in Kansas.

Treatments	Living stems[1]			Single stems			Height		
	NE-1	NE-2	SE-1	NE-1	NE-2	SE-1	NE-1	NE-2	SE-1
	(%)[2]						(ft)[2]		
Arsenal	+51a	-12a	+16a	09a	02a	12a	10.2a	7.2a	6.6a
Garlon 4 + Tordon K	-40bc	-54a	-48b	07a	07a	07a	10.2a	7.0a	6.9a
Krenite[3/]	+02ab	-58a	-04a	21a	06a	22a	6.7b	5.2a	6.5a
Tordon 101M	-42bc	-53a	-47b	11a	00a	10a	9.3a	7.0a	6.8a
Tordon K	-55c	-58a	-60b	10a	00a	11a	8.9a	6.2a	6.8a
Control	+18a	-07a	+02a	19a	06a	09a	9.8a	8.0a	7.9a
Means (herb.)	-17	-47	-40	12	04	12	9.1	6.5	6.7

1. Percent initial number original + new seedlings as compared to pretreatment.
2. Column means followed by different letters are significantly different at the 5% probability level.
3. Krenite S measurements after two growing seasons.

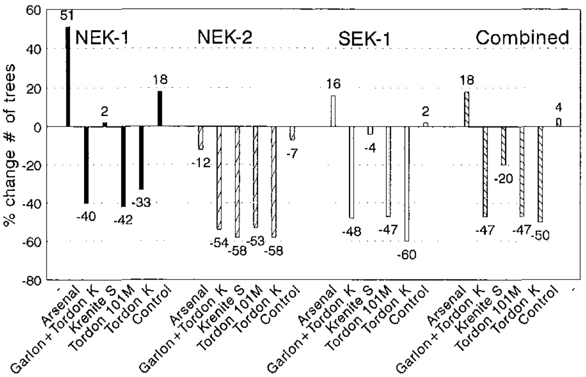

Figure 1. Percent change in number of trees by herbicide treatment after 3 years at each site.

Only the trees (all species) on plots treated with Krenite S herbicide were significantly shorter than those found on the cut only control plots (Table 1). Krenite S plots were treated in the fall, whereas the other herbicides were applied soon after the spring cutting. Thus, height differences are probably insignificant, because data for the former are for only two years as compared to three years for the other treatments.

Conversion vegetation. In eastern Kansas, the most desirable ground cover for landowners having sloping property adjacent to transmission ROWs would be grassland. Land use in these areas would favor ranching. Better sites, such as those areas having deep, loamy soils, level topography, and high soil moisture, would support crop production.

First year nonwoody vegetation response at all three sites is presented in Table 2. Annual foxtail grass quickly invaded the Tordon-treated areas, whereas giant ragweed covered the others in the upland sites. Nutsedge growth was luxuriant on the bottomland site. Herbaceous species composition was noted but not recorded. Ash and elm quickly reseeded some areas.

Discussion and Summary

Three of the five herbicides, when combined with the cut-stubble treatment, reduced the surviving woody plant vegetation by about 50% after three years in the approximately 7-year-old sapling stands as compared to the no-herbicide control (Figure 1).

Tordon 101M, Tordon K, and combined Garlon 4 + Tordon K treatments gave the best results. However, none reduced the number of surviving trees by 90% as desired. Garlon 4 + Tordon K did not effectively control black locust, green ash, or red oak. None of the herbicides controlled green ash. Also cherry, redbud, hickory, osage orange, and walnut were difficult species to kill.

All species were nonresponsive to Arsenal,

Table 2. Natural nonwoody vegetation 1 year following treatment.

Study area	Treatment	Dominant vegetation
NEK-1 (Rock Crk.)	Arsenal	Giant ragweed
	Garlon 4 +Tordon K	Annual foxtail, ragweed, pokeberry
	Tordon 101 M	Annual foxtail, ragweed, grass
	Tordon K	Annual foxtail
	Control	Broadleaf,ragweed, grass
NEK-2 (Branch Crk.)	Arsenal	Giant ragweed
	Garlon 4 +Tordon K	Grass
	Tordon 101 M	Grass
	Tordon K	Grass
	Control	Broadleaf
SEK-1 (Strauss)	Arsenal	Giant ragweed, nutsedge
	Garlon 4 +Tordon K	Nutsedge
	Tordon 101 M	Nutsedge
	Tordon K	Nutsedge
	Control	Grass, ragweed, nutsedge

whereas the other treatments were selective. Arsenal when used at 1/2 the suggested rate had little effect on woody plants. Applying Arsenal at the suggested manufacturer's rate of 1 qt./acre could have resulted in movement of the herbicide off-site to the untreated border zones. Thus, nontarget plants could have been damaged.

Krenite S, when used as a foliage spray in the early fall, reduced the original number of plants by only 20%. Many smaller understory trees probably were overlooked because of the timing late in the growing season and the heavy growth of herbaceous plants. At two of the three geographic areas treated, Krenite was applied just one day before frost. When Krenite S was applied a month before frost, the 58% reduction in stems was comparable to results with the other three herbicides thus earlier treatment during the mid-growing season would have been more effective.

The heavy woody debris left on the ground after the mechanical shearing and chopping interfered with good dispersal of the herbicides onto the ground. Heavy rains shortly after treatment at the NEK-1 site reduced the effective kill. In addition, hand application on difficult hilly and debris-covered sites may have reduced the evenness of the herbicide sprayed on the ground. The 50 gal/acre rate of mix used was effective for application and carrying the mix to the soil. However, a rate of 125 gal/acre might have been more effective.

Our results were based upon a 3rd year evaluation to assure accuracy of survival/mortality. Mid-season 1st year evaluations indicated only a 5% greater kill as compared to results at three years (40 vs. 35%). Although this is a minor difference, the variability among treatments, plots, and years suggests waiting more than one year before evaluating treatment effectiveness.

More than one treatment combining cut-stubble with herbicide application will be necessary to eradicate the woody vegetation on ROW. Repeated cutting favors some species (8). Because all the remaining live trees were about the same height as those on the control plot (Figure 2), the treatment cycle between shearing operations would not be shortened. We estimate that three cut-stubble/herbicide operations will be necessary to convert sites from woody plants to the desired

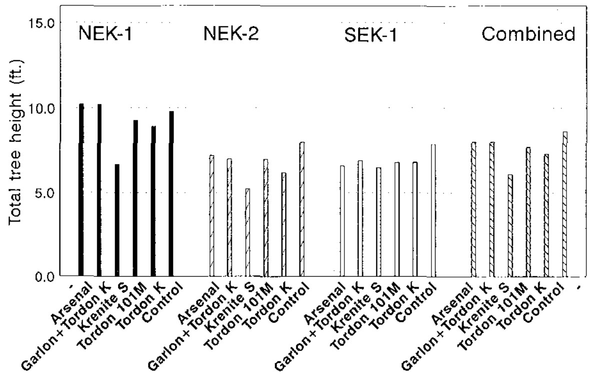

Figure 2. Total height of living trees by herbicide treatment after 3 years at each site location.

grasses. An alternative to multiple cutting operations may be a follow-up treatment of missed "escape" trees with basal spraying during the latter part of the first summer after an initial cut-stubble/herbicide treatment. Delaying the basal treatment would result in large sprouts, thus increasing cost of eradication of the woody stems.

One year after brush control treatment, many annual grasses and herbaceous broadleafed species appeared on the research plots. Some perennial grasses were found and were most likely present before herbicide treatment. Arsenal herbicide, as applied, appears to eliminate all broadleaf weeds but giant ragweed, which is desirable for wildlife.

Because the woody vegetation remained at about 50% of that before treatment, the herbaceous species were unable to respond to a greater extent. Artificial seeding of grass would not have been justified after this single cut-stubble/herbicide operation. However, as subsequent treatments reduce the woody vegetation, grass seeding could be used to speed up the conversion to a grassland environment on the ROW.

Harold Young (former Professor of Forestry at the University of Maine), a visionary in "Puckerbrush" ROW vegetation management, suggested that foresters should be involved in highway planning to alleviate later corridor management problems in the eastern USA (13). His insight into forest ecology/management suggests that similar involvement by foresters in transmission line ROWs in the Plains States would be beneficial. Corridor management favoring low woody plants (5) in the border zones adjacent to the transmission lines should be considered.

Conclusion

The major conclusion of this study is that elimination of unwanted brushy vegetation beneath electrical transmission lines requires more than a single cutting with a brush hog. Many sprouts emanate from a severed tree stem, resulting in dense cover. Application of ground-applied herbicides along with cutting of brush substantially reduces (50%) standing woody biomass in heavy brush areas. A vegetation management system that includes herbicide treatments along with cutting should nearly eliminate the woody plants within a few cutting cycles.

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Résumé. Les traitements appliqués sur une emprise de ligne électrique consistaient en une coupe printanière, effectué avec de l'équipement de fauchage des broussailles, suivie d'applications sur le sol de diverses substances chimiques: 4 pintes américaines à l'acre deTordon K (picloram), à d'Arsenal (imazapyr), mélange de 6 de Garlon (triclopyr) + 2 de Tordon K, ou 12 d'un mélange de Tordon 101M (picloram) + 2, 4-D. Les résultats après trois ans montraient que les traitements au Tordon et au mélange Tordon + Garlon donnaient un taux de mortalité d'environ 50% sur les peuplements de jeunes arbres âgés d'environ sept ans. La hauteur des rejets des souches survivantes n'était pas affectée par les traitements. Le Krenite S était moins efficace lorsqu'il était appliqué en automne au moment de la première gelée qu'avant cette dernière. L'Arsenal ne donnait aucun résultat positif malgré un taux d'application suggéré de 0.5 pinte.

Zusammenfassung. Die Behandlung auf dem Seitenstreifen entlang einer Stromversorgung bestanden aus einem Frühjahrsschnitt mit einer Ausrüstung, gefolgt von einer Bodenapplikation mit verschiedenen Chemikalien: entweder Tordon K (Picloram) mit 4 Arsenal (Imazapyr) mit 1/2, Garlon (Triclopyr) + Tordon K mit 6+2, oder Tordon 101M (Picloram) +2,4D mit 12 Vierteln pro acre. Die Resultate nach drei Jahren zeigten, daß Tordon und Tordon + Garlon Behandlungen in einem Bestand von schätzungsweise 7 jährigen Schoßern über 50% Todesrate lieferten. Die Höhe der überlebenden Wurzelstockausschläge war nicht betroffen. Krenite S zeigte sich weniger effektiv, wenn es im Herbst zur Zeit der ersten Fröste angewendet wurde als zu einem früheren Zeitpunkt. Arsenal war nicht effektiv, aber die Applikationsrate betrug nur die Hälfte der empfohlenen Menge.