TARGET/NON-TARGET EFFECTS OF HERBICIDES IN POWER-LINE CORRIDOR VEGETATION

by J.O. Luken, S.W. Beiting, and R.L. Kumler

Abstract. Four herbicides (Accord, Accord+Escort, Garlon/Tordon, and Krenite) and two cutting regimens (cut/spray and cut/delay spray) were tested in an Ohio power-line corridor. In all herbicide/cutting combinations, tree populations showed some recovery two years after treatment. Although Accord+Escort applied in a cut/spray treatment resulted in the lowest population of trees after two years, this treatment also had the most persistent negative effect on non-target ground cover. Krenite had the least negative impact on ground-cover. Spraying sooner rather than later after cutting improves tree-kill by all herbicides, but may also increase effects on non-target species. More selective herbicides and herbicide application methods are needed for management of natural vegetation.

A large number of different herbicides have been used to manage woody plants in power-line corridors (10). Unfortunately, the effectiveness of a herbicide in natural vegetation is not easily predicted. Effectiveness may vary depending on climate, plant species, and application methods (6). As such, electric utilities should consider field trials of different herbicides and application methods before beginning a large-scale herbicide program.

Managers of power-line corridors will likely define herbicide effectiveness differently than weed scientists working with agricultural crops (8). An effective herbicide in a power-line corridor eliminates populations of target species (i.e., trees), preserves non-target species (i.e., low growing shrubs, vines, grasses, and herbs), and extends management cycles by encouraging vegetation that inhibits tree growth.

This research compared the effectiveness of four different herbicide formulations when applied to vegetation in two different developmental states. The goal was to identify a management combination that would eliminate trees but preserve and release ground-cover species.

Methods and Materials

The Study Site. The study site was a power-line corridor (35 m wide) in Clermont County, Ohio. Matrix vegetation was second-growth forest. Vegetation in the corridor was last cut with a mechanical mowing machine during spring, 1989 and was dominated in May, 1990 by dense patches of tree sprouts that included *Robinia pseudoacacia* (black locust), *Fraxinus americana* (white ash), *Platanus occidentalis* (sycamore), and other woody species.

Experimental Design. During late June, 1990, vegetation in one-half of the corridor was cut at ground level with a mechanical mower. Fifty experimental plots, each 15.2 x 15.2 m, were established in pairs. One member of each pair was established in the recently cut area while the other member of each pair was established nearby in the vegetation last cut during spring, 1989. Two-meter-wide walkways were marked and mown between plots. Five treatments (four herbicide formulations and one control) were randomly assigned to the plot pairs so that in most cases five replicates of each cutting and herbicide combination were measured. Herbicides were chosen to represent a range of selectivity and mode of action: Accord (glyphosate) at 18.7 l/ha; Accord + Escort (glyphosate + metsulfuron) at 18.7 l/ha + 0.14 l/ha; Garlon/Tordon (triclopyr/picloram) at 11.7 l/ha + 18.7 l/ha; Krenite (fosamine) at 28.1 l/ha.

All plots, except controls, were sprayed with a low-volume radiarc spraying apparatus during late August and early September, 1990. Rates of application were suggested by technical representatives of the herbicide manufacturers. Throughout this study, vegetation that was cut during June, 1990 and then sprayed in 1990 is referred to as the cut/spray treatment. Vegetation that was last cut in 1989 and then sprayed in 1990 is referred to as the cut/delay spray treatment.

Sampling Methods. During June, 1991 and

1992, ca. 9 and 21 months after herbicides were applied, the following measurements were taken within the boundaries of each experimental plot. Diameters of all tree and shrub stems were recorded and the stems were categorized as either live or dead. Non-target plant coverage and bare ground were measured in four 1 m^2 subplots. The percentage of subplot area covered by each non-target plant species and bare ground coverage were visually estimated in each subplot, summed among the subplots, and then divided by the total percentage of area sampled to obtain total plant coverage and total bare ground in each larger experimental plot. Tree populations prior to spraying were not measured directly in 1990 but were estimated by an assessment of stems (live and dead) that existed in the 1991 post-treatment plots.

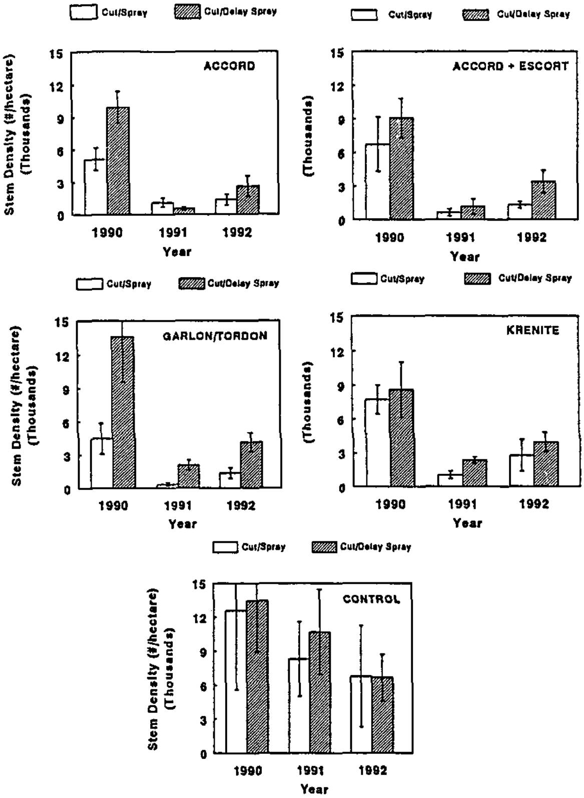

Fig. 1. Densities of live tree stems (number/ha) in experimental plots. Cut/spray plots were cut in June 1990 and sprayed in late August 1990. Cut/delay spray plots were cut in June 1989 and sprayed in late August 1990. Means are presented with standard errors (n=4 or 5).

Results

*Target Effects.*The 1991 stem densities in all herbicide-treated plots were reduced relative to 1990 stem densities and relative to control plots (Fig. 1). However, all herbicide treated plots also showed gradual recovery of stem populations in 1992. This trend was in direct contrast to control plots where presumably self-thinning mortality reduced the stem populations in 1991 and 1992.

At the start of this experiment cut/spray plots had lower numbers of stems relative to the cut/delay spray plots; lower numbers of stems were maintained in these plots after spraying with the exception of Accord-treated plots measured in 1991 (Fig. 1). Strong differences between cut/spray and cut/delay spray treatments were most evident with Garlon/Tordon and Krenite in 1991. By 1992, this difference was preserved with Garlon/Tordon and it emerged anew with Accord+Escort.

Lowest mean stem density in the 1992 cut/spray plots was found in the Accord+Escort treatment (1308 stems/ha) and highest mean stem density was found in the Krenite treatment (2763 stems/ha). Lowest mean stem density in the 1992 cut/delay spray plots was found in the Accord treatment (2591 stems/ha) and highest mean stem density was found in the Garlon/Tordon treatment (4152 stems/ha).

Non-Target Effects. In terms of effects on non-target plant species during 1991, the herbicides could generally be ranked in the following order from least impact to most impact: Krenite, Garlon+Tordon, Accord, Accord+Escort (Figure 2). Relative to controls, all cut/spray plots produced less plant coverage in 1991; in cut/delay spray plots all herbicides except Krenite produced less plant coverage.

Herbicide effects on ground cover were less obvious in 1992 as plant coverage increased in all plots. Still, persistent negative effects on ground cover were present, especially in the Accord+Escort cut/spray treatment and in the Accord+Escort and Garlon/Tordon cut/delay spray treatments.

Herbicide treatment favored the germination and establishment of mostly annual plant species

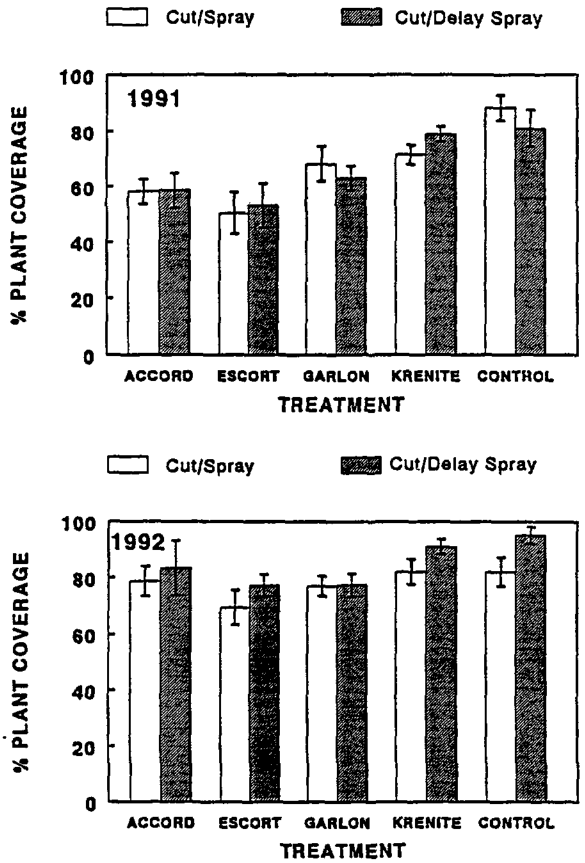

Fig. 2. Percentage of non-target plant coverage in experimental plots. Treatments are explained in Fig. 1. Escort symbol = Accord + Escort; Garlon symbol = Garlon/Tordon. Means are presented with standard errors (n=4 or 5).

in 1991 while other species (mostly perennial herbs and vines) were not favored. In 1991, the following species showed increased importance in all herbicide treated plots relative to controls: *Erechtites hieracifolia* (pilewort), *Juncus tenuis* (slender rush), *Oxalis stricta* (wood-sorrel), and *Setaria Faberii* (giant foxtail). This flush of annual weeds diminished in 1992. In all herbicide treated plots, except the Krenite plots, the perennial vines *Lonicera japonica* (japanese honeysuckle), and *Rhus radicans* (poison ivy) were decreased relative to controls. This response was most evident in the cut/spray treatments and it persisted until 1992.

Discussion

The results of this research present a dilemma for power-line corridor managers seeking an effective herbicide strategy. All of the treated plots showed relatively rapid recovery of tree populations in 1992. Such a response was noted in other herbicide trials (1). These trees represented stems that were not killed by spraying as well as stump and root sprouts. Furthermore, the one herbicide/cutting treatment that produced the lowest tree populations (i.e., cut/spray of Accord+Escort) also had a persistent negative effect on non-target ground-cover.

Efficiency of tree-kill can be improved by spraying sooner rather than later after cutting. This was observed across all herbicides at some time during this experiment but was especially true for Garlon/Tordon. Smaller trees at the time of spraying may allow more efficient capture of herbicide by foliage and stems. Unfortunately, spraying soon after cutting may also open the vegetation so that more herbicide reaches and kills the ground-cover. This was evident for Krenite, the most selective of the herbicides tested.

It is clear from this research that no single application of herbicide will achieve short- or long-term management goals. Previous research has demonstrated that herbicides can produce vegetation with extended management cycles (3,4,9), unique biological attributes (5), and improved wildlife habitat value (2). However, there is a need for further development in the selectivity of herbicide formulations and application methods so that growth forms and even species can be eliminated or released.

Because release of perennial ground-cover species to compete with tree seedlings remains one of the most promising alternatives to repeated cutting or spraying (3,9), novel herbicide strategies should be developed that eliminate trees and stimulate those plants that compete successfully with trees (7). Furthermore, resource managers should view herbicides as one facet of an integrated approach that also includes cutting, prescribed burning, biological control, and seeding (8). These tools must be used within a paradigm that recognizes the various causes of plant community change through time (6).

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Zusammenfassung. Vier Herbizide (Accord, Accord + Escort, Garlon/Tordon und Krenite) and zwei Rückschnittmethoden (schneiden/spritzen und schneiden/ spritzen nach Wartezeit) wurden getestet an einem Stromleitungskorridor in Ohio. In allen Herbizid/Rückschnit-Kombinationen zeigten die Baumpopulationen zwei Jahre nach der Behandlung eine leichte Erholung. Obwohl die Applikation von Accore + Escort in einer Behandllung durch schneiden/spritzen zur geringsten Baumpopulation nach zwei Jahren führte, hatte diese Behandlung auch den am meisten nachhaltig negativen Effekt auf die übrige Bodenflora. Krenite zeigte den geringsten negativen Effekt auf die Bodenbedeckung. Ein Spritzeinsatz, der eher früher als später nach dem Schneiden durchgeführt wird, verbessert die Baumtötungswirkung von allen Herbiziden, hat aber wachsende Auswirkungen auf die übrige Bodenflora.