HERBICIDES: Not a Silver Bullet

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Over decades research has shown herbicides not only to be a cost effective brush control tool but in many circumstances a superior environmental choice to brush cutting. Too often, however, vegetation managers build unrealistic expectations about the durability of results based on constrained budgets necessitating a magic bullet or enthusiasm generated when assessing a first time herbicide application.

This article seeks to build an understanding of why herbicides provide effective brush control; what should be expected to occur on the right of way in the future; data verifying the expectations; and, the origins of economic gains. Discussion is restricted to right of way brush control.

Right of Way Expectations in Ecological Context

Ultimately, utility arboriculture seeks to identify and apply the environmentally acceptable vegetation management method that provides the longest maintenance-free period for the dollar invested. From this perspective, the cutting of woody species that sprout from cut stems or from roots represents a poor investment. It is precisely on such suckering species where herbicides provide the most benefit. Herbicides, by decreasing or eliminating the capacity for vegetative reproduction, extend the maintenance-free period.

Before the introduction of broad scale agriculture, most of North America was forested. The ongoing force of nature is for a return to this condition. An examination of non-cultivated areas will give an indication of what would happen to a right of way without intervention. If such non-cultivated areas have tall maturing, power line incompatible species one must expect ongoing natural pressure to establish these species on the right of way. This pressure cannot be eliminated. Hence, it is impossible to permanently remove incompatible species from the right of way. All we can achieve is to interfere with the rate of succession to the climax plant community. How and when we choose to interfere with succession has major implications for the extent of future efforts required.

How we choose to interfere with succession has impacts on the energy inputs required in the future and thus future costs. It may be useful to view the ecological process of succession as a force. An analogy - We don't see the wind directly but realize its force by observable effects. A sail doesn't stop the wind. Nor, does it stop the wind's direction. It's in recognizing the force of the wind that we open the possibility of tapping the force using a sail. In sailing, abrupt, violent actions tend to require a lot of energy and prove hazardous. In the same way, the response to right of way treatments provides evidence of a force. Our interventions don't stop this force nor change its direction. Maintenance actions that fail to recognize it prove as futile as sailing while ignoring the wind.

Unpublished research results from Alberta serve to illustrate the importance of being aware of the "force". It varies over a year making the timing of interventions relevant. Poplar spp. trees, 6" to 12" dbh, removed to widen right of ways were assessed for subsequent suckering. Trees removed in June, after leaf-out, representing low root reserves, averaged 18 suckers per bole. Trees removed after mid-September, representing maximum root reserves, averaged 64 suckers per bole. Both timings illustrate enormous "pressure" to re-establish trees on the right of way. The June removals, however, will require a smaller investment of energy in the future.

Why Herbicides Are Effective

Herbicides allow us to target energy against incompatible species while leaving other species alone. This has both direct and indirect benefits. The direct benefit of focusing and minimizing the "pressure" we apply to the right of way is minimized maintenance costs. The primary indirect benefit is that since herbicides decrease or eliminate the capacity for vegetative reproduction, incompatible species must establish themselves from seed. For the seed to become a seedling, conditions for germination must be met. Conditions for germination are often enhanced by disturbances. Conversely, a lack of disturbance limits the conditions for germination being met. Upon germination the seedling on an herbicide treated right of way must compete for light, water and nutrients against the existing compatible vegetation community. Thus a further indirect benefit of proper herbicide use is limited success of sexual reproduction for incompatible species.

It's been said that herbicides reduce or eliminate vegetative reproduction. There is a range of efficacy. Herbicide efficacy may be categorized by physiological response as follows:

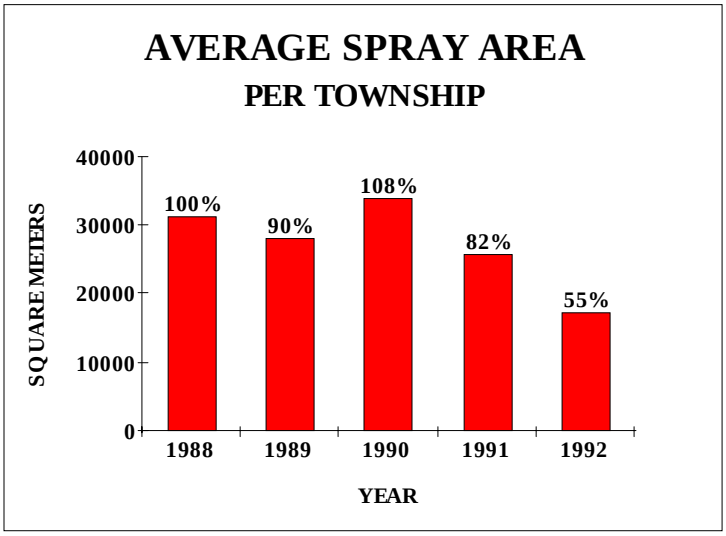
- Herbicides that allow woody species to sucker from existing stems are low in efficacy. They do not eliminate existing stems and because a viable root system is also left, regrowth is rapid. Such herbicides do not offer significant benefits over cutting methods. The incompatible species density, while not expanding as it does with cutting, will not be significantly decreased from the time of treatment.
- Phenoxy herbicides and triclopyr properly applied to susceptible species will kill the existing stem but often do not to provide complete control of the root system. For suckering species, this results in regrowth from the roots. The population density established from root suckers will tend to be 5% to 15% of stem density at the time of treatment. For this second group of herbicides the stem density is significantly decreased and by limiting suckering to roots rather than the stem, one maintenance-free year is gained.
- The most efficacious herbicides translocate very well. Examples include glyphosate, picloram and imazapyr. These herbicides tend to eliminate the capacity for root suckering. Stem density of susceptible species, two growing seasons after application, will tend to be 0 to 2% of the original density. The subsequent emergence of incompatible species is dependent on successful establishment from seed and root suckering from adjacent trees.

The method and timing of vegetation management activities influences the maintenance-free period. There is no method that eliminates the need for maintenance.

Verifying Expectations

Figures 1 through 3 present data from TransAlta Utilities, originally presented to the oil and gas pipeline industry in Alberta in 1993. TransAlta Utilities began first cycle clearing in 1986. A grid approach rather than a circuit approach was used, with the grid unit being a township. Right of way cleared was, wherever possible, foliar sprayed with phenoxy herbicide one or two years later depending on regrowth height. Thus, the first year (1988) shown in the data would be comprised of areas cleared (generally mowed) in 1987, areas cleared in 1986 where regrowth was slower to develop, and re-treatment of areas sprayed in 1985.

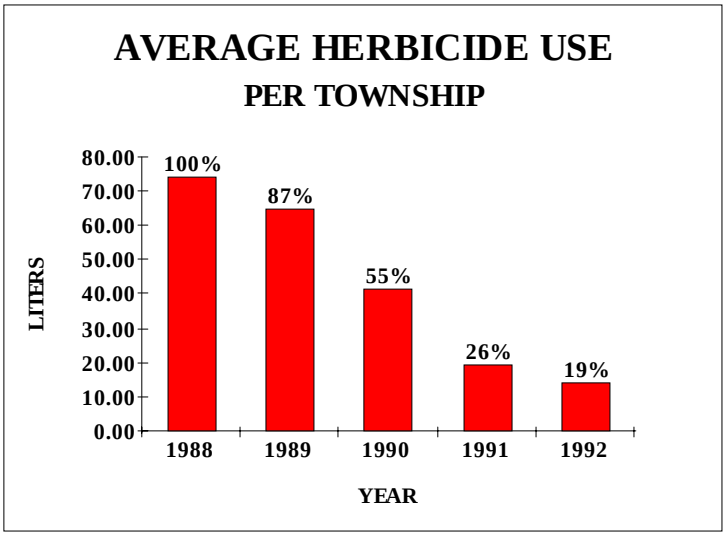
Figure 1



The budget increased about 90% from 1985 to 1986. The highest expenditures were in 1987 while from 1988 onward the budget was trending slightly downward. As a result there was a large increase in annual area cleared after 1985. The first year when the herbicide program would fully capture the effects of increased clearing would be in 1989.

The major incompatible species is poplar. Suckering after mowing was vigorous. Stem densities ranged widely but densities of 64,000 stems per hectare were common.

Figure 2

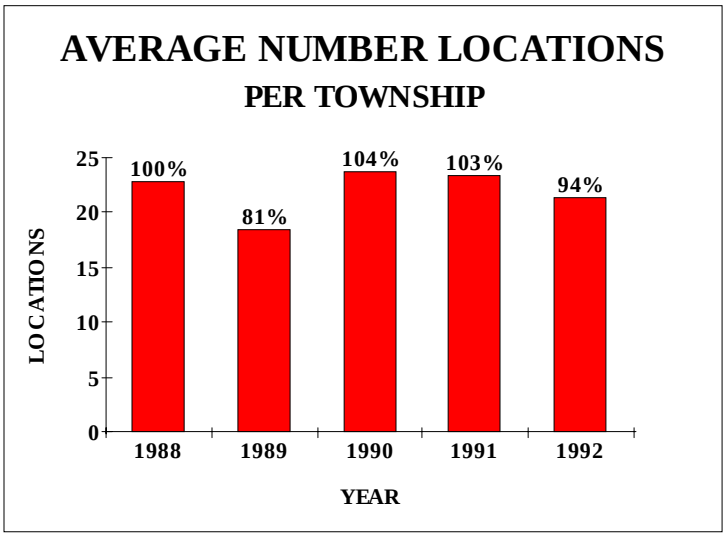


Area sprayed was measured and reported in square metres.

Figure 1 shows the area (square metres/township) requiring herbicides decreasing over time. An examination of the amount of herbicides used (Figure 2) shows a dramatic decrease. Figure 3, which shows the number of locations per township over time, does not exhibit the same trend. In fact, the number of work locations per township has remained relatively stable.

On the surface these data may appear incongruent. They lead us to more thoroughly question what we expect to occur on the right of way. Do these observations fit expectations?

Figure 3



- Applying phenoxy herbicides to strong suckering species, the expectation is that there would be some, though limited, vegetative reproduction. We could expect regrowth with stem densities of 5 to 15% of the original densities for subsequent applications. Thus, we would not expect the number of locations per township to change.
- We would expect incompatible brush regrowth where incompatible trees were removed and/or previously sprayed. We could also expect the regrowth to be distributed over the same original area.
- Due to the distribution of target regrowth brush over the original area and the difficulty in adjusting spray area reported without substantial brush-free gaps, area or square metres per township would not be expected to decrease as much as herbicide use.
- Future work would be decreased not eliminated.

Origin of Economic Gains

The same would hold true for herbicides characterized by superior translocation. Rarely, is 100% control achieved with one application. However, after two applications, each reducing incompatible species stem densities by 98%, there would appear to be no further work. This condition is temporary because new incompatible species seedlings will arise from seed and/or the roots of adjacent trees. The extent of the maintenance-free period will vary with species, local soil characteristics, moisture, climatic conditions and residual herbicide activity. If there are height limitations on brush, which may be treated with herbicide, as there are in Canada, the right of way needs to be monitored for the timing of the next treatment. In the province of Alberta, maximum brush spray height limits of 1.5 to 2.5 metres depending on the degree of visibility result in an average 3-year herbicide cycle. Where ground equipment can be used, it's probable that vastly reduced stem densities will favour a change in herbicide application equipment.

Regardless of the specific efficacy of herbicides in controlling the root system, if they're effective enough to warrant use, after a few cycles vegetative reproduction has been virtually eliminated. The question, that then becomes germane, is what is the natural re-stocking rate for the incompatible species? Unfortunately, funding for research that would have quantitatively

established the colonization rate of incompatible species on rights of way, where vegetative reproduction has been eliminated, was discontinued. The author's estimate based on visual assessment of operational rights of way in Alberta is the annual natural colonization rate is a stem density of about 1% of the post-clearing regrowth density. This general statement needs to be qualified with the comment that the phenoxy applications acted as a conifer release for seedlings established by the mowing disturbance. In some circumstances resulting conifer seedling densities were high.

The general trend is clear. Tapping the competitive aspects of power line compatible species by not disrupting their growth will result in less future work. The preferred methods of vegetation management are those, which remove the immediate hazard of trees contacting the line, and foster the colonization and establishment of a power line compatible vegetation community.

Herbicide applications generally cost less per treatment than a cutting operation. Such a comparison is inadequate however, since cutting increases stem densities and thereby future costs while herbicide applications decrease stem densities and future maintenance costs. Figure 2 verifies that the cost of subsequent applications decreases. In theory, since herbicides effectively decrease the number of incompatible species stems, necessitating less and less herbicide, over multiple applications the cost begins to approach the application component of the treatment cost. A true economic comparison of right of way maintenance with herbicides versus cutting methods needs to cover as a minimum one cutting cycle. Due to different expense strings the time value of money should be included. Work in Alberta found the cheapest cutting method cost about four times as much as herbicide-based maintenance over 30 years (Guggenmoos, S. *Economics of Herbicides for Brush Control.* 1987).

Summary

Herbicides should not be viewed as a one time silver bullet. Rather, their true value is realized when used in an ecological context. Investing energy in major bursts as represented by non-selective clearing, results in a loss of balance and control. Nature abhors a vacuum. Bare ground is quickly filled with incompatible and undesirable species. Paradoxically, too much effort to control can result in none. Returning to the sailing metaphor it's akin to breaking the rudder. It proves beneficial to yield to nature. On rights of way that means recognizing we can't eliminate succession but we can achieve our goals by tapping the competitive aspects of biodiversity through selectively limiting control pressure to incompatible species.

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