



PENNDOT Herbicide Program Overview

PennDOT's *Maintenance Manual*, Publication 23, Chapter 13, spells out the mission of the Department's vegetation management program:

Roadside vegetation management is intended to provide safety, utility, economy, and beauty to the roadside area. Utility is provided by stabilizing roadside soils and preventing erosion and by growing and encouraging desirable vegetation in place of undesirable and future problem vegetation.

The PennDOT vegetation management program encompasses about 150,000 acres. The program provides a means to optimize service to the road user while providing a management framework that makes the system practical to implement and evaluate.

Management Techniques

Herbicide applications are one facet of a broad-based vegetation management program. The PennDOT Roadside Program relies on all practically available methods, and strives to use them in a coordinated fashion so that vegetation management is practiced as preventive maintenance. This is simply a common-sense approach. The systematic approach to common-sense vegetation management is called Integrated Vegetation Management.

Integrated Vegetation Management (IVM)

An IVM program is based on clearly defining *what* species are weeds, *where* they are weeds, and *how many* have to be present before a control operation is necessary (for a more detailed description, see Module 1 in this series, *Integrated Vegetation Management*).

Control operations can be grouped into four broad categories:

- mechanical
- cultural
- biological
- chemical

A well designed IVM program uses all of the available techniques so that one operation enhances the

effect of another, or at a minimum, does not interfere with or reduce the effectiveness of another operation.

Mechanical techniques include mowing, brush cutting and grubbing. Shoulder grading and side-dozing are not employed as weed control techniques, but certainly provide a secondary benefit of mechanical weed control.

Cultural techniques enhance the growth of desirable vegetation, or prevent weed growth and establishment. The selection and proper establishment of seeding formulas in the design and construction phase or during revitalization is PennDOT's most effective cultural tool.

Proper mowing is also an important cultural practice. Mowing at a proper height and frequency reduces stress on roadside turf and allows it to be more competitive with weeds.

Biological control is the introduction of a desirable organism to prey on an undesirable organism. In vegetation management, this is usually the introduction of an insect or disease to attack a specific weed species. A current example is the release of the *Galerucella* beetle to feed on the PA Noxious Weed purple loosestrife (*Lythrum salicaria*).

Chemical approaches include the application of herbicides. PennDOT's herbicide program is the most cost effective element of the overall vegetation management program.

Non-Herbicide Vegetation Management Practices

Herbicide treatments are often the focus of PennDOT's vegetation management efforts, but to be most effective, herbicides need to only part of a broader program.

Mowing

Roadside mowing provides aesthetic and vegetation management benefits. A mowing program that fits into the IVM concept takes into account how grass grows and how mowing affects the growth of grass and other

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vegetation. An effective mowing program will provide both a cost-effective way to manage encroaching vegetation and maintain a roadside that is attractive.

Mowing is always stressful to turf. A well-managed mowing program minimizes the stress to the turf. A less-stressed turf will be more vigorous, and therefore will compete better against weeds, provide superior soil stabilization, and *look better*.

The best way to minimize stress to turf is to *cut high (4 to 8 inches above the soil)*, leaving as much leaf tissue as possible, and to avoid cutting during dry periods when turf is under stress.

Keeping turf as vigorous as possible reduces the amount of weeds in turf, and allows an herbicide application to work better because weeds are weaker when they have to compete for light, moisture, and soil nutrients.

The timing of mowing is also an important part of the herbicide program. Mowing too soon after an herbicide application will remove the treated parts of the plant before the herbicide has a chance to move into the rest of the plant, and will reduce control. Herbicide applications made too soon after a mowing are less effective because there is less leaf area to intercept the spray. A simple guideline is *not* to make an herbicide application within a week before or after a mowing.

Brushing - Trimming and Removal

The Department trims and removes brush to provide horizontal and vertical clearance. PennDOT's herbicide programs can maintain clearance when herbaceous plants or brush foliage are encroaching. Herbicides will not remove encroaching limbs. Encroaching limbs must be trimmed or the tree removed.

Trimming is often necessary because the tree originates off the right-of-way (ROW), but extends into it. In this case, the intent is to leave the tree as intact as practical while maximizing horizontal and vertical clearance.

When the tree can be removed, it should be. It is more efficient to remove trees to improve visibility than to repeatedly trim them. Additionally, if a tree is close enough to impact visibility, it is close enough to be hit, and should be removed.

After removal, the stumps should *always* be treated with herbicides to prevent resprouting. A chainsaw is one of the most potentially hazardous tools used by maintenance personnel or contractors. Forcing an employee to use a chainsaw a second time on woody growth exposes that employee to unnecessary risk – unnecessary because the job can easily be finished the first time with stump treatment.

Revitalization

Roadside vegetation needs to be re-established

after maintenance activities have disturbed soil, or after significant erosion events. Another reason to revegetate an area would be to establish a better-adapted groundcover when the original seeding formula fails to perform as needed.

The Department has specifications for seed mixes, lime and fertilizer, and mulches for a wide range of site conditions and maintenance objectives in Publication 408, *Specifications*.

A well-established groundcover is the best line of defense against weed and brush encroachment.

Herbicide Programs

Though occasionally controversial, herbicides provide the most productive method of managing vegetation.

Combinations of herbicides can be developed to address almost any vegetation management issue.

We will categorize herbicides by some common general terms, as well as in terms of PennDOT's program.

How Herbicides are Used

The following terms are commonly used to describe *how* herbicides are used.

- *Selective* - a treatment that affects one type of plant without affecting another type of plant.
- *Non-selective* - a treatment that affects all plants.
- *Preemergence* - a treatment applied prior to weed growth to prevent germination and establishment.
- *Postemergence* - treatments applied after the weed has emerged or begun active growth.
- *Foliar-applied* - a treatment applied to the leaves and stems of the target weeds.
- *Soil-applied* - a treatment that is applied to the soil, and enters the plant through the roots or the germinating seed.

Herbicide Programs by Cost Function Code

PennDOT's herbicide operations are categorized by their objective, and assigned a Cost Function Code, as described in Pub 113, *Performance Standards of the Highway Maintenance Foreman*. For a given program, there are a number of different herbicide product combinations that can be used to achieve the objective. The District Roadside Specialist formulates each operation based on the target weeds present, the vegetation that needs to be preserved, the application equipment that is currently available, environmental conditions, and product cost and availability.

PennDOT herbicide operations, described by

objective and Cost Function Code, are listed below.

Grass Growth and Height Control (7711-03) - also referred to as the plant growth regulator, or PGR program. A combination of products is applied to roadside turf in the spring, usually before, or very soon after the first mowing cycle. This treatment prevents the formation of grass seedheads and reduces leaf growth. The mixture must contain herbicides to control broadleaf weeds because the treated grass is much less vigorous and could be overwhelmed by untreated weeds. This program is used in areas difficult to mow, or to reduce mowing cycles in the spring. This is a postemergence, foliar application.

Bare Ground (7712) - applied to guiderail and shoulder areas to maintain an area free of vegetation. A mixture of herbicides is used to provide a non-selective application that will control existing vegetation and prevent weed growth throughout the season. The mixture of products provides both preemergence and postemergence activity, and targets both existing foliage and germinating plants.

Selective Weed and Brush Control (7713) - this single cost function often has two distinct objectives - controlling herbaceous (non-woody) broadleaf weeds, and brush control. In the majority of situations, both objectives are achieved with the same application. Broadleaf weeds in turf as well as brush can be effectively treated with the same herbicide mixture. An example of an exception would be treating thistles in crownvetch with the herbicide 'Velpar DF'. Used at labeled rates, 'Velpar DF' is safe to crownvetch but very injurious to turf.

Chemical Sidetrimming (7714) - commonly known as the 'Krenite' program. When applied in late summer, before the leaves turn color, the herbicide product 'Krenite S' (active ingredient fosamine) will cause a slow, less noticeable onset of symptoms, and prevent the treated branches from leafing-out the following spring. Fosamine does not move very far within the plant from where it is applied, so only the side of the treated plant facing the road is affected. This is critical on secondary roads because the majority of a tree canopy might be off the ROW. The use of fosamine provides a way to affect only the canopy encroaching onto the ROW.

Stump Treatment (7715-01,-02) - treating the stump after brush removal is essential to prevent resprouting. This treatment can be applied with a squirt bottle. Avoid the issue of high sap flow in the spring by using an oil-based treatment and treating all the bark of the stump. It is a simple, inexpensive way to prevent future work and exposure to the hazards of chainsaw operation, and improve brushing efficiency.

Basal Bark (7715-03) - a basal bark treatment is the application of an herbicide, diluted in an oil carrier, to

completely circle the base of a tree. Basal bark is very effective from late winter until fall color develops, and less effective in the late fall and early winter. This treatment is applied with a backpack sprayer.

Herbicide Program Calendar

A District's herbicide program is scheduled so that the intended roads are treated with a minimum of spray vehicles working nearly continuously from April into September. The program is easiest to administer when the spray crews are able to concentrate on one program at a time. Figure 1 shows the timelines for the different programs.

Bareground Program

The application season begins with the bareground program. It makes more sense to prevent plant growth under guiderails than to control existing weeds. Plants, whether dead or alive, will affect the flow of water off the roadway and across the shoulder. Plants will also encourage the accumulation of anti-skid and other small aggregates, which also interfere with movement of water across the shoulder.

There is a balance the Roadside Specialist has to find when starting the bareground program. If applications are made too early, the soil-applied herbicides will break down before the end of the season and weeds will begin to germinate in the fall. Also, if perennial weeds are present under the guiderail, they will not be controlled if the treatment is applied before they begin active growth.

Starting the program later means that the weeds will be larger and better established as the program is being completed. Tall dead weeds are unsightly, and draw unnecessary attention to the program. Also, as mentioned above, a thick stand of weed stalks will interfere with drainage, whether alive or dead.

Weather is an important factor in scheduling. The

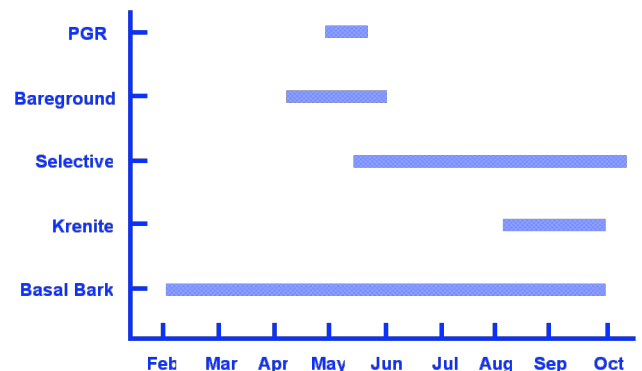


Figure 1. General time frames for PennDOT herbicide application programs. Although the operational windows overlap considerably, the programs are typically conducted one-at-a-time.

herbicide treatments the Department uses cannot be applied in the rain. The bareground program has to be scheduled to account for significant downtime due to spring rains.

It is common to split counties in half, and treat the secondary roadways in each half of the county every other year. The primary roadways are typically treated every year. In this scheme, guiderails should be targeted during the weed and brush program in years when they are not treated with the bareground program.

PGR Program

Scheduling is more complex in Districts where the 7711-03 program is used. The rule of thumb for scheduling a PGR application is to treat the turf when it looks the way you want it to look. If you are using a PGR to prevent seedheads, you need to make the application in early to mid-May, depending on the spring and where you are in the state. This usually means the bareground program will still be underway. Many Districts deal with these 'crunch times' by having two types of spray vehicles per contract - one high-capacity with a large tank, and a smaller vehicle with the same capabilities but easier to use for specialized applications. In a PGR scenario, the high-capacity vehicles can be diverted to treat a lot of limited access roadway turf acres in a short time while the smaller vehicles continue with the bareground program.

Selective Weed and Brush Program

The effective window for the Selective program extends from mid-May until at least the time of killing frosts, and even later for many species. The season for brush control is shorter - it starts later and ends as the leaves begin to change color. This coincides well with the time available at the completion of the bareground program in late-May/early June and the beginning of the sidetrimming program in mid-August.

Sidetrimming (Krenite) Program

One of the factors determining the timing of the Krenite program is minimizing the symptoms of the application. Despite the slow development of symptoms after Krenite treatment, *symptoms do develop*, and Krenite treatments are usually targeted higher and farther than Selective program treatments targeting brush. Therefore the start of the program is delayed until mid-August so that the symptoms blend with the natural onset of fall color.

Basal Bark Program

If basal bark treatments are applied in the early spring prior to leaf-out, there is less 'brown-out' compared to treating trees in full-leaf. For species that sprout from their roots, like tree-of-heaven, it is better to treat later in the growing season to improve the movement of the herbicide into the root system.

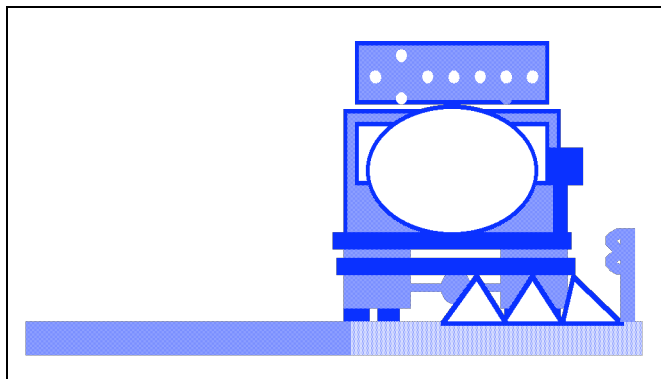


Figure 2. A bareground application uses closely spaced, low mounted nozzles to treat the shoulder and under the guiderail. Each nozzle has an independent switch in the cab so that the width of the shoulder that is treated can easily be changed during the operation.

Herbicide Program Targeting

Each herbicide program used by the Department has a well-defined target.

Bareground Program

The targeting for the bareground program is very constrained - it is limited to shoulders, guiderails, and islands and barriers where any vegetation is undesirable. Shoulder and guiderails are treated with fixed position spray nozzles, mounted low on the spray vehicle, covering 2 to 4 feet per nozzle at the most (Figure 2). Traffic islands are usually treated with a handgun.

PGR Program

Because this program often targets all the turf to be mowed in given area, the spray pattern must cover to the edge of the mow line in a single pass (Figure 3). This treatment will often extend 20 to 30 ft horizontally from the spray vehicle.

Selective Weed and Brush Program

When treating weeds in turf, this program is directed at all the turf and is extensive in coverage. Where a PGR program is used, this program can be done during the same application. Where brush is the target, this

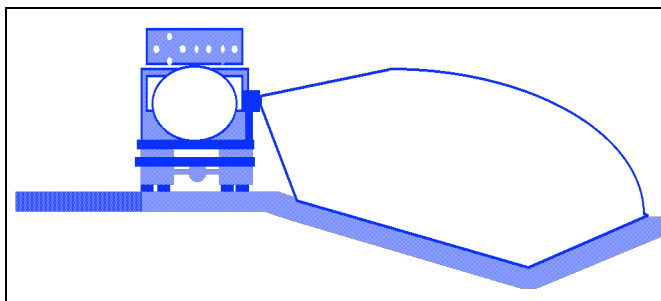


Figure 3. A PGR or broadleaf weed control application along a limited access roadway targets the mowed turf. The spray head would be switched to the left side of the truck to treat the median with a similar pattern.

program is intended to be preventive. The targeted brush should be small (Figure 4), and early in the encroachment process. Although this program would be very effective in killing brush, it is not intended for use as a clearance program. The brown-out of the foliage produced by this program is objectionable. Additionally, any crownvetch that is treated will be killed. Where brush encroachment is significant, the Krenite program and selective trimming/removal should be employed. It is essential that the stumps are treated after removals of any live trees.

Using backpack sprayers combines the concepts of preventive maintenance and extended reach. Crews equipped with backpack sprayers can very effectively treat small brush outside of the conventional spray pattern before it ever becomes big brush.

Krenite Program

Due to the greatly reduced brown-out that results from using Krenite, this is the program of choice to regain significant horizontal and vertical clearance (Figure 5). Current spray technology allows applications to target up to 28 feet vertically or horizontally. Additionally, this distance can be treated with 'multi-boom' spray heads with multiple spray swaths of 4 to 6 ft each. This allows for a selective spray pattern that skips desirable grass and crownvetch close to the road, while targeting brush at the edge of the mow line. This is an important feature, as Krenite treatments are injurious to herbaceous groundcover.

Basal Bark

Much like the scenario described above for the Weed and Brush program, using backpack sprayer-equipped crews to apply basal bark treatments is an effective way to target both small and large brush

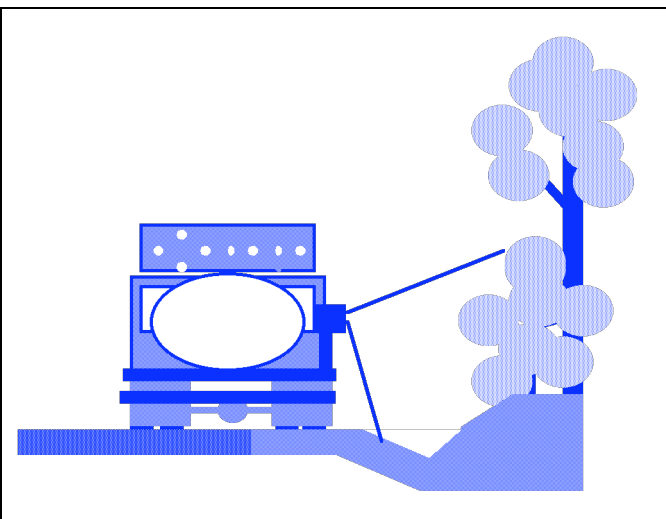


Figure 4. A weed and brush application along a secondary road has a limited target range. The height and width of the spray pattern is restricted to stay on the ROW and to limit unsightly brown-out. The spray pattern is typically angled backwards to limit the horizontal reach to keep the pattern on the ROW at all times.

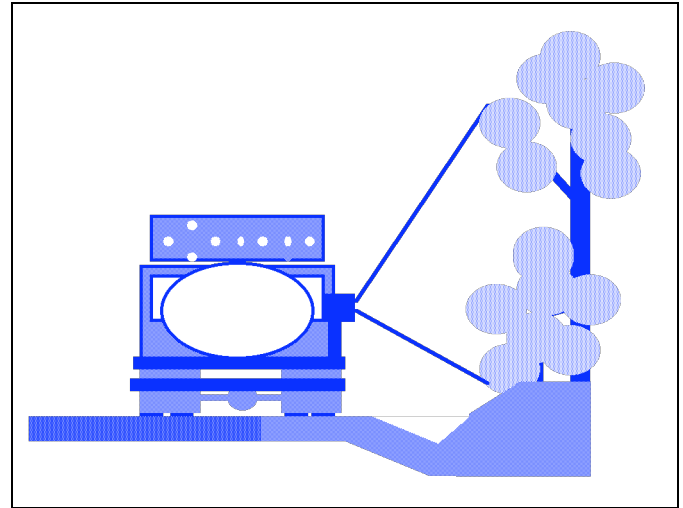


Figure 5. A sidetrim, or 'Krenite' application, along a secondary roadway. The spray pattern is set higher to improve vertical clearance, and also to avoid treating the groundcover. The spray pattern is typically angled backwards to maintain the desired pattern height while keeping the horizontal reach of the pattern within the ROW.

outside of the conventional spray pattern, and prevent the need for future removals. Basal bark treatments can be applied to much taller stems than can be reached with a sprayer, providing an ideal method control larger brush before it reaches the stage where it must be removed.

Summary

PennDOT's herbicide program addresses vegetation management needs throughout the growing season, and does it in a way that is straightforward to manage and administer. Through effective contracting and use of Department forces, the program provides a wide range of options to achieve high productivity with truck-based operations, as well as the mobility and flexibility that is essential to maintain a 42,000-mile highway system.

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