

Recommendations for Herbicide Use in State of Maine Owned Railroad Rights-of-Way

Introduction

The State of Maine owns approximately half of all railroad rights-of-way in Maine. This represents about 600 miles of track and contains single track line, multiple track lines, sidings, bridges, signaled crossings, switching yards, and building structures. Historically, rail lines were constructed on gentle grades, many of which are adjacent to rivers and lakes. Rail lines also cross numerous streams and rivers, both permanent and intermittent, and run through or adjacent to a variety of wetland habitats. In some cases, rail may also run near or across surface water public drinking water supplies or near public drinking water wells. These locations adjacent to valued natural resources, as well as communities and businesses that rail passes through and serves, make the job of maintaining vegetation of critical importance not only to ensure safe operation but also in the choices associated with management of vegetation.

In the modern era, vegetation managers have moved toward the use of herbicides as a key component in the management of railroad rights-of-way. While the use of herbicides may be controversial for some, there is much evidence that proper use of herbicides has lower environmental impact than other methods for control of vegetation. Experiments have been conducted around the world in alternative methods for control of vegetation in railroad rights-of-way. They include the use of steam, infrared radiation, mechanical disturbance, hand labor, mechanical brush removal, controlled burn, open flame burning, hot water, weed barrier, vacuum clearing, freezing, electro-thermal, ultraviolet light, and establishment of monoculture crops such as low growing grass or clover. Many of these methods are classified as short term solutions. In some cases, methods may stimulate vegetative growth, making them counterproductive. These methods are always more expensive than herbicide application and most require multiple re-treatment within the same growing season.

Herbicides represent a reasonable, efficient, cost-effective alternative. Typically treatments need only be done once a year or once every other year to maintain an adequate level of control. The concern for vegetation managers is determining the type of vegetation, vegetative pressure, what products to use, at what rates, adverse weather conditions, when to apply, how to apply, properly identifying risk to workers and the environment, and how to engage the public with information that addresses concerns and informs about products, procedures, and schedule. In addition, managers and applicators must be informed about state and local pesticide regulations, environmental fate for products used, mobility, potential groundwater contamination, and potential harmful health effects, both short and long term. Products that demonstrate carcinogenicity or mutagenicity should be avoided, for example.

For these reasons, understanding the vegetation, the environment, and choice of chemistries, formulas, and methods of application are the central concern and a protocol for decision making needs to be in place. The recommendations that follow are intended to provide a format when making decisions and establishing protocol for the use of herbicides in State of Maine owned railroad rights-of-way managed by the Maine Department of Transportation.

Choice of Chemistries

Decisions about which herbicide products to use should begin with an understanding of the vegetation that needs to be controlled and the amount of vegetation, often referred as stem density. Vegetation may include hardwood and softwood trees, grasses, and annual and perennial weeds. Railroad rights-of-way can be divided into three main components. They are the track and railroad ties, the ballast zone, and the area from the ballast zone to the edge of the right-of-way.

The track and railroad ties that track are attached to comprise an eight to ten foot width. This zone should be free of vegetation to allow for ease of inspection of the infrastructure. The Federal Transportation Board requires that the infrastructure be inspected on a regular schedule, typically once every two weeks regardless of whether the line is active or inactive. Any vegetation growing in and around the rail and ties makes inspection difficult. Breaks and cracks in the rail may go unnoticed, spikes used to attach the rail to the ties may be loose or missing, and couplings may break or loosen. Obscuring vegetation may make these defects more difficult to see. If these defects go unnoticed and unrepaired, the issues may cause trains to derail. Switches, electric boxes, crossing lights and gates may all become inoperable when defects cannot be detected due to obscuring vegetation. The consequences from improper inspection and timely repair can be dramatic and include derailment, car and train collisions, train and large animal collisions, and even loss of life. Vegetation in railroad rights-of-way may also catch on fire. Fire starts may spread beyond the right-of-way into high value properties with dramatic consequences.

The ballast zone typically includes the track and railroad ties and extends out to include the ballast that the track is constructed on. The width of the ballast zone is approximately 20 feet, 10 feet in either direction from the track centerline. The ballast zone provides a stable base for the track and ties and should be well drained material such as 1 to 2 inch sub angular stone. Historically, rail companies used spent coal as a base under the ballast. It was a by-product from burning coal to run steam locomotives. Fly ash may have also been deposited in track construction. This sub-base can be relatively impermeable and may help to prevent herbicides that may otherwise be mobile from percolating down through the soil profile in the ballast zone and potentially into groundwater. The 20 foot ballast zone should also be free of vegetation to allow for proper drainage.

The third zone from edge of ballast to edge of right-of-way presents different challenges for vegetation managers. Active trains, whether passenger or freight, cannot have trees capable of hitting the train. The third zone needs to be free of trees and tree branches that would interfere. State of Maine rail lines can be active or inactive. In either case, they should be treated as if trains would run on them and there should be no trees capable of hitting a train in the third zone. A typical railroad right of way is 66 feet wide, or 33 feet in either direction from the centerline of the track. The tree-free zone typically measures 50 feet, or 25 feet in either direction from centerline.

For simplicity we can call the 8 to 10 foot track and tie zone, Zone 1; the ballast zone, Zone 2; and the remaining portion of the right-of-way, Zone 3.

Zone 1

It is important that Zone 1 be kept free of all vegetation. This includes trees, weeds, and grasses. Therefore, chemistries chosen for control of vegetation in Zone 1 may differ from the other two zones. Choice may include non-selective as well as selective herbicides. It is important to note that choice may also be influenced by how different selective and non-selective herbicides work in synergy with each other. Using a combination of herbicides that have different modes of action increases efficacy and allows individual herbicides in the combination to be used at lower rates than required if each herbicide is used alone.

Herbicides work by interrupting or reducing various metabolic functions in plants. They may affect cell growth by slowing down or speeding up cell division as is the case with metsulfuron methyl and triclopyr respectively, for example. Or, in the case of non-selective glyphosate, the herbicide shuts down a key process of amino acid synthesis essential to sustain life in the plant. Simply put, a given herbicide is designed to disrupt a process in the plant that may result in eventual death. Understanding the mode of action of herbicides is a good starting point to determine how to use them together to successfully kill the target plants in question.

Zone 1 may contain hardwood and softwood tree species as well as grasses and weeds. Any zone within railroad rights-of-way may also have unique invasive species that may require a different approach to control. It is useful to choose several different chemistries when trying to control the combination of trees, weeds, and grasses. Not only is mode of action important to consider, but the persistence and ability to be root absorbed may also enter into the decision.

Some products such as aminocyclopyrachlor, aminopyralid, diuron, metsulfuron methyl, sulfometuron methyl, clopyralid, dicamba, imazapyr, and picloram have some degree of persistence in soil and some may be absorbed through the roots of plants. This behavior is often referred to as being "soil active". While this is beneficial for controlling plants, it may also present risks. This list of products exhibits some degree of persistence, may have potential to leach through the soil profile over time, or may injure non-target plants through root uptake.

It is useful to choose from among this group of products to provide for residual control, however the length of time a product persists, how much is applied per unit, and how leachable it is must be weighed when deciding what product or products are suitable. For example, diuron is not a suitable choice since it may persist for more than a year in Maine soils and has shown up in groundwater sampling nationally. Repeat treatments year to year may result in an increase in the amount of product in the soil and may increase potential groundwater contamination. It should be noted that leaching potential increases with an increase in application rate.

In contrast, of the products mentioned above, the sulfonylurea herbicides metsulfuron methyl and sulfometuron methyl have relatively short persistence in soils and a moderate to low risk of leaching when used at lower rates. This makes them a good choice when persistence and leaching are a concern.

It may be useful to use a non-selective herbicide as part of a combination of products to provide a wider range of control across species. For example, the presence of hardwood and softwood trees will require a product or combination of products that can provide control of them. Most sites will have weeds and grasses. Grasses can only be controlled with non-selective herbicide such as glyphosate, imazapyr, or higher rates of the sulfonylurea's, while weeds are typically easily controlled with selective herbicides

such as triclopyr. When choosing a chemical combination for the control of trees, weeds, and grasses herbicides that can impact 2 or 3 of these plant types are preferred over herbicides that only impact a limited group of plants. Imazapyr, for example, is effective at lower rates of 8 to 16 ounces per acre and in combination with other products such as glyphosate, metsulfuron methyl and sulfometuron methyl when grasses and weeds are the target. However, when hardwood and softwood trees are present the rate of imazapyr may be more effective at 16 to 32 ounces per acre and in combination with other products.

In recent years there has been some interest in using aminocyclopyrachlor or aminopyralid as a substitute for imazapyr for selective control of weeds. Both products are soil active and aminocyclopyrachlor is especially harmful to pine and spruce when taken up through the roots. Even lower rates of aminocyclopyrachlor such as 6 ounces per acre may cause severe injury or death to non-target pine or spruce. Recent work by the Department in trials of aminocyclopyrachlor for guardrail application showed excellent control of broadleaf weeds at a rate of 4 ½ ounces per acre. Imprelis[®], a product containing aminocyclopyrachlor, was removed from the market within several years of registration. It was registered for use on broadleaf weeds in turf at a rate of 4 ½ ounce per acre and proved to be highly injurious to non-target pine and spruce at that rate.

Since this new class of chemistry, the pyrimidine carboxylic acid group, can be highly mobile and injurious to non-target plants, use rates should be kept as low as possible. Experiments need to be conducted to see if this class of chemistry may be of benefit in combination with other products at rates lower than 4 ½ ounces per acre. The Department will conduct limited experiments with lower rates to determine if the product has use in rights-of-way application in Maine. For now, the Department will not experiment with aminocyclopyrachlor for railroad application.

The sulfonylurea's, metsulfuron methyl and sulfometuron methyl, have the qualities of selective herbicides when used at very low rates but display non-selective characteristics at higher rates. Glyphosate, considered non-selective, may not adequately control some tree species at lower rates of ½ to 2% solutions, but increased to 5 to 10% solutions will kill all species. Imazapyr has a unique mode of action, entering the plant and moving to meristematic growth points, and is effective at controlling new growth at low rates. It will also move into and store in the root system and move outward the following season. This impact may be seen over several seasons in trees and result in eventual death of the plant.

The first step in deciding what herbicides to use in Zone 1 is determining what vegetation requires control, and then deciding what concentrations will eliminate the vegetation. For example, if there are no trees in Zone 1 imazapyr does not need be part of the mix. Using a combination of glyphosate, metsulfuron methyl and sulfometuron methyl should control the weeds and grasses and provide a residual level of control for up to a month or more. Choose the lowest rates possible for the desired results. Active rail will require yearly applications in Zone 1, however inactive rail may not. Decisions should be made based on field observation.

Zone 2

Zone 2 does not differ greatly from Zone 1 in the need to keep the zone free of vegetation. However, the reasons for a vegetation free Zone 2 are different from the reasons for a vegetation free Zone 1. No trees should be allowed to grow in Zone 2 and this is best accomplished with herbicide application before trees grow beyond the legal height limits for application as set forth in Maine pesticide regulation. Due to the height restrictions for foliar spraying of six feet for hardwood and three feet for softwood, applications should be scheduled every year or no more than every other year based on field

observation. Ballast material should be free draining; therefore controlling vegetation on a regular schedule will help prevent buildup of organic matter from plant decomposition. Using a combination of imazapyr, glyphosate, metsulfuron methyl and sulfometuron methyl should control trees, weeds and grasses and provide a residual level of control for up to a month or more. Choose the lowest rates possible for the desired results. Active rail will require yearly applications in Zone 2, however inactive rail may not. Decisions should be made based on field observation.

Zone 3

Vegetation in Zone 3 may be allowed to grow, however trees may need to be removed periodically and some weeds and grasses may be problematic if they create flammable material. If large trees in Zone 3 begin to encroach into the area of operation they need to be removed mechanically. Untreated hardwood stumps will re-sprout. Spraying re-sprout may not prevent future re-sprouting, making re-treatment necessary.

Recent research by the Department shows that a combination of imazapyr and fosamine ammonium may be more effective at keeping a stump from re-sprouting than traditional. Fosamine ammonium moves to meristematic growth points (next year's leaf buds) and prevents leaf sprouting the season after treatment. Imazapyr stores in the roots and moves out to the same meristematic growth points the following season, but may also move through new shoots developed from epicormic or adventitious growth. A stump treatment of the cut surface and root flare within 24-48 hours after cutting would provide the best control of re-sprout, however this is impractical when mechanical removal of brush is done in railroad rights-of-way due to the large number of stumps over a large clearing area. The periodic cost of mechanical tree removal and follow-up herbicide treatments to control re-sprouting stumps needs to be weighed against the cost of a more rigorous approach to vegetation control using herbicides. Typically, regularly scheduled treatments of vegetation in Zone 3 with herbicides is dramatically less expensive than waiting until trees are larger and require mechanical removal.

Active rail demands a more cost effective approach to dealing with vegetation in Zone 3 than inactive rail. Vegetation in Zone 3 on active rail should be controlled with herbicides on a regular basis to prevent buildup of flammable material, prevent trees from growing beyond the point that herbicide can be applied legally, and to provide a safety clear zone for overall operation. Zone 3 may be less well managed on inactive rail, however budget may dictate that a schedule be established and maintained rather than letting this section grow out of control.

Another alternative for Zone 3 is side branch trimming with herbicide. The only product legally allowed in Maine for side branch trimming is fosamine ammonium. Any branch with foliage sprayed will die back. Fosamine ammonium only moves outward and therefore cannot negatively impact the tree but will kill branches that may interfere with rail operation. This product is prohibitively expensive, but may be considered as an alternative to mechanical removal.

Other Considerations

Many of the herbicides in current use on rail in the United States and in Maine demonstrate some degree of mobility, both in lateral movement across the surface of the right-of-way and also for movement through the soil profile and potentially to groundwater. Manufacturers of pesticide products have long promoted the use of additives, also called adjuvants, which enhance performance by improving the spread of products across leaf surfaces or that increase absorption into leaf tissue. Non-ionic surfactants are among the typical adjuvants recommended for use. Many products sold commercially contain surfactant added by the manufacturer. Surfactants are useful, however they have

proven to cause issues in rail applications. Simply put, surfactants are soaps and experience has shown they increase the potential for herbicide products to move laterally and potentially through the soil profile. The Department has sought out alternatives and beginning in 2006 no longer use products containing surfactants and no longer use surfactants in spray formulas.

A better alternative is now being used that has proven to help keep herbicides in place for up to 3 to 4 weeks. The material is pinolene. Several manufacturers provide products with this active ingredient. It is considered a sticker-spreader-extender and helps to encapsulate pesticides, gluing them to plants, or to the ground. Typically these products make pesticide applications rain-fast within 30 minutes, reducing the potential for lateral movement and movement through the soil profile.

In the past, when rain occurred shortly after application and with surfactants in the mix, plant control was compromised and re-treatment was necessary to control vegetation. Not only was this wasting time and money but more products would be applied increasing the application rate in a given re-treated area. The use of a spreader extender has dramatically reduced movement, eliminated call backs, and improved control of vegetation.

Some herbicide products are volatile, transforming to a gaseous state after application when temperatures rise. Products that display volatile characteristics should be avoided. Volatile products may also have a significant objectionable odor. The gaseous portion is susceptible to moving off target, in some atmospheric conditions miles from the target. This gaseous portion can cause damage to crops, landscape plants, and other non-target vegetation creating potential liability.

Conclusions

- Herbicides are a useful, cost effective, and environmentally friendly tool for managing vegetation in railroad rights-of-way when applied properly.
- Herbicide choice is important. Non-volatile, less persistent, non-carcinogenic, non-mutagenic products should be chosen.
- Products that have less risk of lateral movement or movement through soil profiles should be used.
- Understanding mode of action is a good first step in choosing products and should be understood when combining products to achieve a wider range of control across species.
- Using different products in combination, which have differing modes of action, provides a synergy not possible when using one product alone.
- This synergy allows for each product to be used at lower application rates than if used alone.
- Products used in combination should be used at the lowest possible rates that achieve the desired results.
- Application rate, not only the amount of material applied per acre but the amount of water used per acre, can impact efficacy. Low volume application is more effective than high volume application since more products will stay in place on the plant and on the ground.
- Surfactants and products containing surfactants should be avoided.
- Adjuvants containing pinolene are recommended to stick herbicides to plants and ground surfaces, reduce potential for movement, eliminate callbacks, and improve efficacy.