HERBICIDES TO CONTROL TREE ROOTS IN SEWER LINES

by John W. Groninger[1], Shepard M. Zedaker[2], and John R. Seiler[2]

Abstract. The use of metham (methylcarbamadithioic acid) to control tree roots obstructing municipal sewer lines faces possible restriction by the U.S. EPA. In an effort to find a herbicidal alternative to metham, eight presently available herbicides (asulam, DCPA, EPTC, MSMA, glufosinate, glyphosate, sodium chlorate and triclopyr) were screened for efficacy in killing roots without visibly damaging other portions of the tree. Exposed roots in containerized seedlings of four species: water tupelo (*Nyssa aquatica* L.), wax myrtle (*Myrica cerifera* L.), water oak (*Quercus nigra* L.), and chinaberry (*Melia azadarach* L.), were exposed to herbicides at rates equal to or 10 times the cost of operational rates of metham. Five weeks following treatment, triclopyr, glufosinate and sodium chlorate showed herbicidal activity against roots. Only glufosinate had activity against roots without damaging foliage. Glufosinate was effective at a 10x rate, but not 1x, the cost of metham. While these chemicals may have the potential to be developed as alternatives to metham, increased material costs would likely result.

Introduction

Obstruction of municipal sewer lines with tree roots is a widespread problem in urban communities. Often, these blockages originate when tree roots enter sewer lines through cracked joints. Grease and solids flowing in sewer lines may then become entangled in these roots, ultimately producing backups. Roots can be physically removed by cutting, but this practice generally does not prevent root regrowth. Flooding affected sewer lines with mixtures of metham (methylcarbamadithioic acid) and dichlobenil (2,6-dichlorobenzonitrile) in a water-based foam solution has proven an effective management tool to control roots and prevent obstructions (4,5). Toxic effects of metham to sewage treatment plant nitrifiers (3) are likely to limit or curtail this practice. Therefore, a new cost-effective alternative for killing roots in sewer lines must be identified.

The objectives of this study were to identify and test herbicides with the potential to kill roots in sewer lines without injuring the shoot under each of two application rates based on the bulk rate cost of metham.

[1]Assistant Professor
[2]Professor

Methods

Eight presently available herbicides (asulam, DCPA, EPTC, MSMA, glufosinate, glyphosate, sodium chlorate and triclopyr) were selected for testing based on the following criteria (2):

- Present availability. Herbicides that currently are or could be labeled for use in aquatic systems received strongest consideration due to their proven efficacy and potential safety in waste water treatment and downstream aquatic systems.
- Possess a biological mode of action likely to be effective against root tissue.
- Chemical compatibility with currently used application equipment and foaming agents.
- Poor xylem translocation, therefore, not likely to result in injury to the rest of the tree.
- Potential to limit regrowth of roots.

Experimental methods described by Ahrens et al. (1) were modified to better simulate conditions inside a sewer line. Individual tree seedlings grown in 164 ml Leach(TM) tubes for several months were used as the experimental material. The growth medium consisted of 1:1 v/v mixture of Pro-mix BX (TM) and sand. Trees used in treatments were water tupelo (*Nyssa aquatica* L.), wax myrtle (*Myrica cerifera* L.), water oak (*Quercus nigra* L.), and chinaberry (*Melia azadarach* L.) provided by the Virginia Tech Reynolds Homestead Forestry Resources Research Center, Critz, VA. Seedlings were typically 15-40 cm tall at the time of this experiment. The bottom 2 cm of Leach tubes were cut off to prevent restriction of root growth.

To simulate the rooting environment in sewer lines, the bottom of tubes were suspended in trays containing a dilute nutrient solution to encourage root growth from the bottom of tubes and into the solution. The rooting zone was enclosed in a black plastic bag to maintain low light and high humidity levels conducive to root growth and the

Table 1. Herbicide prices based on manufacturer and wholesaler estimates of the cost of a bulk purchase, January 1996. Herbicide concentration is presented on a volume $_{\text{herbicide formulation}}$/volume $_{\text{solution prior to agitation}}$ basis.

Common name	Formulation	Assumed Formulation Cost/gal.	% solution (1x)
metam	Rout	$3.50	4.00
asulam	Asulox	56.00	0.25
DCPA	Dacthal	37.50	0.37
MSMA	MSMA	20.00	0.70
EPTC	Eptam	29.00	0.48
glufosinate	Finale	48.50	0.29
glyphosate	Accord	40.00	0.35
sodium chlorate	Sodium Chlorate	4.50	3.10
triclopyr	Garlon 3A	58.00	0.24

rooting solution was changed bi-weekly to ensure adequate aeration. Seedlings were kept in a heated greenhouse where seedling shoots were exposed to a 16 hr photoperiod.

Formulations of eight herbicides were applied at rates equal to 1 and 10 times the cost of metham (Table 1). Treatments were imposed by combining herbicides with 2% Rout (TM) foaming agent (Florida Petrochemicals, Syracuse, New York) in an aqueous solution. A control treatment consisting of Rout foaming agent and water only was also established. Following agitation of the herbicide solution with a blender, exposed roots were dipped and returned to Leach tube racks. To simulate herbicide exposure regimes likely to occur in sewer lines, the remaining solution was poured into the tray containing roots. After 20 minutes, the herbicide solution was removed and replaced with a nutrient solution to simulate removal of herbicide solution by sewer flow. Treatments were made under well-lighted conditions when trees were physiologically-active. Following treatment, nutrient solution was replaced every two days.

Exposed roots were harvested five weeks after treatment. Immediately prior to harvest, seedling shoot health was determined by visual assessment according to the following criteria: 0=no damage; 1=foliar discoloration; 2=some foliar necrosis 3=all foliage dead. Root mortality was expressed as the percentage dry weight of exposed root biomass that was dead at the time of harvest. Dead roots were characterized by their soft texture and separation of cortex from stele when lightly pulled.

All treatments were replicated four times. Each replicate consisted of three (water tupelo and water oak) or two (wax myrtle and chinaberry) seedlings. The average of each species within a replicate constituted an experimental unit. All data were analyzed using one-way analysis of variance using a randomized complete block design with percentage data subjected to arcsine transformation.

Table 2. Foliar damage class and percent root mortality for tree roots subjected to herbicide treatments. Herbicide rates are presented as cost relative to metham at operational rates. Damage class ranges from 0=no damage to 3=complete foliar mortality. Means followed by an asterisk differed significantly from controls.

Herbicide	Rate	Mean root mortality (%)	Mean Foliar Damage Class
metham	1	100 *	0.25
triclopyr	10	100 *	2.20 *
glufosinate	10	85 *	0.33
sodium chlorate	10	70 *	0.67 *
triclopyr	1	64 *	0.50
glyphosate	10	45	0.25
DCPA	1	40	0.75 *
glyphosate	1	39	0.33
DCPA	10	23	0.67
asulam	10	22	1.17 *
sodium chlorate	1	26	0.12
asulam	1	22	0.71 *
glufosinate	1	19	0.12
EPTC	1	18	0.25
MSMA	1	18	0.50
control	-	13	0.00
MSMA	10	11	0.75 *
EPTC	10	9	0.54

Results and Discussion

Complete root mortality occurred in response to metham at the operational rate and in the triclopyr 10x treatments (Table 2). Glufosinate at the 10x rate, 10x sodium chlorate and 1x triclopyr also produced significant, but incomplete, root mortality. Observations of untreated, exposed fine roots prior to and during this study led us to regard the 13% root mortality in the control treatment as normal root turn-over. The foaming agent did not have a discernable role in causing root mortality.

Triclopyr, asulam, MSMA and sodium chlorate at the 10x rate and asulam and DCPA at the 1x rate produced foliar symptoms significantly different from control (Table 2). Herbicide damage was greatest in the 10x triclopyr treatment where five of the ten seedlings were killed. Metham applied at the operational rate resulted in complete mortality of exposed roots without producing foliar symptoms. The only other herbicide that produced significant root mortality without causing foliar damage was glufosinate.

Visual observations of experimental plants during the five weeks following treatment indicated that metham resulted in the most rapid mortality of tree roots with death occurring within several days of treatment. In all other herbicides showing root activity, the visual symptoms of mortality developed more slowly, approximately two weeks following treatment. In this study, the only treatment rates producing root mortality comparable to metham were those equal to 10x the cost of metham. Failure of any herbicide to produce root mortality at a rate equal in cost to metham suggests that these alternative herbicides may result in higher material costs and poorer control relative to the conventional treatment.

Estimates of foliar damage and seedling mortality due to herbicide treatments likely represent a worst case scenario if extrapolated from these experimental seedlings to trees growing along sewer lines. Roots growing into sewers typically represent only a small portion of the total tree rooting system. In contrast, the majority of the rooting system of our experimental seedlings was treated. Therefore, a larger portion of the experimental seedlings was exposed to herbicide treatments than would be the case in actual sewer treatments.

Acknowledgements. Funding and material support for this research was provided by Duke's Sewer Root Control Specialists, Inc., Syracuse, NY.

Literature Cited

1. Ahrens, J. F., O. A. Leonard, and N. R. Townley. 1970. *Chemical control of tree roots in sewer lines.* Journal Water Pollution Control Federation. 42:1643-1655.
2. Ahrens, W. H. 1994. Herbicide handbook. 7th ed. Weed Science Society of America, Champaign, IL. 352 p.
3. Ake, T. N. 1995. The evaluation of metham sodium and dichlobenil impacts on activated sludge nitrification. Unpublished M.S. Thesis, Virginia Polytechnic Institute and State University, Blacksburg, VA. 115 p.
4. Leonard, O. A. and N. R. Townley. 1971. *Control of tree roots in sewers and drains.* California Agriculture. 25:13-15.
5. Leonard, O. A., D. E. Bayer, and R. K. Glenn. 1974. *Control of tree roots.* Weed Science. 22:516-520.

[1]Department of Forestry
Southern Illinois University
Carbondale, IL 62901-4411

[2]Department of Forestry
Virginia Polytechnic Institute
and State University
228 Cheatham Hall
Blacksburg, VA 24061-0324

Résumé. L'utilisation de l'acide ethylcarbamadithioique (metham) pour contrôler l'obstruction des tuyaux d'égouts par les racines pourrait rencontrer des restrictions auprès de l'Agence américaine de protection de l'environnement (EPA). Dans le but de trouver une alternative au metham, huit herbicides présentement disponibles sur le marché (asulam, DCPA, EPTC, MSNA, glufosinate, plyphosate, sodium chlorate, trichlopyr) ont été examinés en regard de leur efficacité à détruire les racines tout en évitant d'endommager de façon visible les autres portions de l'arbre. Les racines exposées à l'air de semis cultivés en pot de *Nyssa aquatica*, *Myrica cerifera*, *Quercus nigra* et *Melia azadarach* ont été vaporisées d'herbicides à des doses équivalentes ou jusqu'à 10 fois supérieures à celles metham. Cinq semaines après ce traitement, le glufosinate, le sodium chlorate et le trichlopyr montraient des indices d'activité contre les racines sans toutefois affecter le feuillage. Bien que ces substances chimiques peuvent potentiellement être développées comme solution alternative au metham, un accroissement des coûts en produits pourrait aussi en résulter.

Zussammenfassung. Der Gebrauch von Methylcarbemadithioin-Säure (metham) zur Bekämpfung von eindringenden Wurzeln in kommunalen Abwasserrohren wird möglicherweise durch das Bundesumweltamt beschränkt. Um eine Alternative für den Einsatz von Metham zu finden, wurden acht, am Markt erhältliche Herbizide (Asulam, DCPA, EPTC, MSNA, Glufosinat, Glyphosat, Sodiomchlorat und Trichlopyr auf ihre Tauglichkeit bei der Bekämpfung von Wurzeln ohne andere Teile vom Baum zu schädigen. Bei verschieden Containerpflanzen (*Nyssa Sylvatica, Myrica cerifera, Quercus nigra* und *Melia azadarach*) wurden entblößte Wurzeln bestimmten Dosen von Herbiziden ausgesetzt, die von gleich bis zur zehnfachen Höhe der Kosten von Metham verursachen. Fünf Wochen zeigten die Bäume nach der Behandlung mit Glufosinat, Sodiumchlorat und Trichlopyr herbizide Wirkungen auf die Baumwurzeln. Nur Glufosinat zeigte dabei keine Auswirkungen auf den übrigen Baum. Während diese Chemikalien gute Chancen haben, als Alternative zu Metham eingesetzt zu werden, würden im Gegenzug die Materialkosten in die Höhe steigen.