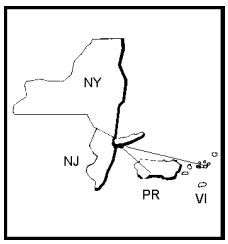

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Part 5

New Alternatives to Synthetic Herbicide Techniques for Treating Roadside Vegetation

Final Report
December, 2005

By:

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In cooperation with

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Department of Transportation
and
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TECHNICAL REPORT STANDARD TITLE PAGE

1. Report No.	2.Government Accession No.	3. Recipient's Catalog No.

4. Title and Subtitle	5. Report Date
New Alternatives To Synthetic Herbicide Techniques For Treating Roadside Vegetation.	December 2005
	6. Performing Organization Code
7. Author(s)	8. Performing Organization Report No.
Christopher A. Nowak and Benjamin D. Ballard	SUNY-ESF Project Report #5
9. Performing Organization Name and Address	10. Work Unit No.
University Transportation Research Center City College of New York, Marshak Hall J910 New York, NY 10031	11. Contract or Grant No.
12. Sponsoring Agency Name and Address	13. Type of Report and Period Covered
New York State Department of Transportation **50 Wolf Road** Albany, NY 12232 U.S. Department of Transportation Washington, D.C.	Research Report, 1/1/2004-12/31/04
	14. Sponsoring Agency Code

15. Supplementary Notes

16. Abstract

Herbicides have been widely used to control vegetation on roadside rights-of-way because they are perceived as more cost effective than other treatments. However, as knowledge of environmental systems has developed along with a growing social perception of health and environmental issues, a need for alternative methods to synthetic herbicide use for vegetation control along roadsides has become a prominent issue. Earlier phases of this research indicated several promising physical, cultural, biological/ecological, and chemical controls. A small subset of these treatments, which included three barriers (two mulches and one soil solidifier), four natural herbicides, and one mycoherbicide, were selected for more detailed review. These alternatives were detailed in terms of: 1) treatment type, 2) product name; 3) manufacturer; 4) website; 5) general information; 6) efficacy and effectiveness; and 7) recommended techniques for future testing. A brief treatise on research methods for testing the effectiveness of these new techniques for controlling roadside right-of-way vegetation was developed based on expert opinion and experience of the authors.

17. Key Words	18. Distribution Statement
mulches, soil solidifiers, natural herbicides, mycoherbicide	No Restriction

19. Security Classif (of this report)	20. Security Classif. (of this page)	21. No of Pages	22. Price
Unclassified	Unclassified	24	NA

Form DOT F 1700.7 (8-69)

CITATIONS

This report was prepared by:

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1 EXECUTIVE SUMMARY

Overall Project: Assessing New York State DOT's Alternatives to Herbicides, Integrated Vegetation Management, and Related Research Programs

A set of five research projects on roadside right-of-way (ROW) vegetation management were conducted in 2004-2005 by the State University of New York College of Environmental Science and Forestry (SUNY-ESF) for the New York State Department of Transportation (NYSDOT).

Objectives for the research were as follows (as provided in the problem statement provided by NYSDOT):

- Objective No. 1: evaluate NYSDOT's current vegetation management program and "Alternatives to Herbicide" program
- Objective No. 2: develop recommendations for the vegetation management program and "Alternatives to Herbicide" program
- Objective No. 3: develop a systematic framework and research protocol for identification, evaluation and implementation of environmentally sensitive, lower maintenance, and cost -effective vegetation management techniques that can be integrated into the overall vegetation management program

SUNY-ESF met these objectives over the course of 2004-2005 using the following projects (all reports finalized in December 2005).

Research Project #1

A thorough search for existing information and knowledge on highway ROW vegetation management policies and techniques, and alternatives to herbicides programs and demonstrations, as applicable to New York State

Final report—PHASE 1:

Alternatives to Herbicides: Literature Review and Annotated Bibliography

Research Projects #2 and #3

Development of assessment standards (Project #2) and assessment of NYSDOT's vegetation management program (Project #3)

Final report—PHASE 2, Part 1 of 2:

Performance Standards for Assessing Vegetation Management on Rights-of-Way: Case Study of New York State DOT's Roadside Rights-of-Way Vegetation Management Program

Final report—PHASE 2, Part 2 of 2:

SUNY-ESF Right-of-Way Vegetation Management Program Assessment Report for New York State Department of Transportation, Albany, New York

Research Project #4

Development of a cost-effectiveness model for evaluating alternative vegetation management techniques for research, development, and application.

Final report—PHASE 3:

Developing a Cost-Effectiveness Model for Research, Development, and Application of Herbicide and Non-Herbicide Vegetation Management Treatments for Roadside Rights-of-Way

Research Project #5

Proposition of alternative vegetation management techniques and evaluation protocol for testing, demonstration, and operational application of those techniques.

Final report—PHASE 4:

New alternatives to herbicide techniques for treating roadside vegetation: Recommended techniques for future testing.

Phases of work were ordered according to the progression in project accomplishments, proceeding over time from Phases 1 through 4. All four phases of work and the associated five research projects were related to one or more of the other projects, as follows.

Project #1 was used to:

- collect information needed to develop the cost-effectiveness model in Project #4
- define different treatments as alternatives to herbicides as needed in Project #5

Project # 2 was used to:

- construct the performance standards needed for Project #3

Project #3 depended on results from Project #2

Project #4 depended on Project #1 and was used to

- define different treatments as alternatives to herbicides as needed in Project #5

Project # 5 depended on results from Projects #1 and 4.

All five projects together, and separately, can be viewed as foundations for future research and development work on vegetation management issues (especially those related to non-herbicide alternatives) by NYSDOT.

Research Project #5: New Alternatives to Synthetic Herbicide Techniques for Treating Roadside Vegetation

Study Objective

Produce a report that presents the most promising new techniques as alternatives to herbicide for treating roadside vegetation. The report includes some background information on each treatment and methods of testing them in comparison with conventional and other experimental treatments.

Proposition

Phase 1 (annotated bibliography) and Phase 3 (cost-effectiveness matrix via expert opinion and a Delphi process) were consistent in indicating the following promising physical, cultural, biological/ecological, and chemical controls.

	Based on Project #4	Based on Project #1
Zone 1*	Mulches	ForeverMulch™ Weed Ender™
	Solidifiers	Polypavement™
	Natural herbicides	Finale™ Burnout™ EcoEXEMPT ™ Scythe™
Zone 2*	Mycoherbicide	Chondrostereum pupureum
	Natural herbicides	Finale™ Burnout™ EcoEXEMPT™ Scythe™

*Zone 1 is generally defined as the area under and near to the guiderail, the shoulder, and the areas around sign posts. Zone 2 is generally defined as the remainder of the roadside right-of-way.

All of these techniques are reported on in more detail, as part of Phase 4 (see "Study Objective" above). Additionally, a brief is provided on how to test these treatments on roadside rights-of-way (Appendix).

2 INTRODUCTION

A wide variety of non-herbicide methods and non-synthetic chemical treatments are available to control roadside right-of-way vegetation and reduce the use of herbicides (see results of Research Project #1 "Alternatives to Herbicides: Literature Review and Annotated Bibliography"). These treatments are generally viewed as being inferior to synthetic chemicals in terms of efficiency and effectiveness of treatments (see Research Project #4 "Developing a Cost-Effectiveness Model for Research, Development, and Application of Herbicide and Non-Herbicide Vegetation Management Treatments for Roadside Rights-of-Way"). However, their optimized use would lead to a reduction in the use of synthetic chemicals. Additionally, through further experimentation, some non-herbicide methods and non-synthetic chemical treatments may be found to be as efficient and effective as synthetic chemicals.

OBJECTIVE

Objective #1: Produce a brief report that presents the most promising new techniques as alternatives to synthetic herbicides for treating roadside vegetation.

Objective #2: Develop a brief on research methods for testing the effectiveness of these new techniques for controlling roadside right-of-way vegetation.

3 METHODS

Results from the cost-effectiveness model used in Research Project #4 were used to select a small subset of physical, chemical, and biological treatments methods as alternatives to synthetic herbicides for use on roadside rights-of-way vegetation management. These alternatives were detailed in terms of: 1) treatment type, 2) product name; 3) manufacturer; 4) website; 5) general information; 6) efficacy and effectiveness; and 7) recommended techniques for future testing. This information for each treatment was based on results from Research Project #1 "Alternatives to Herbicides: Literature Review and Annotated Bibliography".

A brief treatise on research methods for testing the effectiveness of these new techniques for controlling roadside right-of-way vegetation was developed based on expert opinion and experience of the authors.

4 RESULTS

A small subset of physical (three barriers), biological (one mycoherbicide), and chemical (four natural herbicides) treatments were identified and researched as new alternatives for testing on roadside rights-of-way (see following pages).

The treatise on research methods for testing the effectiveness of these new techniques for controlling roadside right-of-way vegetation can be found in the Appendix.

New alternative to synthetic herbicide techniques for treating roadside vegetation—ForeverMulch

Treatment Type: physical—barrier
Product Name: ForeverMulch
Manufacturer: Global Constructs Group
Website: www.forevermulch.com

General Information

ForeverMulch is made from shredded, recycled tires with a non-hazardous color coating that includes herbicide and fungicide (ingredients not know). Product is advertised to last 15 years.

Efficacy and effectiveness—science-based evidence

No information found.

Recommended techniques for future testing

Zone 1: under guide rails, around sign posts—areas of no/low tolerance for any vegetation
Zone 2: no application

Test Application: Apply as piles of chips in small, linear-areal sections of right-of-way, perhaps with and without landscape fabric.

New alternative to synthetic herbicide techniques for treating roadside vegetation—Weed-Ender

Treatment Type: physical—barrier
Product Name: Weed-Ender
Manufacturer: U-Teck
Website: www.uteck.com

General Information

Weed-Ender is presented as a "tough, non-wooven material which is constructed of a very dense, multi-directional needling of synthetic fibers (that is) totally impregnated with a special resin that has ultraviolet inhibitors to safeguard against deterioration. The estimated life of (Weed-Ender) is in excess of 10 years under normal conditions."

Efficacy and effectiveness—science-based evidence

No information found.

Recommended techniques for future testing

Zone 1: under guide rails, around sign posts—areas of no/low tolerance for any vegetation
Zone 2: no application

Test Application: Apply in small, linear-areal sections of right-of-way. Material is provided in sheets that are laid out over the area of interest and cut around fixed objects (e.g., guide rail posts, sign posts). This treatment could be combined with natural herbicides to treat vegetation that may come in along seams and edges.

New alternative to synthetic herbicide techniques for treating roadside vegetation—PolyPavement

Treatment Type: physical—barrier
Product Name: PolyPavement
Manufacturer: not evident
Website: www.polypavement.com

General Information

PolyPavement is a liquid soil solidifier that results in a trafficable, wearable surface that purportedly rivals asphalt and concrete. The existing soil in place or a suitable imported soil is used for 98% of the pavement construction material. Estimated life of the surface is 5 to 10 years depending on the presence of a toughening coat, actual wear of the surface, the friability of the soil, and weather conditions.

Efficacy and effectiveness—science-based evidence

No information found.

Recommended techniques for future testing

Zone 1: under guide rails, around sign posts—areas of no/low tolerance for any vegetation
Zone 2: no application

Test Application: Apply in small, linear-areal sections of right-of-way. Material is provided in cans to be mixed with soil surface.

New alternative to synthetic herbicide techniques for treating roadside vegetation—Finale

Treatment Type: chemical—natural herbicide
Product Name: Finale
Manufacturer: Bayer CropScience
Website: www.bayercropscience.com.au

General Information

Finale is a non-selective, foliar-applied herbicide that inhibits photosynthesis and has no soil activity. It is considered a "burn-down" contact herbicide that impacts the plant surfaces with which it comes in contact with (in contrast, Roundup—active ingredient glyphosate—is a synthetic herbicide that kills the whole plant) (Johnson et al. 1997). The active ingredient glufosinate-ammonium occurs as a metabolic compound from a soil-inhabiting bacterium, making it a natural herbicide.

Efficacy and effectiveness—science-based evidence

Finale has been shown to provide early necrosis of treated plants, but produces poor control in the long-term, as compared to synthetic herbicidies (Johnson et al. 1997). If both rapid burn down and long-term control is desired, it has been shown that mixtures of Finale with select synthetic herbicides may be effective (Johnson et al. 1997). This ability to mix natural and synthetic herbicides may be an important means to reducing the use of synthetic herbicides.

Literature Cited

Johnson, J.M., L.J. Kuhns, C.W. Spakman, and T.L. Watschke. 1997. Using burn-down materials for total vegetation control under guiderails. p. 54-55 *In:* Roadside Vegetation Management Research Report – Thirteenth Year Report, Vol. PA-4620-99-01, Pennsylvania State University, University Park, PA.

Recommended techniques for future testing

Zone 1: under guide rails, around sign posts—areas of no/low tolerance for any vegetation
Zone 2: spot treatment of undesirable plants

Test Application: Apply in small, linear-areal sections of right-of-way, or on individual plants. Material is as a liquid concentrate to be mixed with water and sprayed on foliage of target plants.

New alternative to synthetic herbicide techniques for treating roadside vegetation—Burnout II

Treatment Type: chemical—natural herbicide
Product Name: Burnout II
Manufacturer: St. Gabriel Laboratories
Website: www.biconet.com/lawn/burnout.html

General Information

Burnout II is primarily a blend of vinegar and lemon juice. It is considered a "burn-down" contact herbicide that impacts the plant surfaces with which it comes in contact with (see also description for "Finale" natural herbicide).

Efficacy and effectiveness—science-based evidence

No documentation was found on effectiveness of this mixture of vinegar and lemon juice. Vinegar (acetic acid) alone has been compared to Roundup (glyphosate as active ingredient). Acetic acid was shown to be somewhat effective, but no acetic acid treatment was as effective as glyphosate (Chinery 2002).

Literature Cited

Chinery, D. 2002. "Using acetic acid (vinegar) as a broad-spectrum herbicide". Website: http://www.cce.cornell.edu/rensselaer/Horticulture/acetic_acid_as_herbicide.htm, access 2/21/05.

Recommended techniques for future testing

Zone 1: under guide rails, around sign posts—areas of no/low tolerance for any vegetation
Zone 2: spot treatment of undesirable plants

Test Application: Apply in small, linear-areal sections of right-of-way, or on individual plants. Material is as a liquid to be sprayed on foliage of target plants.

New alternative to synthetic herbicide techniques for treating roadside vegetation—EcoEXEMPT

Treatment Type: chemical—natural herbicide
Product Name: EcoEXEMPT
Manufacturer: EcoSMART Technologies, Inc.
Website: www.ecosmart.com

General Information

EcoEXEMPT is a contact, non-selective, broad-spectrum, foliar-applied herbicide that "burns" annual and perennial broadleaf and grass weeds, and has no soil activity. The active ingredients phenethyl propionate and eugenol (clove oil) are plant derived, making EcoEXEMPT a natural herbicide.

Efficacy and effectiveness—science-based evidence

No evidence was found on effectiveness for this natural herbicide.

Recommended techniques for future testing

Zone 1: under guide rails, around sign posts—areas of no/low tolerance for any vegetation
Zone 2: spot treatment of undesirable plants

Test Application: Apply in small, linear-areal sections of right-of-way, or on individual plants. Material is as a liquid concentrate to be mixed with water and sprayed on foliage of target plants.

New alternative to synthetic herbicide techniques for treating roadside vegetation—Scythe

Treatment Type: chemical—natural herbicide
Product Name: Scythe
Manufacturer: Mycogen Corporation
Website: www.biconet.com/lawn/scythe.html

General Information

Scythe herbicide is a fatty acid-based, non-selective, contact herbicide. It is considered a "burn-down" contact herbicide that impacts the plant surfaces with which it comes in contact with (see also description for "Finale" natural herbicide). It is applied as a foliar spray for the control of annual weeds, and as a top kill for perennial weeds. The active ingredient is pelargonic acid.

Efficacy and effectiveness—science-based evidence

Scythe was found to be less effective than Finale (Johnson et al. 1997) (see description above for Finale). It may be that with New York climate and weed populations, Scythe may be more effective than was observed in Pennsylvania (Johnson et al. 1997).

Literature Cited

Johnson, J.M., L.J. Kuhns, C.W. Spakman, and T.L. Watschke. 1997. Using burn-down materials for total vegetation control under guiderails. P. 54-55 In Roadside Vegetation Management Research Report – Thirteenth Year Report, Vol. PA-4620-99-01, Pennsylvania State University, University Park, PA.

Recommended techniques for future testing

Zone 1: under guide rails, around sign posts—areas of no/low tolerance for any vegetation
Zone 2: spot treatment of undesirable plants

Test Application: Apply in small, linear-areal sections of right-of-way, or on individual plants. Material is as a liquid concentrate to be mixed with water and sprayed on foliage of target plants.

New alternative to synthetic herbicide techniques for treating roadside vegetation—*Chrondrostereum purpureum*

Treatment Type: biological—mycoherbicide
Product Name: *Chrondrostereum purpureum*
Manufacturer: MycoLogic Incorporated
Website: www.epa.gov/pesticides/biopesticides

General Information

The basidiomycete fungus *Chrondrostereum purpureum* is an indigenous pathogen with potential as a biocontrol agent. It requires a fresh wound to infect a susceptible host; non-target woody plants in the vicinity will be unaffected by application.

Efficacy and effectiveness—science-based evidence

Many reports and refereed papers have been published over the last decade on the use of the fungus to control weed trees. The fungus can be used on roadside rights-of-way to kill freshly cut shrubs and trees, in place of cut stump-synthetic herbicide treatments. This biological control should be tested thoroughly with anticipation that level of control will not be as high as with synthetic herbicides.

Recommended techniques for future testing

Zone 1: spot treatment of undesirable woody plants
Zone 2: spot treatment of undesirable woody plants

Test Application: Apply on a plant-by-plant basis

A APPENDIX: GENERAL RECOMMENDATIONS AND GUIDELINES FOR NYSDOT VEGETATION MANAGEMENT FIELD RESEARCH

Components of a well-executed vegetation management research study/experiment:

- Clearly defined and stated study questions/objectives
- Experimental design to answer research questions/objectives (consultation with a statistician/researcher could be very helpful in design and planning specific experiments)
- Treatments of interest selected for study, including a "control" (i.e., untreated, and a standard/typical/conventional vegetation management treatment)
- Appropriate experimental/statistical design (as stated above)—factorial experiment, matched pairs, split-plot, completely randomized design, randomized complete block design, etc.
- Well-planned selection of study sites (replication, blocks, experimental units, etc.; sampling from the target population—population you want to be able to apply results to, e.g., vegetation under all guide rails in New York State, or wetlands adjacent to roads in Bear Swamp, or knotweed on Adirondack roadside ROWs)
- Use of buffers between treatments (avoid sampling the edges—"edge effect"); buffer is usually 2 to 4 times the maximum height of the sample plant population
- Pre-treatment inventory of vegetation conditions on the study sites using documented, "standard" sampling protocols
- Well-documented treatment applications (quantity, type, mixtures, rates of materials used; equipment used; weather conditions at time of treatment and soon after; e.g., "letter to the record")
- Post-treatment inventory and monitoring (consistent with pre-treatment protocols; short- and long-term monitoring as needed to meet study objectives)
- Data analyses utilizing real data (pre- and post-treatment, taking advantage of the experimental design used)
- Documenting study and results—reporting, publishing
- Documentation and monumentation—good maps, both to locate study sites and to identify plot or experimental unit layout at a site; and some type of "permanent" markers at the site to identify the location of sampling points, plots, etc.

- Number of treatment units—three to four replications of each treatment is a good guideline for community-based responses; 30 or more individuals per treatment is a good rule of thumb for individual plants
- Unreplicated treatments or case studies are of limited scientific value—not that they can not/should not be used; as an early screening of a treatment (before spending the time and money on a full-scale trial) they may help decide whether to investigate further (but do not expect them to stand up to scrutiny by the scientific community or a public that wants a fair evaluation relative to conventional treatments).

Selection criteria and others considerations for study sites related to vegetation management research:

Representative?

Has the ROW been normally managed, i.e., is past management history the norm for the region? Is the plant community on the ROW representative of the population of interest? Site conditions uniform? ROW width typical? Surrounding land use?

Accessible?

Can the study sites be readily traveled to for treatments (various types of equipment) and monitoring (but not too accessible to the public—see 'Protected' below)? Can the sites be used for demonstration and education? Can the treatment plots be accessed by walking (minor physical challenges for walkers)? Is there a parking area? Big enough for a bus or two to park and turn around in?

Other?

Study sites should not be in areas with large wetlands, deer yards, or other unique ecological features (these may be interesting, and worth study, but will be a nuisance when studying treatment effects). Are boundaries of the ROW well defined and ownership/lease agreements well executed?

Treatable?

Blocks (or replicates) of relatively uniform vegetation, on and off ROW, are needed to support a controlled experiment. Size of the blocks/sites will be dependent upon the objectives of the study (e.g., is control of an individual species the focus of the study, or is the larger plant community of interest). At least three such blocks should be used in most experiments. For pre-selection of potential plots six to nine areas should be located, so that there is some flexibility in choosing the final study plot locations.

Protected?

Vandalism can be a concern. Sites are needed where access minimizes vandalism or inadvertent manipulation/disturbance by the public. Long-term commitment to the project will be useful (areas are needed that will not have large-scale surface disturbance in the foreseeable future).