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WEED CONTROL AND GROWTH REGULATION

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INTRODUCTION

Members of the Guelph Turfgrass Institute are pleased to present their Annual Report for 1987. The report is not a complete recording of all data collected by the various researchers, but it reflects the highlights of their work. The comprehensive nature of the report is a reflection of the Guelph Turfgrass Institute's goal to provide information on turfgrass production and management to members of the Ontario Turfgrass Industry.

Highlights of the report include studies on **Alternatives to 2,4-D for Control of Broadleaf Weeds** by Chris Hall and Kathy Christensen, and research on the **Rate and Persistence of 2,4-D in Turf** by Cindy Bowhey, Chris Hall and Gerry Stephenson. New initiatives include the work of Bev Raimbault and Ed Gamble on **Perennial Ryegrass Seed Production,** as well as studies on the Use of **Zeolites in Sand Root Zone Mixes** by Paul Voroney and Virginia Marcille. Research on the **Use of Sewage Sludge as a Turf Fertilizer** by Jack Eggens and Ken Carey will be of interest of those concerned about waste management in the province of Ontario. Important survey data on the **Nutrient Status of Ontario Golf Greens** is reported by Tom Bates and Annette Anderson. In the area of pest management, emphasis has been placed on **Biological Control of Dollarspot Disease and Snow Molds** by Mark Lawton, Doug Goodman, Lorraine Goulty and Lee Burpee. Also of interest will be the preliminary work by Gord Riddle and Lee Burpee on **Biological Control of Dandelions.** Thanks to the efforts of Norm McCollum, readers can make use of **Evaluations of Turfgrass Cultivars** provided by Ken Carey, Norm McCollum and Jack Eggens. Annette Anderson, the Ontario Ministry of Agriculture and Food Turfgrass Extension Specialist, has made this report complete by providing highlights in **Turfgrass Extension** for 1987.

Turfgrass Field Research for 1987 culminated in a successful Field Day held at the Cambridge Research Station on 27 August. We want to thank the **Ontario Turfgrass Research Foundation** for supporting the Field Day, and for contributing significantly to the Guelph Turfgrass Institute's research program in 1987.

Further appreciation is extended to Gordon Bannerman Ltd., Brower Turf Equipment Ltd., and Duke Equipment for the loan of equipment in 1987. This support, along with contributions made by companies, agencies and institutions listed on the following page, helped to make 1987 a successful year for turfgrass research.

L.L. Burpee
Editor

ACKNOWLEDGEMENTS

We wish to extend our appreciation to the Ontario Ministry of Agriculture and Food for continued support during the year. The Ontario Turf Research Foundation continued to play a major role, not only in providing funding for a variety of projects, but also by indicating direction the research should take to resolve the problems which occur in the field. We also extend sincere thanks to the agribusiness community who provided extra operating dollars, chemicals and equipment which made many of the projects reported herein a success.

Ontario Ministry of Agriculture and Food
Natural Science and Engineering Research Council
Ontario Turfgrass Research Foundation
The Ontario Ministry of Environment
Duke Equipment Ltd.
Chemlawn Inc.
Elanco Monsanto Canada Inc.
Hoechst Canada Ltd.
Brouwer Turf Equipment Ltd.
Chipman Inc.
Ciba-Geigy Canada Ltd.
May and Baker Canada Inc.
O.M. Scotts and Sons
OSECO
OTTO Pick -and Sons Seeds Ltd.
Rothwell Seeds
SDS Biotech Corporation
Turf Care Equipment
Dupont Canada Inc.
Beaconsfield Golf Club
Chevron Chemical Co.
BASF Canada Inc.
Cyanamid Canada Inc.
Dow Chemical Canada
Compact Sod
Stauffer Chemical Company of Canada Ltd.
Union Carbide
Ag-Turf Chemicals Inc.

The setting of this report in type by Ms. Lisa Legault is sincerely appreciated by the contributors.

Turfgrass Industry Priorities	Research Objectives - Guelph Turfgrass Institute
1. Develop effective methods for eliminating undesirable species of grasses in swards of quality turfgrass.	1A. Evaluate potential of growth regulating chemicals for enhancing competition of desirable grass species over undesirable species.
	1B. Develop effective and efficient methods for seeding a desirable grass species into a stand composed of a less desirable species.
2. Evaluate experimental pesticides for control of weeds, diseases and insect pests in turfgrass swards.	2A. Determine disease suppression potential of experimental fungicides for dollarspot disease and pink and grey snow mold.
	2B. Select new herbicides for control of broad-leaf weeds and grasses in turf.
	2C. Determine the effectiveness of new insecticides for control of chinch bug and European chafer in turf.
3. Develop a fertility program for optimum rooting depth and recuperative potential of perennial turfgrasses.	3A. Determine the effects of different sources of nitrogen on root development and wear tolerance in turfgrasses.
	3B. Evaluate the role of minor nutrient elements on the growth of turfgrass on sand.
4. Develop improved sports-field construction and maintenance techniques.	4A. Determine the cause of "black layer" in turf root zones.
	4B. Evaluate the effects of incorporating zeolite clays into root zone mixes for sports turf.

5. Develop improved methods for biological and cultural control of diseases and weeds in turfgrass swards.	5A. Select improved strains of the snow mold suppressive fungus *Typhula phacorrhiza*.
	5B. Develop a biological control for dollarspot disease of turfgrass.
	5C. Evaluate strains of fungi and bacteria for their ability to kill dandelions in turf swards.
	5D. Determine the optimum source of nitrogen for suppression of dollarspot disease.
6. Measure movement and persistence of pesticides in turfgrass thatch and soil.	6A. Determine the fate of 2,4-D and diazinon in turfgrass soils.
	6B. Evaluate the movement of 2,4-D residues on grassy inclines.

PARTICLE SIZE ANALYSES OF ROOT ZONE MIXES IN GOLF GREENS SUFFERING FROM BLACK LAYER

Lee Burpee and Annette Anderson
Department of Environmental Biology and
Ontario Ministry of Agriculture and Food

Black layers, associated with high moisture and low oxygen, have been detected in profiles of root zone mixes in many golf greens in North America. Although controversy has erupted over the exact composition of black layers, most scientists agree that excess moisture plays a crucial role in creating the environmental conditions that are required for development of these layers.

Examinations of golf greens in southern Ontario have revealed that black layers may form in at least two different ways. In Type 1 black layers the bottom of the layer is not distinguishable (Figure 1). The layer extends deep into the soil profile and comes in contact with a natural water table or an artificial water table produced by the lack of sufficient drainage. A Type 2 black layer manifests itself as a horizontal band in the profile of a green (Figure 2). The band may be several centimeters thick but, in most cases, the top and bottom of the band can be distinguished easily.

Research reported here deals with the physical properties of Type 2 black layers. We tested the hypothesis that the particle size distribution (PSD) in Type 2 black layers is significantly different from the PSD in the soil immediately below black layers. The existence of aberrations in PSD within the profile of a golf green may lead to development of poorly drained, anaerobic conditions.

Figure 1. Type 1 black layer extending deep into soil profile, coming in contact with natural or artificial water table.

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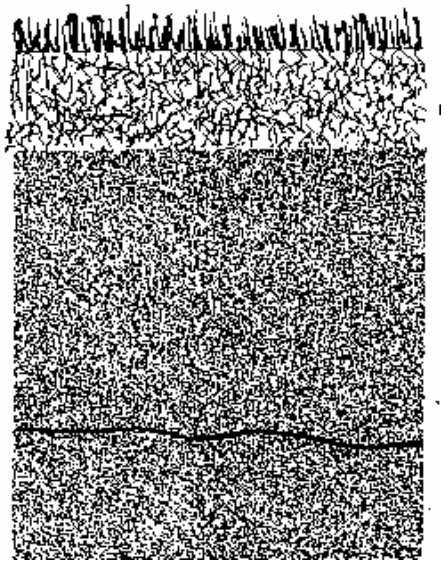
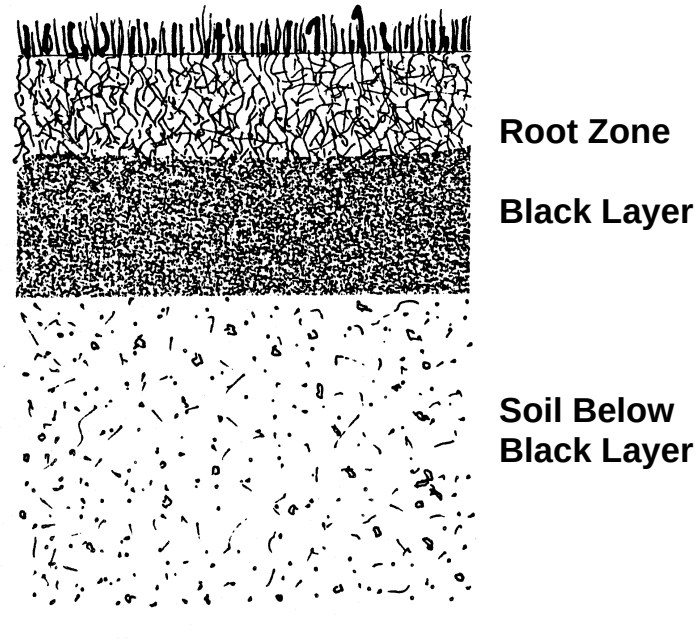


Figure 2. Type 2 black layer. A horizontal band in the soil profile.



METHODS

Cores of root-zone mixes (10.8 cm in diam. and up to 20 cm deep) were removed from eight golf greens at five golf courses in southern Ontario between June and October, 1987. Each green had been diagnosed as suffering from Type 2 black layer. Cores were wrapped in papers or placed in plastic bags and transported intact to the University of Guelph. Cores were sectioned transversely to separate each black layer from the soil below. Samples of black layers and the soil below black layers were analyzed individually for particle size distribution and organic matter content by the University of Guelph soil lab.

RESULTS

All the greens tested had a greater percentage of coarse sand (0.5 - 2 mm) below black layers than in black layers. The mean percentage of very coarse sand plus coarse sand (0-5 - 2 mm) below black layers was significantly greater (P=0.1) than the percentage of these sands in black layers (Table 1).

The mean distribution of coarse sand + medium sand (0.25 - 1.0 mm) did not exceed 50% in black layers or in layers below black layers.

Table 1. Distribution of very coarse sand (VSC), coarse sand (CS), and medium sand (MS) in black layers and below black layers. in root zones of golf greens in southern Ontario. 1987.

	Distribution (% by wt.)[1]			
Zone	VCS	CS	VCS + CS	CS + MS
	(1 - 2 mm)	(0.5 - 1 mm)	(0.5 - 2 mm)	(0-25 - 1.0 mm)
Black Layer	6.9	16.5	23.4	1 45.4
Below Black Layer	11.0	19.7	30.7*	46.2

[1]Means from 8 golf greens
*Significant at P=0.1 according to t-test

Percent distribution of very fine sand (0.05 - 0.1 mm) and fine sand (0.1 - 0.25 mm) were higher in black layers than below black layers in 7 of 8 greens test. However, the mean percent distributions for these particle sizes were not significantly different between black layer and layers below black layers (Table 2).

Table 2. Distribution of very fine sand (VFS) and fine sand (FS) in black layers and below black layers in root zones of golf greens in southern Ontario. 1987.

	Distribution (% by wt.)[1]		
Zone	VFS	FS	VFS +FS
	(0-05 - 0.1 mm)	(0.1 - 0.25 mm)	(0.05 - 0.25 mm)
Black Layer	7.4	28.0	35.4
Below Black Layer	6.9	23.0	30.0

[1]Means from 8 golf greens

Distribution of silt (2 - 53 µ) and clay (< 2 µ) were not significantly different in black layers as opposed to layers below black layers (Table 3). However, the mean distribution of silt plus clay exceeded 10% in each of the two zones tested.

Table 3. Distribution of silt (2 - 53 µ) and clay (< 2- µ) in black layers and below black layers in root zones of golf greens in southern Ontario. 1987.

	Distribution (% by wt.)[1]		
Zone	Silt (2 - 53 µ)	Clay (< 2 µ)	Silt + Clay (< 2 - 53 µ)
Black Layer	8.8	3.5	12.2
Below Black Layer	9.4	3.5	12.0

[1]Means from 8 golf greens

The mean percent organic matter in black layers and below black layers were 3.7 and 1.9 respectively.

CONCLUSIONS

1. Among the 8 golf greens tested, particle size distributions were not homogeneous between black layers and zones below black layers, particularly with respect to the very coarse sand and coarse sand f ractions. These fractions were greater in zones below black layers than in black layers.

2. Distribution of particles < 0.25 mm (ie. silt, clay, fine sand and very fine sand) exceeded 30% in 6 of 8 greens tested. U.S.G.A. specifications call for a maximum of 25% with this range.

3. Distributions of coarse sand + medium sand (0.25 - 1.0 mm) were less than 50% in 7 of 8 greens tested. U.S.G.A. specifications call for a minimum of 65% coarse + medium sand in a root zone mix.

4. Results of this preliminary study indicate that layers of different particle size distribution exist in golf greens in southern Ontario, and these layers may play a role in the development of black layer. Furthermore, results suggest that the concentration of fine particles (ie. fine sand, very fine sand, silt and clay) in root zone mixes and top dressing materials exceed recommended levels. A re-evaluation of topdressing materials for golf greens in southern Ontario is warranted.

A SURVEY OF THE PLANT NUTRIENT STATUS OF ONTARIO GOLF GREENS

Thomas E. Bates and Annette Anderson

Department of Land Resource Science and Ontario Ministry of
Agriculture and Food, respectively

OBJECTIVE

To measure the extent of macro and micronutrient deficiencies and/or toxicities in golf greens in Ontario and to survey the fertilizer practices on greens.

RESEARCH PROCEDURE

Thanks to appreciable effort on the part of greenskeepers, clippings, soils and a documentation of management practices were collected from golf courses across the province. Only 16 clipping samples were obtained and a lesser number of soil samples as the project started in mid summer of 1987.

Clippings were analyzed at the Plant Analysis Laboratory, Department of Land Resource Science, University of Guelph and soil analysis was performed by Agrifood Laboratories.

PRELIMINARY RESULTS

A summary of the plant results is presented in Table 1. Critical nutrient concentrations in turf grass do not appear to be well documented, particularly for individual species. However based on the information that is available some conclusions can be reached.

None of the samples tested was sufficiently low in nitrogen to suggest deficiency. Phosphorus content was quite high, probably well above requirements in half of the samples. Potassium concentrations were adequate in all but one sample which may have been approaching deficiency. Magnesium appears to range from adequate to well above adequacy.

The micronutrients were all within an acceptable and reasonable range except manganese or one sample which at 176 ppm was high but probably not toxic. A manganese level that high in Ontario soils is almost certainly due to soil acidity or poor drainage. Soil pH was not measured on this particular green. Iron was not determined on these samples because some soil contamination was expected and even small amounts of soil dust can make plant analysis for iron quite meaningless.

Since most greens received regular micronutrient applications it is not possible to determine whether the micronutrient applications were needed.

Soil analyses are presented in Table 2 and covered quite a wide range except for soil pH which was very uniform. Some samples tested exceptionally low in phosphorus and potassium but plant samples from those sites were not low. This appeared to be explainable by the rates of fertilizer applied. One top-dressing material was analyzed. Table 2. Some greens were heavily top-dressed at regular intervals and this may explain some of the low soil tests.

The study will continue in 1988.

Project funded by the Ontario Ministry of Agriculture and Food.

Table 1. Nutrient Content of Clippings from 16 Ontario Golf Greens in 1987.

Nutrient	Units	Average	Range
Nitrogen	%	5.12	3.25 - 6.35
Phosphorus	%	0.62	0.40 - 0.85
Potassium	%	2.88	1.53 - 3.95
Calcium	%	1.43	0.64 - 4.53
Magnesium	%	0.36	0.19 - 0.92
Boron	PPM	13	8 - 22
Copper	PPM	15	9 - 24
Manganese	PPM	62	28 - 176
Zinc	PPM	59	37 - 88

Table 2. Soil Test Ratings from Ontario Golf Courses in 1987

	11 Greens		One Top Dressing
Measurement	Average	Range	Material
Soil pH	7.6	7.4 - 7.9	8.3
Phosphorus	42	5 - 95	1
Potassium	77	23 - 134	9
Magnesium	138	66 - 262	66

USE OF SEWAGE SLUDGE AS A TURF FERTILIZER - LOW MAINTENANCE LAWN TURF

J. L. Eggens and K. Carey

Department of Horticultural Science

The objective of this research was to determine the suitability of Windsor composted sewage sludge, produced by the Beltsville aerated pile method, as a general turf fertilizer on relatively low maintenance lawn turf. The Windsor sewage sludge was compared to other nitrogen sources.

RESEARCH PROCEDURE

Twenty 1 x 18 m plots were established at the Cambridge Research Station in a mature Kentucky bluegrass-red fescue turf mowed at 4 cm without regular irrigation. A control and four treatments (sulfur-coated urea, Milorganite 6-2-0, Canagro 12-6-6, and Windsor composted sewage sludge) were replicated four times each in a randomized complete block design. Nitrogen was applied 6 times (4-06, 10-06, 27-07, 10-08 4-09, and 25-09) at 100 kg N ha^{-1} for a total of 600 kg N ha^{-1}.

RESULTS

There was generally little difference among the various nitrogen sources in terms of color response as evaluated visually (Table 1). The fertilized plots produced better color than the untreated control, at times significantly better, but differences among fertilized plots were not pronounced. The Windsor sewage sludge produced as good a color response as the other organic N sources, and often as good a response as the inorganic sulfur coated urea.

General appearance of the plots and sensitivity to drought stress, evaluated visually, were not significantly different among any of the plots, either fertilized or unfertilized (Table 2).

Table 1. The effect of various nitrogen sources on the color[z] of a non-irrigated Kentucky bluegrass turf.

	Date of evaluation						
Treatment[y]	29-07	14-08	20-08	14-09	22-09	1-10	14-10
SCU	7.3a	8.8a	9. 5a	9.8a	9. 5a	10.0a	10.0a
CSS	7.0a	9.0a	8.8a	9.0bc	8.5a	9.3ab	9.5ab
Milorganite	8.0a	7.8a	8.8a	9.5ab	8.5a	8.5 b	9.0 b
Canagro	7.8a	7.8a	7.3a	8.0d	8.3a	8.5 b	9.0 b
Control	b.8a	6.3 b	7.8a	8.5cd	9.5a	8.5 b	9.3 b

[y]SCU = sulfur-coated urea, CSS = composted sewage sludge.
[z]Visual evaluation, scale 0 to 10, 10 = darkest green.

Table 2.The effect[z] of various nitrogen sources on the general appearance and drought tolerance[y] in non-irrigated Kentucky bluegrass turf.

	General appearance		Drought tolerance	
Treatment[x]	Date of evaluation			
	18-06	28-08	18-06	30-07
SCU	8.0 a	8.0 a	8. 3 a	9.3 a
CSS	8.5 a	7.8 a	8.0 a	8.8 a
Milorganite	7.8 a	7.8 a	7.8 a	8.5 a
Canagro	6.3 a	7.0 a	7.5 a	7.8 a
Control	7.0 a	8.0 a	7.0 a	9.0 a

[x]SCU = sulfur-coated urea, CSS = composted sewage sludge.
[y]Visual evaluation, scale 0 to 10, 10 = no drought stress, 5 = 25% of turf showing some drought stress.
[z]Visual evaluation, scale 0 to 10, 10 = perfect turf, b acceptable turf.

Table 3. The effect of various nitrogen sources on the pH of the thatch layer in non-irrigated Kentucky bluegrass turf.

Treatment[z]	Date of evaluation	
	4-09[y]	6-10[x]
CSS	7.16a	6.56ab
Control	6.94a	6.78a
Canagro	6.87a	6.42 b
Milorganite	6.87a	6.49 b
SCU	6.01 b	6.32 b

[x] Mean of 20 readings taken at top of thatch layer with a Lazar PHR-146 microelectrode, thatch having been saturated with distilled water and drained.

[y]Mean of 6 readings taken as in x, but with a standard Ag-Cl electrode (Cole-Parmer 5992-20).

[z]SCU = sulfur-coated urea, CSS = composted sewage sludge.

USE OF SEWAGE SLUDGE AS A TURF FERTILIZER - HIGH MAINTENANCE LAWN TURF

J. L. Eggens and K. Carey

Department of Horticultural Science

The objective of this research was to determine the suitability of Windsor composted sewage sludge, produced by the Beltsville aerated pile method, as a general turf fertilizer on high maintenance lawn turf. The Windsor sewage sludge was compared to other nitrogen sources. Also of interpst was a comparison of various N sources on thatch buildup and breakdown. Several chemical and mechanical thatch control/reduction treatments were included as cross treatments.

RESEARCH PROCEDURE

A 20 x 18 m plot was established at the Cambridge Research Station in a mature Kentucky bluegrass-creeping bentgrass turf mowed at 3 cm with regular irrigation to prevent drought stress. Ten main effect plots (2 x 18 m) received the four nitrogen treatments (sulfur-coated urea, Milorganite 6-2-0, Canagro 12-6-6, and Windsor composted sewage sludge), replicated two times each in a randomized complete block design. Nitrogen was applied 5 times (15-06, 27-07, 6-08, 3-09, and 25-09) at 100 kg N ha^{-1} for a total of 500 ky N ha

Four cross effects plots (2 x 20 m) received chemical thatch control treatments as follows: a single treatment of lime (Canagro granulated limestone, 10 kg are^{-1}); a repeated treatment of lime (3 x 10 kg are^{-1}); a repeated treatment of Ringer LawnRestore (3 x 5 kg are^{-1}); or a single treatment of Bov-A-Mura (1.25 L are^{-1}). Other cross effects plots will receive no treatment or mechanical thatch control treatments.

RESULTS

There was little evidence of difference among the four nitrogen sources in effect on turf color (Table 1). A lower color rating for the Windsor sludge treated plots in July disappeared in later evaluations.

Evaluation has not yet begun on thatch characteristics of the various treatments. Some differences are evident in the acidity of the thatch layer, which may affect thatch buildup and decomposition (Table 2), with the inorganic nitrogen source resulting in the lowest pH, as might be expected.

Table 1. The effect of various nitrogen sources on the color[z] of a high maintenance Kentucky bluegrass turf.

	Date of evaluation				
Treatment[y]	21-07	14-08	31-08	6-10	14-10
Milorganite	8.5a	8. 5a	8. 0a	9. 0a	9. 0a
SCU	8.0ab	7.5a	9.5a	9.5a	9.5a
Canagro	7.0 b	5.5a	8.0a	8.0a	7.5a
CSS	5.5 c	8.0a	8.5a	9.5a	9.5a

[y]SCU = sulfur-coated urea, CSS = composted sewage sludge.
[z]Visual evaluation, scale 0 to 10, 10 = darkest green.

Table 2. The effect of various nitrogen sources on the pH of the thatch layer in a high maintenance Kentucky bluegrass turf.

	Date of evaluation	
Treatment [z]	3-09[y]	22-09[x]
CSS	6.73a	5.99a
Canagro	6.56a	5.47a
Milorganite	6.46a	5.81a
SCU	5.66 b	5.88a

[z]SCU = sulfur-coated urea, CSS = composted sewage sludge.
[y]Mean of 6 readings taken at top of thatch layer with a standard AgCl electrode (Cole-Parmer 5992-20), thatch having been saturated with distilled water and drained.
[x]Mean of 10 readings taken as in Y, but with a Lazar PHR-146 microelectrode.

USE OF SEWAGE SLUDGE AS A TURF FERTILIZER - BENTGRASS PUTTING GREEN TURF

J. L. Eggens and K. Carey

Department of Horticultural Science

The objective of this research was to determine the suitability of Windsor composted sewage sludge, produced by the Beltsville aerated pile method, as a general turf fertilizer on bentgrass putting green turf. The Windsor sewage sludge was compared to other nitrogen sources. Also of interest was a comparison of various N sources on thatch buildup and breakdown. Several chemical and mechanical thatch control/reduction treatments were included as cross treatments.

RESEARCH PROCEDURE

A 20 x 20 m plot was established at the Cambridge Research Station in a mature creeping bentgrass-annual bluegrass turf mowed at 5 mm (clippings removed) and maintained as a putting green turf.

Twenty main effect plots (1 x 20 m) received no treatment or one of the four nitrogen treatments (sulfur-coated urea, Miloryanite 6-2-0, Canagro 12-6-6, and Windsor composted sewage sludge), replicated four times each in a randomized complete block design. Nitrogen was applied 5 t1mes (11-06, 22-07, 10-08, 4_Y9, and 30-09) at 100 kg N ha- for a total of 500 kg N ha- .

Three cross effects plots (2 x 20 m) received chemical thatch control treatments as follows: a repeated treatment of Ringer LawnRestore (3 x 5 kg are 1: 27-07, 4-09, 30-09 a repeated treatment of Kelp-Mate kelp meal (3 x 5 kg are- 27-07, 4:Y9, 30-09); or a single treatment of Bov-A-Mura (1.25 1 are : 9-09). A fourth cross effect plot recelved a single treatment of Ferromec acid iron (190 ml are : 9-09). A fifth and sixth cross effects plot received repeated treatments of artificial wear simulated by a 2) weighted roller covered with golf shoe studs (I per in pulled behind a turf tractor. Heavy wear was applied in one plot until compaction and abrasion damage appeared and was maintained in the turf; the other plot received light wear (one half the number of passes in the heavy wear plot).

RESULTS

There were significant differences among the main

treatments in their effects on the color of the turf (Table 1). In general, the inorganic N source (SCU) produced the darkest color. The Windsor sludge produced as dark a color as SCU on 7 of the 11 evaluation dates, but in general there was no significant difference among the three organic N sources. All fertilized plots were significantly darker than the control except for 2 dates. Differences in color were not reflected in growth, as clipping weights did not differ significantly among the fertilized plots, though all were significantly heavier than the control (Table 3).

There were also differences among the main treatments in their sensitivity to various stresses. The initial response to simulated wear separated the 2 sewage sludge sources (Windsor and Milorganite), which were less damaged, from the other three treatments (Table 2). These differences disappeared by the third evaluation date, and the long-term sensitivity to wear remains to be determined. Differences also were evident following the mowing for clipping weight, with mowing damage worse in the treatments with higher growth rates (Table 4). All fertilized treatments were equally resistant to damage from two overseeding treatments, and to a dollar spot infestation (Table 4).

There were effects of the main treatments on the acidity of the thatch layer (Table 5), but the long term effects on thatch buildup and decomposition remains to be determined.

Table 1. The effect of various nitrogen sources on the color[z] of creeping bentgrass turf maintained as a putting green.

	Date of evaluation					
Treatment[y]	15-06	21-07	29-07	14-08	24-08	31-08
SCU	7.3 b	9.0 a	9.0 a	8.5 a	10.0 a	9.3a
CSS	7.5 b	8.3 ab	9.3 a	9.0 a	9.0 ab	8.3 b
Milorganite	3.5 c	8.3 ab	8.0 ab	7.8 ab	8.5 b	7.8 b
Canagro	9.0 a	7.8 b	8.0 ab	6.8 b	8.3 b	8.3 b
Control	3.3 c	6.5 c	6.5 b	5.0 c	5.0 c	5.5 c

Table 1, continued.

	Date of evaluation				
Treatment[y]	4-09	14-09	22-09	29-09	15-10
SCU	9.8a	9.0a	10.0a	9.8a	9.5a
CSS	7.8 b	9.0a	9.5ab	8.3 b	9.5a
Milorganite	7.8 b	9.0a	9.5ab	9.8a	8.3 b
Canagro	7.8 b	6.8 b	8.8 b	8.5 b	8.3 b
Control	6.0 c	8.8a	7.8 c	6.8 c	5.5 c

[y]SCU = sulfur-coated urea, CSS = composted sewage sludge.
[z]Visual evaluation, scale 0 to 10, 10 = darkest green.

Table 2. Wear damage[z] from simulated wear in creeping bentgrass turf maintained as a putting green.

	Date of evaluation		
Treatment[y]	14-08	19-08	24-08
Canagro	4.3a	3.0a	2.3a
SCU	3.3ab	2.3a	2.8a
Control	2.5 b	1.5ab	1.0a
CSS	0.8 c	0.5 b	0.0a
Milorganite	0.0 c	0.3 b	0.3a

[y]SCU = sulfur-coated urea, CSS = composted sewage sludge
[z]Visual evaluation, scale 0 to 5, 5 = worst damage, 0 = no damage.

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Table 3. Clipping weight[z] sampled from creeping bentgrass turf maintained as a putting green.

Treatment[y]	
Canagro	201.45a
CSS	174. 36a
Milorganite	173.88a
SCU	161.64a
Control	96.12 b

[y]SCU = sulfur-coated urea, CSS = composted sewage sludge.
[z]Plots left unmowed for 5 days, then mowed at 3 mm. Clippings represent gm dry weight (7 days at 50°C) from 4 m^2.

Table 4. Sensitivity to various stresses in creeping bentgrass turf maintained as a putting green.

Treatment[z]	Mowing damage[y]		Overseeding damage[x]		Dollar spot[w]
	A	B	C	D	
Canagro	3.8a	3.8a	0.8 b	0.0 b	0.0 b
Milorganite	2.3 b	1.5 b	0.3 b	0.0 b	0.8 b
SCU	2.0 b	1.3 b	0.5 b	0.0 b	0.0 b
CSS	1.8 b	1.0 b	0.5 b	0.0 b	1.0 b
Control	0.3 c	0.0 b	3.0a	1.0a	40.5a

[w]Mean number of lesions per 20 m2.
[x]Visual evaluation, scale 0 to 5, 0 = no damage, 5 = worst damage. C = overseeded with slit/disc overseeder, D = overseeded with Multi-core aerater (" hollow tines).
[y]Visual evaluation, scale 0 to 5, 0 = no damage, 5 = worst damage. A = damage in clipping weight turf, B damage in rest of turf, mowed at 3 mm after 5 days unmowed.
[z]SCU = sulfur-coated urea, CSS = composted sewage sludge.

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Table 5. Acidity of thatch in creeping bentgrass turf maintained as a putting green.

	Date of evaluation		
Treatment[z]	1-09[y]	22-09[x]	15-10[x]
Control	6.81a	5. 7 4a	7.41a
Canagro	6.85a	5.74a	7.43a
Milorganite	6.82a	5.76a	7.21 b
SCU	6.96a	6.04a	6.77 c
CSS	6.40 b	5.81a	7.27 b

[x]Mean of 20 readings taken at top of thatch layer with a Lazar PHR-146 microelectrode, thatch having been saturated with distilled water and drained.

[y]Mean of 6 readings taken as in X, but with a standard Ag-Cl electrode (Cole-Parmer 5992-20).

[z]SCU = sulfur-coated urea, CSS = composted sewage sludge.

Use of natural zeolites in sand rootzones for putting greens

Paul Voroney and Virginia Marcille, Dept. of Land Resource Science, Univ. of Guelph.

Background. The selection of the most appropriate rootzone mix is a critical decision that affects the long-term performance of a putting green in terms of surface quality, ease of turfgrass establishment and culture, and in maintenance cost. The USGA Green Section Method of putting green construction, which is based on extensive research and is widely used, combines a perched water table with a high sand content rootzone. While soil stress problems related to compaction and excess water are prevented by construction of a sand only or sand plus organic material (usually peat) rootzone, the resultant rootzone does have: (i) limited cation exchange capacity which results in low nutrient retention and reserve, (ii) poor pH buffering capacity, and (iii) low and non-uniform water-retention characteristics.

Natural zeolite minerals offer an alternative in putting green construction having the desirable physical properties associated with sand and the favorable chemical properties associated with clay and organic matter. They have an extremely high, effective cation exchange capacity, commonly ranging from 200 to 400 cmol (+) kg^{-1} and can be prepared, by crushing and sieving, as sand-sized particles. Zeolites have a high specific affinity for NH4+ and K+ which enhances their effectiveness for reducing the amounts of these nutrients lost by leaching and volatilization. The direct benefits of this are two-fold: first, fertilizer costs are reduced and second, groundwater contamination is reduced.

The goals of this research are to develop a rootzone mix for turfgrass on putting greens, using natural zeolite as an amendment, which has: (i) a high fertilizer-use efficiency, (ii) improved turfgrass establishment, growth and quality, (iii) efficient long-term maintenance, and (iv) improved water retention characteristics.

Experiment 1. The growth of creeping bentgrass on three different sands was studied with and without amendments of 5, 10 and 20% zeolite, peat and/or fine vermiculite. The sands were selected based on their grain-size distribution (conforming to USGA specifications), pH, carbonate content and

their availability (Table 1).

Table 1. Properties of rootzone material

Material	Source	pH ($CaCl_2$)	Major minerals	Carbonates %
Sand				
	Bloomingdale	7.71	quartz, calcite, dolomite feldspar, amphibole	34.3
	Huntsville	6.03	quartz, feldspar, mica	0
	Quebec	5.98	quartz	0
Vermiculite		7.5		
Peat Humus		5.0		
Zeolite (clinoptilolite)	Teaque Minerals-USA	>7		

Results:

1. Germination was most rapid and extensive on Quebec sand alone and amended with zeolite and/or peat possibly due to better water retention.

2. Growth for the next 6 weeks, in terms of plant density and uniformity of stand, texture and colour was best in the Bloomingdale sand amended with zeolite and/or vermiculite and/or peat. Growth on the Huntsville sand was slightly improved by addition of peat and/or vermiculite. Growth was poorest on the Quebec sand, however amendment with zeolite did increase plant density.

3. Addition of zeolite increased the quality of the grass grown on the Bloomingdale and Huntsville sands with respect to colour and texture.

4. Algal growth was first evident by week 6-7 on the Huntsville sand but soon became most extensive in the Bloomingdale sand with and without amendments. This was due possibly to greater nutrient and water retention in the surface sand. Zeolite appeared to promote algal growth to a greater extent then the other amendments.

The algal infection made it difficult to interpret further treatmenteffects.

Experiment 2. The Bloomingdale and Huntsville sands from the first experiment were used to study further the effect of amendments with peat and zeolite (20% by volume). Three parameters were studied: (i) establishment of bentgrass, (ii) competition with annual bluegrass, and (iii) tolerance to moisture stress.

Results:

1. Initially growth was better on the Huntsville sand, however after 5 weeks the grass was better on the Bloomingdale sand.

2. Amendment with peat and zeolite increased the rate of establishment of bentgrass and its subsequent growth. However, this did not seem to make bentgrass more competitive to bluegrass establishment.

3. Sands amended with peat and zeolite were more tolerant to moisture stress (watering once per week vs three times per week). Growth as measured by number of tillers, quality of grass and plant biomass productivity was significantly higher.

4. While peat and zeolite both resulted in increased growth, uniformity of stand was considerably less on the peat mixtures.

This is due to the difficulty in mixing peat uniformly with sand. Summary:

Addition of peat and/or zeolite to sand rootzones enhanced growth of bentgrass and made the grass more tolerant to moisture stress. The benefit derived from the zeolite amendment was more consistent than that from peat.

Future research

Lysimeters, 10 cm diameter X 50 cm length, will be set up in the greenhouse to study the potential use of zeolites and peat to increase nutrient retention in the rootzone. Rootzones will be constructed according to USGA standards using the Bloomingdale and Huntsville sands. The surface 7.5 cm will be amended with either zeolite or peat. Potassium and ammonium leaching as well as bentgrass growth will be monitored over a 6-month period.

Perennial Ryegrass Seed Production

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Introduction

In recent years Canadian imports of perennial ryegrass seed have increased to almost 900,000 kg. per year. Ryegrass seed production could be a profitable crop to some farmers in Ontario. However, there is no information on production techniques for high seed yields of perennial ryegrass under the Ontario climate. Therefore a series of experiments were conducted to determine factors such as rate of nitrogen, planting density, row width, etc. in perennial ryegrass seed production.

Methods

For all three of the following experiments the methods are standard (with exceptions noted). Perennial ryegrass cv. Fiesta was planted July 1986 at a seeding rate of 2 kg/ha (except for seeding rate experiment) at the Elora Research Station. Harvested plot size was 1.5m by 6m. All plots received 460 kg/ha of 0-20-20 and, with the exception of the nitrogen study, 50 kg N/ha in the fall of 1986 and 50 kg N/ha in the spring of 1987. During the growing season notes on lodging, plant height and growth stages were recorded. One half meter samples were taken from each plot just prior to harvest to determine seed yield components. The plots were harvested from July 10 to July 21, 1987 and yields were calculated at 9% seed moisture content.

Rate and Time of Nitrogen

The experiment was arranged in a split plot design, the main plot being 4 rates of nitrogen (0, 30, 60, 90 kg/ha) applied in the fall, and the subplot, the same 4 rates of nitrogen applied in the spring.

Resul ts

Although there appears to be yield increases up to 90 kg/ha nitrogen, there were no significant differences between nitrogen levels of 30, 60, and 90 kg/ha (Table 1). This may be due to the already high levels of nitrogen in the soil at the Elora Research Station. This experiment will be repeated in the same plots in 1988 as well as on a new stand of perennial ryegrass established in 1987.

Table 1. Yields of Perennial Ryegrass in response to levels of Nitrogen.

	Seed Yield	
Nitrogen kg/ha	Fall Application kg/ha	Spring Application kg/ha
0	915	910
30	1005	1039
60	1033	1070
90	1186	1120
	LSD = 213	LSD = 172
	CV = 13%	CV = 10%

Row Width and Seeding Rate

To facilitate planting, this experiment was set up in a split block design. The main blocks were 4 row widths of 7, 14, 21 and 28 inches and the seeding rates of 1, 2 and 4 kg/ha were randomized within these blocks.

Results

The 7 and 14 inch rows gave the highest seed yield (Table 2). Seed yield appeared to increase as seeding density increased although the yields for 2 and 4 kg/ha are not significantly different (Table 3).

Table 2. Yields of Perennial Ryegrass in response to different Row Widths.

Row width cm.	Seed Yield kg/ha
17.8	861
25.6	892
53.4	720
71.6	683
	LSD = 163
	CV = 18%

Table 3. Yields of Perennial Ryegrass in response to Rate of Seeding.

Seeding rate kg/ha	Seed Yield kg/ha
1	694
2	817
4	LSD = 176
	CV = 13

Time and Rate of Fungicide Application

The foliar fungicides, Bayleton and Tilt, were applied at rates of 0.125 and 0.250 kg ai/ha at growth stages of pre stem elongation, boot and both (ie 2 applications). Percent rust on head and upper stem was recorded on 20 tillers per plot:

Due to the possibility of fungicide drift on the control plots, border plots away from the experiment were also included in the results.

Results

The control plot yielded as high as the fungicide sprayed plots which may have been due to fungicide drift and reduced disease pressure within the experiment (Table 4). When compared to border plots which had higher disease percentage a significant seed yield increase is noted in the fungicide treated plots. While early application of Bayleton and late application of Tilt have higher seed yields then the other fungicide treatments, there were no significant differences.

Table 4. Seed Yields of Perennial Ryegrass in response to Fungicides.

Fungicide	Application Time	Application Rate	Seed Yield	Rust
	Growth Stage	g a.i./ha	kg/ha	%
Control			1620	3.85
(Border)			(1182)	10.00
Bayleton	pre stem elongation	125	1576	1.96
		250	1502	2.49
	pre stem elongation + boot	125+250	1514	1.90
		250+250	1581	1.19
	boot	125	1495	2.29
		250	1460	2.65
Tilt	pre stem elongation	125	1574	2.04
		250	1489	1.46
	pre stem elongation + boot	125+125	1574	1.85
		250+250	1598	2.20
	boot	125	1539	2.05
		250	1626	2.13
			LSD = 169	
			CV = 8%	

Conclusion

The data seems to show that higher nitrogen rates, narrower row widths, higher seeding density and fungicide application result in higher seed yields of perennial ryegrass seed. However the experiments have been conducted for only one year and therefore need to be repeated before drawing final conclusions.

AN EVALUATION OF THE EFFECT OF SIDEWALK DE-ICERS ON TURFGRASS

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Department of Land Resource Science

OBJECTIVES

To determine the effects of Domtar salt based sidewalk de-icing chemicals on survival and growth of turfgrass and on those soil properties which are likely to affect the growth of plants.

RESEARCH PROCEDURE

In one experiment a number of different chemical compounds were applied at three rates to the surface of Kentucky bluegrass sod in the greenhouse and the effect on survival and growth of the bluegrass was measured. In a second experiment the same compounds were applied to soil in the greenhouse which was then sodded and the survival and growth of the bluegrass was monitored. In a third experiment these compounds were applied to the surface of soil columns and leached with water followed by chemical analysis of the soil and of the leachate.

RESULTS

Several compounds have resulted in considerably less damage to Kentucky bluegrass than sodium chloride. Tests will be carried out on Kentucky bluegrass under winter conditions in the field.

Project funded by the Sifto Salt Division of Domtar

EFFECTS OF SITE PREPARATION INTENSITY AND TIMING ON TURF RENOVATION BY SODDING

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Department of Horticultural Science

The objective of this research is to evaluate the success of turf renovation by sodding on plots in which the turf has been killed and various intensities of site preparation employed. The effects of timing are also being evaluated.

RESEARCH PROCEDURE

Research plots representing three sodding times (mid-summer, fall, and spring) have been or will be established in high maintenance mixed lawn turf at the Cambridge Research Station. Within each 3 x 18 m plot the turf is killed with glyphosate, and 10 to 20 days after application, resodded with commercial Kentucky bluegrass sod after various site preparation treatments.

The site preparation treatments, on 1 x 3 m subplots randomized and replicated within the main plot, represent a range from low to high intensity. These include 1. no site preparation - resodding over killed turf; 2. close mowing of killed turf, addition of 3 mm of topsoil, and resodding; 3. close mowing, vertical mowing (5 cm depth) to open up turf, and resodding; 4. close mowing, light rototill (8 cm depth), levelling and resodding; and 5. stripping of killed turf with a sod cutter and resodding over bare soil.

Evaluation of the treatments includes the degree of stress/dedth and speed of recovery of new sod, relative knitting of sod, differences in summer and winter stress responses among treatments, and the fate of killed turf debris incorporated under low and medium intensity site preparation.

RESULTS

At the time of preparation of this report, the mid-summer plot (August 11) has been established and evaluation is proceeding, and the fall plot has been resodded (October 20). Preliminary evaluations indicate that the higher intensity site preparations result in significantly less stress/depth and more rapid recovery in new sod. Differences among all but the lowest intensity

treatment had disappeared by 17 days after resodding, and among all treatments by 50 days after resodding. Under high maintenance conditions, even mid-summer sodding over lower intensity site preparation may result in acceptable medium term results (see Table 1). The relative long term success (over winter) remains to be determined.

Table 1. Relative recovery (percent of turf not dead or stressed) of Kentucky bluegrass sod over various intensities of site preparation.

Resodded over	Days after resodding				
	7	13	17	34	50
Killed sod (no preparation)	5a	15a	40a	70a	100a
Close mowed killed sod + 3 mm topsoil	47b	60b	82b	97b	100a
Close mowed killed sod, vertical mowed to 5 cm	60b	67bc	87b	97b	100a
Close mowed killed sod, rototilled to 8 cm and levelled	87c	85cd	92b	100b	100a
Bare soil (killed sod stripped with sodcutter)	100c	97d	100b	100b	100a

SELECTION OF INDIGENOUS FUNGI FOR CONTROLLING DANDELIONS IN TURFGRASS SWARDS

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Department of Environmental Biology

Due to recent toxicological concerns, the continued widespread use of 2,4-D, and related herbicides may be in doubt. Therefore, studies were initiated to assess the potential use of indigenous fungi as biological agents to control dandelions in turfgrass swards.

METHODS

Controlled Environment Studies

Leaves excised from 8 week old dandelions grown in controlled environment were inoculated with 6 mm diameter discs of PDA medium infested with isolates of plant pathogenic fungi. The inoculated leaves were incubated at 22°C in 100% relative humidity. The aggressiveness of an isolate was determined by measuring lesion size at 23, 42, 56, and 69 hours post inoculation. The relative aggressiveness of 59 isolates was determined by dividing the mean size of lesions produced by each isoalte by the mean size of lesions produced by isolate number 30.

Field Studies

The dandelion control potential of isolate 30 was evaluated on four 1 m2 swards of dandelion-infested turfgrass. Applications of 100 g/m^2 of heat-killed perennial ryegrass seed infested with isolate 30 were repeated at 3 week intervals. Dandelion plant counts were taken in treated areas and in untreated areas immediately before each application. Mean % survival of dandelion plants was calculated.

RESULTS

Controlled Environment Studies

Fifty-nine isolates were observed to be pathogenic on dandelion. Aggressiveness (relative to that of isolate 30) varied among the isolates tested (Figure 1).

Field Studies

Applications of inoculum of isolate 30 (100 g/m^2) significantly reduced the population of dandelions in turfgrass swards (Figure 2). Surviving dandelions in the treated areas had smaller and fewer leaves than in the untreated areas. Isolate 30 had no visible effect on turfgrass during the course of the study.

Figure 1. Relative virulence of 59 fungus isolates on dandelion expressed in comparison to isolate 30 (value of 1.0).

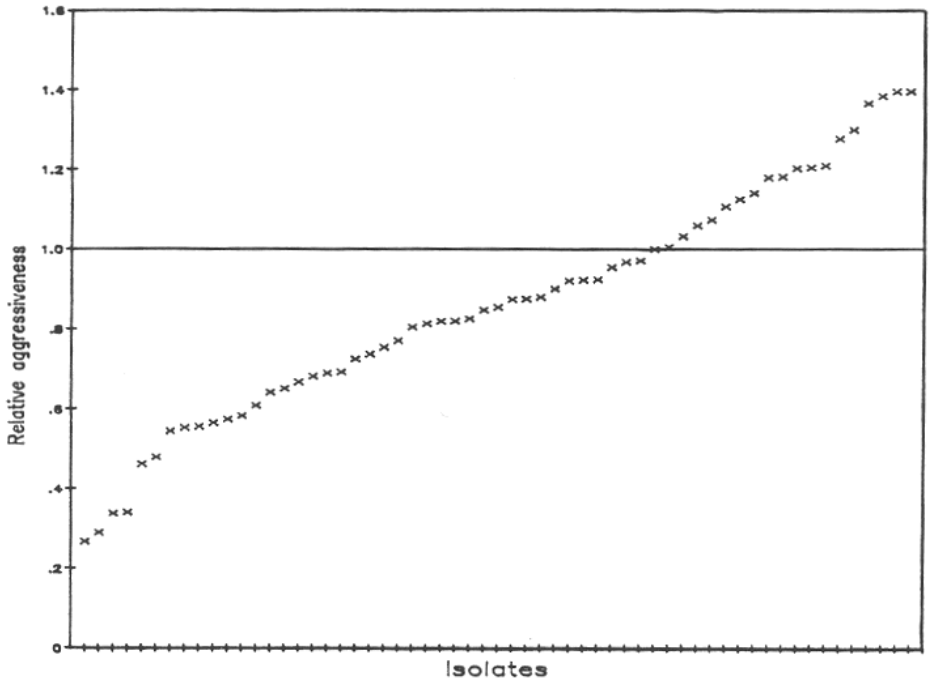
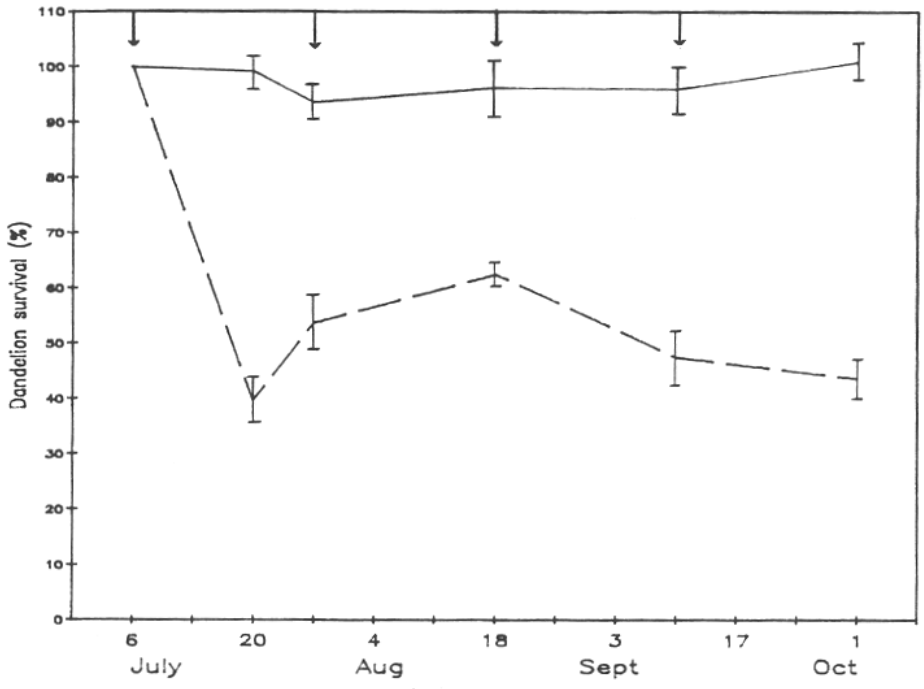


Figure 2. Survival of dandelions in a turgrass sward following repeated application of fungal isolate 30. (-) untreated ------ treated with isolate 30. Arrows indicate treatment dates.



CONCLUSIONS

1. Virulence on detached dandelion leaves varied among 59 pathogenic isolates of fungi.

2. Repeated applications of inoculum of a moderately virulent fungus isolate significantly reduced the population of dandelions in a turf sward.

Summary of Field Research on the Efficacy of Herbicides and Plant Growth Regulators Used on Turfgrass in Ontario

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Preemergence control of crabgrass. Bensulide, chlorthal-dimethyl, EXP4233, ethalfluralin, Mon-15126, Mon-15172, pendimethalin, oxidiazon, and trifluralin (EC) gave excellent control of crabgrass for 2 to 3 months after treatment, but caused moderate injury to K. bluegrass. AC-263499 suppressed crabgrass for two months after treatment. Severe injury occurred to K. bluegrass with trifluralin 5G and AC-263499. The turf was under extreme drought and heat stress during the summer and this may have contributed to the injury by the herbicides. In other experiments in 1986 and 1987, the same herbicides caused no injury to turf that was irrigated.

Postemergence control of crabgrass. Mon-15126 provided excellent control of 1 to 3 leaf and multi-tillered crabgrass grown in a pure stand (no turf), whereas AC-263499 did not provide satisfactory control of crabgrass at either growth stage. In K. bluegrass swards, both AC-263499 and Mon-15126 gave excellent control of multi-tillered crabgrass, but no control of 1 to 3 leaf crabgrass. Crabgrass control was poor at the 1 to 3 leaf stage because of seedling emergence after treatment. K. bluegrass was injured by both herbicides at the early growth stage of crabgrass but not at the late growth stage. At the early growth stage of crabgrass the turf was under extreme heat and drought stress. Neither AC-263499 nor Mon-15126 caused injury to K. bluegrass that was irrigated at regular intervals.

Two formulations of fenoxaprop-ethyl, Hoe 46360 (0.095, 0.105, and 0.125 kg/ha) and Hoe 33171 (0.20 and 0.250 kg/ha) provided excellent control of 2 to 3 leaf crabgrass up to 28 days after treatment. In some cases, control was reduced after 28 days because of new seedling emergence. At the 1 to 3 tiller stage of crabgrass, both formulations of fenoxaprop-ethyl, provided excellent long term control. Generally, both formulations provided excellent long term control of multi-tillered crabgrass. In those cases where long term control was not adequate, regrowth occurred from plants that were shielded from the herbicide spray. The addition of clopyralid, liquid fertiliser, paclobutrazol, or DPX M6316 did not reduce the efficacy of fenoxaprop-ethyl. In these experiments, no injury occurred to K. bluegrass with either formulation of fenoxaprop-ethyl. Excellent control of green foxtail, barnyardgrass, and witch grass also was achieved with both formulations of fenoxaprop-ethyl.

Phytotoxicity of fenoxaprop-ethyl to various turf species. Perennial ryegrass (Palmer and Yorktown II) and fescue (Victory and Banner) were not injured by the fenoxaprop-ethyl. Injury was moderate with complete recovery when both formulations of fenoxaprop-ethyl were applied to newly established (one or less years old) K. bluegrass swards (Baron, Sydsport, Adelphi, Regent). Unacceptable injury occurred to all bentgrass varieties tested. The Hoe 46360 formulation was less phytotoxic than the Hoe 33171 formulation.

Selective control of annual bluegrass in K. bluegrass. At doses of 1 to kg/ha, linuron significantly reduced the populations of annual bluegrass

infesting stands of K. bluegrass. In some but not all cases, linuron caused slight yellowing and tip burn of K. bluegrass but the turf recovered in 3 to 4 weeks.

Selective control of bentgrass in K. bluegrass. Sethoxydim at 0.1 to 0.3 kg/ha significantly reduced bentgrass infestations in K. bluegrass. Although all doses of the herbicide injured K. bluegrass, the turf recovered one month after treatment. Clethodim caused severe injury to K. bluegrass at 0.05 to 0.15 kg/ha. However, there was no stand reduction and the K. bluegrass recovered one month after treatment. The bentgrass infestations were reduced by more than 80% with the 0.10 and 0.15 kg/ha doses of clethodim.

Alternatives to 2,4-D. Excellent control of dandelion and clover was achieved with MCPA (1.25 kg/ha), chlorflurenol (0.28). dicamba (0.14), MCPP (1.25), clopyralid (0.14), S-1092, S-2150, S-2149, S-1858, INT-86061, INT86062, INT-86063, INT-86064, INT-86065, INT-86066, INT-87067, INT-87068, INT-87069, INT-87070, MCPA + dicamba (1.25 + 0.14), MCPA + MCPP + dicamba (1.25 + 0.63 + 0.14), clopyralid + triclopyr (0.14 + 0.28), clopyralid + triclopyr + dicamba (0.14 + 0.28 + 0.14), clopyralid + triclopyr + chlorflurenol (0.14 + 0.28 + 0.14), and triclopyr + dicamba + chlorflurenol (0.14 + 0.14 + 0.28).

Plant growth regulator use on bentgrass and Kentucky bluegrass. The plant growth regulators paclobutrazol and XE-1019 did not suppress seedhead development of bentgrass and Kentucky bluegrass, but significantly reduced growth of both species. EPTC reduced turf growth and seedhead development of both species. Maleic hydrazide and chlorflurenol did not suppress growth, but they did reduce seedhead development. Paclobutrazol on fertilizer reduced the growth of K. bluegrass but not the growth of bentgrass. Tank mixing paclobutrazol or XE-1019 with EPTC, maleic hydrazide, or chlorflurenol significantly reduced the growth and seedhead development of both species. These tank mixes caused severe yellowing of the turf for several weeks after application.

Plant growth regulator use on annual bluegrass. Maleic hydrazide and EPTC gave excellent short term growth reduction of annual bluegrass. Paclobutrazol and XE-1019 gave long term suppression of growth and reduced the density of annual bluegrass stands. Tank mixing paclobutrazol or XE1019 with chlorflurenol, EPTC, or maleic hydrazide reduced growth and stand density to a greater extent than paclobutrazol or XE-1019 applied alone.

Preemergence control of crabgrass grown in monoculture. Hall, J.C. and K. Christensen. Experiment location - Cambridge Research Station; Crop - Crabgrass; Variety - *Digitaria ischaemum*; Soil type - Sandy loam; Planting date - 870510; Plot size- 1 x 2 m; Experimental design - randomized complete block; Replicates - 4; AT APPLICATION: Date and method - 870513-PRE, 40 day split/5 kg/ha (TMT 16) 870622; Equipment - bicycle sprayer, granular applicator; Volume - 700 L/ha; Pressure - 200 kPa; Tips - SS8002LP; Date of assessment- % of plot infested with crabgrass; (T1) 870520, (Ti) 870527, (T3) 870603, (T4) 870610, (T5) 870617, (T6) 870624, (T7) 870701, (T8) 870706, (T9) 870709, (T10) 870720, (T11) 870729, (T12) 870805, (T13) 870812.

# TREATMENT	DOSE	INFESTATION (% OF PLOT)												
	kg/ha	T1	T2	T3	T4	T5	TS	T7	T8	T9	T10	T11	T12	T13
1 Control		0	15	44	60	63	63	63	100	100	100	100	100	100
2 Mon-15126 3 EC	0.28	0	4	19	11	11	10	10	20	20	35	50	64	69
3 Mon-15126 3 EC	0.42	0	0	2	4	6	16	4	9	9	24	29	30	35
4 Mon-15126 3 EC	0.56	0	0	2	4	6	6	5	15	15	29	34	35	35
5 Mon-15126 3 EC	0.84	0	0	24	4	4	3	3	3	4	4	5	14	15
6 Mon-15126 3 EC	1.12	0	0	0	1	1	1	1	0	0	0	a	0	0
7 Mon-15172 0.5G	0.28	0	5	9	18	21	21	26	38	38	58	65	73	75
8 Mon-15172 0.5G	0.42	0	0	2	2	3	3	3	14	14	23	15	20	24
9 Mon-15172 0.5G	0.56	0	0	0	3	4	3	3	6	6	6	16	18	18
10 Mon-15172 0.5G	0.84	0	0	1	1	3	3	3	4	4	4	4	4	5
11 Mon-15172 0.5G	1.12	0	0	1	1	1	1	1	1	1	1	1	3	3
12 AC 263499 EC	0.10	0	1	1	4	5	5	9	36	49	71	83	83	88
13 AC 263499 EC	0.15	0	0	0	4	5	4	4	30	30	78	88	100	100
14 AC 263499 EC	0.20	0	0	0	0	1	1	1	8	8	23	33	55	63
15 Chlorthal-dimethyl WP	10.00	0	0	0	0	0	0	0	0	0	0	0	a	1
16 Chlorthal-dimethyl WP	10.00/5 40d	0	a	1	1	1	0	0	0	0	1	1	3	4
17 Chlorthal-dimethyl WP	15.00	a	0	0	0	6	0	1	3	3	3	3	3	3
18 Pendimetholin WC*	1.68	0	1	1	1	3	3	3	6	6	9	19	24	24
19 Pendimethalin TWC*	1.68	0	0	0	0	3	3	3	4	4	4	4	6	6
20 Pendimethalin TF+WC*	1.69	0	1	8	8	a	8	8	13	13	18	40	40	40
21 Pendimethalin TB+HALTS*	1.68	0	0	0	0	3	1	1	4	4	4	4	11	14
22 Bensulide EC*	11.20	0	0	1	3	3	3	3	3	3	3	4	4	4
23 Bensulide EC*	14.00	0	0	1	1	5	1	3	3	3	3	3	3	4
24 Bensulide EC*	16.80	0	0	0	3	4	4	6	3	3	3	3	3	4
25 Control		0	14	30	25	43	43	43	100	100	109	100	100	100

* bensulide-Betason; T14C-turf weedgross control (O.M. Scott); TF-turf fertilizer (O.M. Scott); WC-weedgrass control (O.M. Scott); TB-turf builder (O.M. Scott)

Crabgrass was grown in a pure stand. Excellent long term (three months) crabgrass control was achieved with all doses of bensulide and chlorthal-dimethyl; the two highest doses of Mon-15126 and Mon-15172; pendimethalin (TWC) and pendimethalin (TB+HALTS). Excellent crabgrass control was achieved for 1.5 months with the 0.42 and 0.56 doses of Mon15126 and Mon-15172; all doses of AC 263499; and pendimethalin (WC) and pendimethalin (TF+WC). (Dept. Environ. Biol., Univ. Guelph).

Preemergence control of crabgrass in Kentucky bluegrass. Hall. J.C. and K. Christensen. Experiment location- Cambridge Research Station; Crop- Crabgrass (*Digitaria ischaemum*) and Kentucky bluegrass mixed stand; Soil type- Sandy loam; Planting date- 870515; Plot size- 1 x 2 m; Experimental design- randomized complete block; Replicates- 4; H APPLICATION: Date and method- 870519-PRE, 40 day split/S kg/ha (TMT 16) 870629; Equipment - bicycle sprayer, granular applicator: Volume- 700 L/ha; Pressure 200 kPa: lips- SS8902LP: Date of assessment- % crabgrass suppression; crop injury; (T1) 870603, (T2) 870617. (T3) 870701. (T4) 870812. (TS) 870729, (T6) 870812.

# TREATMENT	DOSE	INJURY AND CRABGRASS SUPPRESSION											
	kg/ha	T1		T2		T3		T4		T5		T6	
		%S	I	%S	I	%S	I	%S	I	%S	I	%S	I
1 Control		100	0	100	0	0	0	0	0	0	0	0	0
2 Mon-15126 3 EC	0.28	100	0	100	2	100	2	100	1	100	1	100	1
3 Mon-15126 3 EC	0.42	100	0	100	3	100	3	100	2	100	1	100	1
4 Mon-15126 3 EC	0.56	100	0	100	4	100	4	100	4	100	4	100	2
5 Mon-15126 3 EC	0.84	100	0	100	3	100	3	100	3	100	3	100	1
6 Mon-15126 3 EC	1.12	100	0	100	5	100	4	95	4	95	4	80	2
7 Mon-15172 0.5G	0.28	100	0	100	3	100	2	62	0	50	0	0	0
8 Mon-15172 0.5G	0.42	100	0	100	1	100	1	100	3	100	3	100	2
9 Mon-15172 0.5G	0.56	100	0	100	2	100	1	100	3	100	3	100	2
10 Mon-15172 0.5G	0.84	100	0	100	3	100	3	100	4	100	4	100	3
11 Mon-15172 0.5G	1.12	100	0	100	4	100	4	100	6	100	6	100	4
12 AC 263499 EC	0.10	100	2	100	8	100	6	87	7	77	4	35	2
13 AC 263499 EC	0.15	100	2	100	7	100	6	82	5	65	5	17	3
14 AC 263499 EC	0.20	100	2	100	9	100	9	90	9	77	9	0	3
15 Chlorthal-dm	10.00	100	1	100	3	100	3	100	4	100	3	100	2
16 Chlorthal-dm	10.00/5	100	0	100	2	100	1	100	3	100	4	100	2
17 Chlorthal-dm	15.00	100	1	100	3	100	2	100	2	100	3	100	2
18 Pendimethalin*	1.68	100	0	100	2	100	1	80	1	70	1	52	0
19 Pendimethalin**	1.68	100	1	100	3	100	3	96	3	90	3	85	3
20 Pendimethalin#	1.68	100	1	100	3	100	2	96	2	95	2	95	1
21 Pendimethalin##	1.68	100	1	100	2	100	2	100	3	100	3	108	2
22 Bensulide EC*	11.20	100	1	100	3	100	3	100	3	100	2	100	1
23 Bensulide EC*	14.00	100	1	100	3	100	3	100	2	100	2	100	1
24 Bensulide EC*	16.80	100	0	100	3	100	2	100	2	100	1	100	0
25 Control		100	0	100	0	100	0	20	0	17	0	0	0

%S-%crabgrass suppression; I-injury 0-10; 10 complete kill of established K. bluegrass;
*bensulide-Betason; *WC- weedgrass control (O.M. Scott); **TWC-turf weedgross control (O.M. Scott);
#TF+WC-turf fertilizer + weedgrass control, ##TB+HALTS-turf builder + halts

All herbicides suppressed crabgrass growth for 1.5 months. However, Mon15126, Mon-15172, chlorthal-dimethyl, all pendimethalin formulations (except pendimethalin WC). and bensulide gave excellent control for 2 months after treatment. When compared to controls all herbicides caused some injury to K. bluegrass. Injury was severe with all doses of AC 263499. and moderate with all doses of Mon-15172 and the three highest doses of Mon-15126. The turf was under severe drought stress during the experiment. (Dept. Environ. Biol., Univ. Guelph).

Use of trifluralin, ethalfluralin, and oxadiazon for the preemergence control of crabgrass grown in monoculture. Hall, J.C. and K. Christensen. Experiment location- Cambridge Research Station; CropCrabgrass; Variety- *Digitoria ischaemum*; Soil type- Sandy loam; Planting date- 870510; Plot size- 1 x 2 m; Experimental design- randomized complete block; Replicates- 4; AT APPLICATION: Date and method870513-PRE; Equipment- bicycle sprayer; granular applicator; Volume- 700 L/ha; Pressure- 200 kPa; Tips- SS8002LP; Date of assessment- % of plot infested with crabgrass; (T1) 870520, (-F2) 8~0527, (T3) 870603, (T4) 870610, (T5) 870617, (T6) 870624, (T7) 870701, (T8) 870706, (T9) 870709, (T10) 870720, (T11) 870729, (T12) 870805, (T13) 870812.

# TREATMENT	DOSE	INFESTATION (% OF PLOT)												
	kg/ha	T1	T2	T3	T4	T5	TS	T7	T8	T9	T10	T11	T12	T13
1 Control		0	8	14	63	78	83	88	100	100	100	100	100	100
2 Trifluralin EC (Treflan)	1.70	0	0	0	1	3	4	4	13	13	23	48	58	60
3 Trifluralin EC (Treflan)	1.95	0	0	1	1	1	3	3	8	8	13	15	25	45
4 Trifluralin EC (Treflan)	2.20	0	0	1	1	5	6	6	18	18	18	33	58	65
5 Trifluralin EC (Rival)	1.70	0	0	0	3	4	4	5	15	15	28	46	56	58
6 Trifluralin EC (Rival)	1.95	0	0	1	1	3	3	3	6	6	6	8	14	16
7 Trifluralin EC (Rival)	2.20	0	0	0	1	6	6	6	13	15	15	31	53	60
8 Trifluralin SG (Treflan)	1.70	0	0	1	1	4	5	6	19	19	26	40	70	70
9 Trifluralin 5G (Treflon)	1.95	0	0	0	0	3	4	4	28	28	30	58	65	78
10 Trifluralin 5G (Treflan)	2.20	0	1	4	8	13	14	18	25	25	38	50	65	70
11 Ethalfluralin OF (Edge)	1.70	0	0	0	0	0	0	0	0	0	4	10	15	15
12 Ethalfluralin OF (Edge)	1.95	0	0	0	0	0	0	0	0	0	8	14	19	24
13 Ethalfluralin OF (Edge)	2.20	0	0	0	0	0	0	0	0	0	8	18	24	16
14 Oxodiazon 2.0% F*	3.00	0	0	0	0	0	1	1	14	14	26	50	73	80
15 Oxadiazon 0.4% F*	2.00	0	0	1	5	5	6	9	35	35	85	100	100	100
16 Oxadiazon 0.6% F*	3.00	0	1	3	6	6	5	9	34	34	40	60	65	73
17 Oxadiazon 0.8% F*	4.00	a	0	1	0	2	3	6	28	28	60	88	90	95
18 Exp 4233 2.2% F*	2.20	0	0	1	6	6	8	15	53	53	90	100	100	100
19 Exp 4233 2.2% F*	4.40	0	0	0	a	1	1	3	13	13	23	48	68	80

* F-Oxodiazon on fertilizer

Crabgrass was grown in a pure stand. All doses of ethalfluralin provided excellent control for 2.5 months. All doses of trifluralin EC and 5G, oxadiazon, as well as Exp 4233 provided excellent control for 1.5 months. Control was extended to 2-month control with 2 % oxadiazon on fertilizer and the highest dose of Exp 4233. Fertilizer doses were not the some for the oxadiazon treatments. (Dept. Environ. Biol., Univ. Guelph).

Use of trifluralin, ethalfluralin and oxadiazon for the preemergence control of crabgrass in Kentucky bluegrass. Hall, J.C. and K. Christensen. Experiment location- Cambridge Research Station; Cropcrabgrass (*Digitaria ischaemum*) and Kentucky bluegrass mixed stand; Soil type- Sandy loam; Planting date- 870515; Plot size- 1 x 2 m; Experimental design- randomized complete block; Replicates- 4; AT APPLICATION: Date and method- 870519-PRE; Equipment- bicycle sprayer; granular applicator; Volume- 700 L/ha; Pressure- 200 kPa; TipsSS8002LP; Date of assessment- % crabgrass suppression, crop injury; (T1) 870603, (T2) 870617, (T3) 870701, (T4) 870715, (T5) 870729, (T6) 870812.

TREATMENT	DOSE	INJURY AND CRABGRASS SUPPRESSION											
	kg/ha	T1		T2		T3		T4		T5		T6	
		%S	I	%S	I	%S	I	%S	I	%S	I	%S	I
1 Control		100	2	57	2	0	0	0	0	0	0	0	0
2 Trifluralin (Treflon) EC	1.70	100	1	100	1	100	3	97	2	95	1	90	0
3 Trifluralin (Treflan) EC	1.95	100	1	100	2	100	3	100	3	96	2	92	2
4 Trifluralin (Treflon) EC	2.20	100	2	100	3	100	4	97	4	94	2	91	1
5 Trifluralin (Rival) EC	1.70	100	2	100	3	100	2	91	2	82	1	75	0
6 Trifluralin (Rival) EC	1.95	100	2	100	2	100	2	99	2	94	1	87	1
7 Trifluralin (Rival) EC	2.20	100	2	100	1	100	4	96	3	90	0	85	1
8 Ethalfluralin OF	1.70	100	2	100	3	100	3	94	3	86	2	74	1
9 Ethalfluralin OF	1.95	100	2	108	3	100	3	92	2	85	1	77	0
10 Ethalfluralin OF	2.20	100	2	100	2	100	4	97	4	95	3	90	2
11 Trifluralin SG	1.70	100	1	100	5	100	9	100	9	97	8	96	6
12 Triflurolin 5G	1.95	100	1	100	3	100	8	100	8	100	8	100	7
13 Trifluralin 5G	2.20	100	1	100	2	100	9	100	8	100	7	100	6
14 Oxodiazon 2.0% F*	3.00	100	1	100	1	100	1	100	3	100	1	97	0
15 Oxodiazon 0.4% F*	2.00	100	0	100	1	100	1	100	2	100	1	87	0
16 Oxadiazon 0.6% F*	3.00	100	0	100	0	100	0	100	2	97	1	89	0
17 Oxodiazon 0.8% F*	4.00	100	0	100	1	100	0	100	2	100	1	97	0
18 Exp 4233 2.2% F*	2.20	100	1	100	2	100	1	95	4	91	2	78	0
19 Exp 4233 2.2% F*	4.40	100	1	100	3	100	1	100	3	97	2	96	0

%S - % crabgrass suppression; I -crop injury 0-10; 10 - complete kill of established Kentucky bluegrass
* F- oxadiazon on fertilizer

Oxadiazon, Exp 4233, ethalfluralin, and all formulations of trifluralin gave excellent suppression of crabgrass for three months. Some turf injury occurred with the EC formulations of trifluralin, ethalfluralin, oxadiazon, and Exp 4233. Severe injury occurred with the granular formulation of trifluralin. It is important to note that the turf was under extreme drought stress for most of the season and this may have increased herbicide injury. In other experiments, on turf that was not under stress the EC formulations of trifluralin did not cause injury to turf. (Dept. Environ. Biol., Univ. Guelph).

Use of AC 263499 and Mon-15126 for the post-emergence control of crabgrass grown in monoculture. Hall, J. C. and K. Christensen. Experiment location- Cambridge Research Station; Crop- Crabgrass; Variety- (*Digitaria ischaemum*); Soil type- sandy loam; Planting date: 870513; Plot size- 1 x 2 m; Experimental design- randomized complete block; Replicates- 4; AT APPLICATION: Date and method- 870610-POST (3 leaf stage); 870729-POST (multi-tiller leaf stage); Equipment- bicycle sprayer; Volume- 700 L/ha; Pressure- 200 kPa; Tips- SS8002LP; Crop stage of growth- 2-3 leaf and multi-tillered leaf stage; Date of assessment- % of plot infested with crabgrass; (T1) 870617, (T2) 870624, (T3) 870701, (T4) 870706, (T5) 870709; (T6) 870720, (W) 870729, (T8) 870805, (T9) 870812, (T10) 870819, (T11) 870826, (T12) 870902.

# TREATMENT AT	DOSE	% CRABGRASS INFESTATION									
2-3 LEAF STAGE	kg/ha	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10
1 Control		100	100	100	100	100	log	100	100	100	100
2 Mon-15126 + Agral 90	0.50 + 0.50%	100	43	20	16	16	16	16	14	16	16
3 Mon-15126 + Agrol 90	0.75 + 0.50%	100	43	13	3	11	11	14	24	39	39
4 Mon-15126 + Agrol 90	1.00 + 0.50%	100	33	13	9	10	10	11	24	29	30
5 Mon-15126 + Agral 90	1.50 + 0.50%	100	35	13	3	4	4	5	5	6	6
6 AC 263499 + Triton X	0.10 + 1.25%	100	60	40	65	95	95	100	100	100	100
7 AC 263499 + Triton X	0.15 + 0.25%	100	48	35	50	90	90	100	100	100	100
8 AC 263499 + Triton X	0.20 + 0.25%	100	38	15	20	70	70	100	100	100	100
9 AC 263499 + Nitrogen 28%	0.10 + 1.25%	100	50	38	43	95	95	100	100	100	100
10 AC 263499 + Nitrogen 28%	1.15 + 1.25%	100	35	15	25	73	73	100	100	100	100
11 AC 263499 + Nitrogen 28%	0.20 + 1.25%	100	45	10	20	70	70	100	100	100	100

# TREATMENT AT MULTI-	DOSE	% CRABGRASS INFESTATION				
TILLER LEAF STAGE	kg/ha	T8	T9	T10	T11	T12
1 Control		100	100	100	100	100
2 Mon-15126 + Agral 90	0.50 + 0.50%	100	85	40	0	0
3 Mon-15126 + Agral 90	0.75 + 0.50%	100	65	38	0	0
4 Mon-15126 + Agral 90	1.00 + 0.50%	100	38	0	0	0
5 Mon-15126 + Agral 90	1.50 + 0.50%	100	95	30	0	0
6 Mon-15126 + Agral 90	0.10 + 0.25%	100	73	85	95	100
7 AC 263499 + Triton X	0.15 + 0.25%	100	83	95	95	100
8 AC 263499 + Triton X	0.20 + 0.25%	100	46	58	100	100
9 AC 263499 + Nitrogen 28%	0.10 + 1.25%	100	70	85	100	100
10 AC 263499 + Nitrogen 28%	0.15 + 1.25%	100	43	63	100	100
11 AC 263499 + Nitrogen 28%	0.20 + 1.25%	100	45	60	100	100

Crabgrass was grown in pure stand. At the multi-tiller leaf stage all doses of Mon-15126 + Agral 90 provided excellent control of crabgrass, whereas no dose of AC 263499 provided adequate crabgrass control. At the 2-3 leaf stage the 1.5 kg/ha dose of Mon-15126 + Agral 90 provided excellent control of crabgrass~- The three lowest doses of Mon-15126 did not provide as good weed control at the 2-3 leaf stage as at the multi-tiller stage because crabgrass seed germinated several weeks after treatment. At the two highest doses, AC 263499 + 28% nitrogen provided some control of crabgrass at the 2-3 leaf stage. (Dept. Environ. Biol., Univ. of Guelph).

Use of AC 263499 and Mon-15126 for the post-emergence control of 2 to 3 leaf crabgrass in Kentucky bluegrass. Hall, J.C. and K. Christensen. Experiment location- Cambridge Research Station; Crop- Crabgrass (*Digitaria ischaemum*) and Kentucky bluegrass mixed stand; Soil type- sandy loam; Planting date: 870515; Plot size- 1 x 2 m; Experimental design- randomized complete block; Replicates- 4; AT APPLICATION: Date and method- 870701-POST; Equipment- bicycle sprayer: Volume- 700 L/ho; Pressure-200 kPa; Tips- SS8002LP; Weed Stage of Growth- 2-3 leaf; Date of assessment- % crabgrass suppression. crop tolerance; (T1) 870701. (T2) 870704. J3) 870708, J4) 870715, J5) 870729, (T6) 870812.

# TREATMENT	DOSE	% CRABGRASS SUPPRESSION											
	kg/ha	T1		T2		T3		T4		T5		T6	
		%S	I	%S	I	%S	I	%S	I	%S	I	%S	I
1 Control		0	0	0	0	0	0	0	0	0	0	0	0
2 Mon-15126 + Agral 90	0.50 + 0.50%	0	0	0	0	40	0	40	4	40	5	40	5
3 Mon-15126 + Agral 90	0.75 + 0.50%	0	0	0	0	0	0	0	4	0	5	0	5
4 Mon-15126 + Agral So	1.00 + 0.50%	0	0	0	0	0	9	0	5	0	6	0	6
5 Mon-15126 + Agral 90	1.50 + 0.50%	0	0	0	0	0	0	0	6	0	6	0	6
6 AC 263499 + Triton X	0.10 + 1.25%	0	0	0	6	0	6	0	7	0	7	0	7
7 AC 263499 + Triton X	0.15 + 0.25%	0	0	0	0	0	0	0	5	0	7	0	7
8 AC 263499 + Triton X	0.20 + 0.25%	0	0	0	0	0	0	0	6	0	7	0	7
9 AC 263499 + Nitrogen 28%	0.10 + 1.25%	0	0	0	0	0	0	0	6	0	8	0	0
10 AC 263499 + Nitrogen 28%	0.15 + 1.25%	0	0	0	0	0	0	0	6	0	7	0	7
11 AC 263499 + Nitrogen 28%	0.20 + 1.25%	0	0	0	0	0	0	0	7	0	8	0	8

%S - % crabgrass suppression; I - injury 0-10; 10 - complete kill to established Kentucky bluegrass

Use of AC 263499 and Mon-15126 for the post-emergence control of multi-tillered crabgrass in Kentucky bluegrass. Hall. J.C. and K. Christensen. Experiment location- Cambridge Research Station; Crop-Crabgrass (*Digitaria ischaemum*) and Kentucky bluegrass mixed stand; Soil type- sandy loam; Planting date870515; Plot size- 1 x 2 m; Experimental design- randomized complete block; Replicates- 4; AT APPLICATION: Date and method- 870811-POST; Equipment bicycle sprayer; Volume- 700 L/ha; Pressure- 200 kPa; TipsSS8002LP; Weed stage of growth- multi-tiller; Date of assessment- % crabgrass suppression; (T1) 870811, J2) 870812. (T3) 870814. J4) 870816, (TS) 870818, (T6) 870821; (T7) 870825, (T8) 870902.

# TREATMENT	DOSE	% CRABGRASS SUPPRESSION							
	kg/ha	T1	T2	T3	T4	T5	TS	T7	T8
1 Control		0	0	0	0	0	0	0	0
2 Mon-15126 + Agral 90	0.50 + 0.50%	0	0	0	0	20	35	60	70
3 Mon-15126 + Agral 90	0.75 + 0.50%	0	0	0	0	7	30	35	77
4 Mon-15126 + Agral 90	1.00 + 0.50%	0	0	0	0	0	7	20	80
5 Mon-15126 + Agral 90	1.50 + 0.50%	0	0	0	0	15	30	32	55
6 AC 263499 + Triton X	0.10 + 1.25%	0	0	0	35	52	65	80	90
7 AC 263499 + Triton X	0.15 + 0.25%	0	0	0	0	20	37	37	85
8 AC 263499 + Triton X	0.20 + 0.25%	0	0	0	0	20	30	36	92
9 AC 263499 + Nitrogen 28%	0.10 + 1.25%	0	0	0	0	33	42	84	90
10 AC 263499 + Nitrogen 28%	0.15 + 1.25%	0	0	0	0	13	50	70	90
11 AC 263499 + Nitrogen 28%	0.20 + 1.25%	0	0	22	40	57	74	87	100

Both AC 263499 and Mon-15126 gave good crabgrass control at the multi-tiller stage. but not at the 2 to 3 leaf stage. K. bluegrass was injured by both herbicides at the 2 to 3 leaf stage but not at the multi-tiller stage. Crabgrass control was poor at the 2 to 3 leaf stage because of seed germination that resulted in a new flush of growth. Turf was under extreme drought stress at the 2 to 3 leaf stage. (Dept. Environ. Biol., Univ. Guelph).

Efficacy of fenoxoprop-ethyl on crabgrass grown in monoculture. Hall, J.C. and K. Christensen. Experiment location- Cambridge Research Station; Crop- Crabgrass monostand; Variety- *Digitaria ischaemum*; Soil type- sandy loam; Planting date: 870510; Plot size- 1 x 2 m; Experimental design- randomized complete block; Replicates- 4; AT APPLICATION: Date and method- 870610 (2-3 leaf stage); 870625 (1-3 tiller stage): 870729 (multi-tiller stage); Equipment- bicycle sprayer; Volume- 400 L/ha; Pressure- 200 kPa; Tips- 538002LP; Crop stage of growth- 2-3 leaf; 13 tiller; multi-tiller; Date of assessment- % crabgrass infestation; (T1) 870617, J2) 870624, (T3) 870701. J4) 870706, J5) 870709; (T6) 870720. J7) 870729, J8) 870805, J9) 870812, J10) 870819 (T11) 870826, J12) 870902.

# TREATMENT	DOSE	LEAF	% CRABGRASS INFESTATION											
	kg/ha	STAGE	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12
1 Control		2-3L*	100	100	100	100	100	100	100	100	100	100	100	100
		1-3T*			100	100	100	100	100	100	100	100	100	100
		multi*								100	100	190	100	100
2 Hoe 046360 75 EW	0.040	multi								100	33	28	43	58
3 Hoe 046360 75 EW	0.060	2-3L	100	53	5	4	5	5	8	13	18	25	25	25
		1-3T			50	10	10	10	13	19	26	34	34	34
		multi								100	6	4	20	40
4 Hoe 046360 75 EW	0.075	2-3L	100	48	9	3	3	3	6	9	24	29	29	29
		1-3T			43	6	5	5	5	10	20	21	21	21
		multi								100	5	6	25	48
5 Hoe 046360 75 EW	0.085	2-3L	100	45	0	0	0	0	3	6	13	23	23	23
		1-3T			35	0	0	0	0	0	0	4	4	4
		multi								100	3	7	10	23
6 Hoe 046360 75 EW	0.095	2-31.	100	43	5	0	1	1	3	13	16	19	19	19
		1-3T			40	0	0	0	0	0	0	4	4	4
		multi								100	5	4	15	20
7 Hoe 046360 75 EW	0.105	2-3L	100	43	1	1	1	1	4	8	10	26	26	26
		1_3T			43	0	0	0	0	0	0	1	1	1
		multi								100	3	5	28	28
8 Hoe 046360 75 EW	0.115	2-31.	100	38	5	0	0	0	3	4	5	13	13	13
		1-3T			30	0	0	0	0	0	0	3	3	3
		multi								100	25	25	33	35
9 Hoe 046360 75 EW	0.125	2-31.	100	50	1	0	0	0	0	3	3	11	11	11
		1-3T			40	0	0	0	0	0	4	8	8	8
10 Hoe 046360+Triton X	0.040+0.25%	multi								100	1	5	13	28
11 Hoe 046360+Triton X	0.060+0.25%	2-3L	100	45	4	4	4	4	5	23	31	48	48	48
		1_3T			43	a	0	0	1	1	1	10	10	10
		multi								100	4	6	23	35
12 Hoe 046360+Triton X	0.075+0.25%	2-3L	100	33	3	3	4	4	4	11	19	23	23	23
		1-3T			48	3	0	0	0	0	1	8	8	8
		multi								100	2	5	10	13
13 Hoe 046360+Triton X	0.085+0.25%	2-3L	100	38	4	3	3	3	5	6	10	25	25	25
		1_3T			43	0	0	0	0	0	0	5	5	5
14 Hoe 033171 90 EC	0.100	2-3L	100	33	6	3	3	3	3	4	5	10	10	10
		1-3T			33	1	0	0	0	0	1	6	6	6
15 AC 263499+Triton X	0.100+0.25%	2-3L	100	28	11	11	33	40	100	100	100	100	100	100
		1-3T			43	9	15	15	75	100	100	100	100	100
		multi								100	88	88	100	100

* 2-3 L - 2-3 leaf; 1-3 T - 1-3 tillers: Multi - Multi-tiller

Crabgrass was grow in a pure stand. At the 2-3 leaf and 1-3 tiller stage, all doses of fenoxaprop-ethyl, including the lowest (0.060 kg/a.i.) provided complete crabgrass control. The addition of triton did not improve the efficacy of fenoxaprop-ethyl at the 2-3 leaf stage. However, at the 1-3 tiller stage, the addition of triton improved the efficacy of the 0.060 and 0.075 kg/ha doses. At the multi-tiller leaf stage, all doses of fenoxaprop ethyl except the 0.040 kg/ha dose, provided excellent short-term crabgrass control. However, because the crabgrass canopy was so dense, some regrowth occurred from plants that were shielded from the herbicide. Addition of triton improved efficacy of only the lowest doses at the multi-tiller stage. (Dept. Environ. Biol., Univ. Guelph).

Use of fenoxaprop-ethyl for the postemergence control of 2 to 3 leaf crabgrass in Kentucky bluegrass. Hall, J.C. , and K. Christensen. Experiment location- Cambridge Research Station; Crop- Crabgrass (*Digitaria ischaemum*) and Kentucky bluegrass mixed stand; Soil type- Sandy loam; Planting date- 870515; Plot size- 1 x 2 m; Experimental design- randomized complete block; Replicates- 4; AT APPLICATION: Date and method- 870701-POST; Equipment- bicycle sprayer; Volume- 400 L/ho; Pressure- 200 kPa; Tips- SS8002LP; Weed stage of growth: 2-3 leaf; Date of assessment- % crabgrass suppression; (T1) 870701; (T2) 870702, (T3) 870704, (T4) 870706, (T5) 870708, (T6) 870711, (T7) 870715, (T8) 870722, (T9) 870729, (T10) 870805, (T11) 870812, (T12) 870819, (T13) 870826.

# TREATMENT	DOSE	% CRABGRASS SUPPRESSION												
	kg/ha	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12	T13
1 Control		0	0	0	0	0	0	0	0	0	0	0	0	0
2 Hoe 046360	0.105	0	0	0	0	0	0	100	100	100	84	73	0	0
3 Hoe 046360 + DPX M6316	0.105+0.015	0	0	0	0	0	0	100	100	100	100	100	88	50
4 Hoe 046360 + DPX M6316	0.105+0.023	0	0	0	0	0	0	100	100	88	88	62	33	33
5 Hoe 046360 + DPX M6316	0.105+0.030	0	0	0	0	0	0	100	100	91	73	73	27	0
6 Hoe 046360 + Clopyralid	0.105+0.200	0	0	0	0	0	0	100	100	50	33	33	0	0
7 Hoe 046360 + Paclobutrazol	0.105+1.000	0	0	0	0	0	0	100	100	100	92	92	92	54
8 Hoe 046360 + 16-2-6	0.105+25%	0	0	0	0	0	0	100	100	89	66	33	33	0
9 Hoe 046360	0.125	0	0	0	0	0	0	100	100	100	100	100	63	0
10 Hoe 046360 + DPX M6316	0.125+0.015	0	0	0	0	0	0	100	100	100	100	100	73	55
11 Hoe 046360 + OPX M6316	0.125+0.023	0	0	0	0	0	0	100	100	100	100	100	70	20
12 Hoe 046360 + DPX M6316	0.125+0.030	0	0	0	0	0	0	100	100	50	50	10	20	0
13 Hoe 046360 + Clopyralid	0.125+0.200	0	0	0	0	0	0	100	100	90	90	90	60	20
14 DPX M6316	0.023	0	0	0	0	0	a	0	0	0	0	0	0	0
15 Hoe 033171	0.200	0	0	0	0	0	0	100	100	100	100	100	92	80
16 Hoe 033171 + DPX M6316	0.200+0.023	0	0	0	0	0	0	100	100	100	100	100	62	25
17 Hoe 033171 + 16-2-6	0.200+25%	0	0	0	0	0	0	100	100	100	94	94	80	60
18 Control		0	0	0	0	0	0	0	0	0	0	0	0	0

Hoe 046360 and Hoe 033171 provided excellent control of 2 to 3 leaf crabgrass 14 to 28 days after treatment. Crabgrass control was reduced 28 days after treatment because of new seedling germination. The addition of clopyralid, liquid fertilizer and paclobutrazol, did not reduce the activity of Hoe 046360 or Hoe 033171. However, the 0.030 Kg/ha dose of DPX M6316 may have reduced the crabgrass control. (Dept. Environ. Biol., Univ. Guelph).

Use of fenoxaprop-ethyl for the postemerqence control of 1 to 3 tillered crabgrass in Kentucky bluegrass. Hall, J.C. and K. Christensen. Experiment location- Cambridge Research Station; Crop- Crabgrass (*Digitaria ischaemum*) and Kentucky bluegrass mixed stand; Soil type- sandy loam; Plot size- 1 x 2 m; Experimental design- randomized complete block; Replicates- 4; AT APPLICATION: Date and method - 870723-POST; Equipment- bicycle sprayer; Volume- 400 L/ha; Pressure-200 kPa; Tips- SS8002LP; Weed Stage of Growth- 1-3 tiller; Date of assessment- % crabgrass suppression; (T1) 870723, (T2) 870724, (T3) 870726, (T4) 870728, (T5) 870730, (T6) 870802, (T7) 870806, (T8) 870813, (T9) 870820.

# TREATMENT	DOSE	% CRABGRASS SUPPRESSION								
	kg/ha	T1	T2	T3	T4	T5	T6	T7	T8	T9
1 Control		0	0	0	0	0	0	0	0	0
2 Hoe 046360 75 EW	0.075	0	0	0	0	52	69	91	82	69
3 Hoe 046360 75 EW	0.095	0	0	0	0		100	100	100	100
4 Hoe 046360 75 EW	0.105	0	0	0	0	0	100	100	100	94
5 Hoe 046360 + OPX M6316	0.105 + 0.015	0	0	0	0	0	100	100	100	95
6 Hoe 046360 + OPX M6316	0.105 + 0.023	0	0	0	0	0	100	100	100	90
7 Hoe 046360 + DPX M6316	0.105 + 0.030	0	0	0	0	0	100	100	100	91
8 Hoe 046360 + clopyralid	0.105 + 0.200	0	0	0	0	0	95	95	91	86
9 Hoe 046360	0.125	0	0	0	0	0	100	100	100	100
10 Hoe 046360 + DPX M6316	0.125 + 0.015	0	0	0	0	0	100	100	100	100
11 Hoe 046360 + OPX M6316	0.125 + 0.023	0	0	0	0	0	100	100	100	92
12 Hoe 046360 + OPX M6316	0.125 + 0.030	0	0	0	0	0	100	100	100	100
13 Hoe 046360 + clopyralid	0.125 + 0.200	0	0	0	0	0	100	100	100	100
14 DPX M6316 90 EC	0.023	0	0	0	0	0	0	0	0	0
15 Hoe 033171 60 EC	0.200	0	0	0	0	15	94	100	100	100
16 Hoe 033171	0.200	0	0	0	0	0	92	190	100	100
17 Hoe 033171 + DPX M6316	0.200 + 0.023	0	0	0	0	0	100	100	100	95
18 Hoe 033171 + 16-2-6	0.200 + 25%	9	0	0	0	0	100	100	100	100
19 Hoe 046360 + paclobutrazol	0.105 + 1.000	0	0	0	0	0	100	100	0	0
20 Hoe 046360 + 16-2-6	0.105 + 25%	0	0	0	0	0	100	0	0	93
21 Hoe 046360 + triclopyr	0.105 + 0.25	0	0	0	0	54	69	100	100	97
22 Hoe 646360 + triclopyr	0.125 + 0.25	0	0	0	0	42	58	100	100	100
23 Hoe 033171 + triclopyr	0.200 + 0.25	0	0	0	0	52	86	100	90	100
24 Control		0	0	0	0	0	0	0	0	0

All doses of Hoe 046360 and Hoe 033171 gave excellent control of 1 to 3 tillered crabgrass in K. bluegrass. The addition of liquid fertilizer, triclopyr, clopyralid, or DPX M6316 did not reduce crabgrass control. No injury occurred to K. bluegrass. (Dept. Environ, Biol., Univ. Guelph).

Use of fenoxoprop-ethyl for the postemergence control of multitillered crabgrass in Kentucky bluegrass. Hall, J.C. , and K. Christensen. Experiment location- Cambridge Research Station; Crop- Crabgrass (*Digitaria ischaemum*) and Kentucky bluegrass mixed stand; Soil type- sandy loam; Planting date-870515; Plot size- 1 x 2 m; Experimental design- randomized complete block; Replicates- 4; AT APPLICATION: Date and method-870811-POST; Equipment- bicycle sprayer; Volume- 400 L7ha-, Pressure-200 kPa; Tips-SS8002LP; Date of assessment- % crabgrass suppression; (T1) 870811, (T2) 870312, (T3) 870814, (T4) 870816, (T5) 870818, (T6) 870821, (T7) 870825, (T8) 870902.

# TREATMENT	DOSE	% CRABGRASS SUPPRESSION							
	kg/ha	T1	T2	T3	T4	T5	T6	T7	T8
1 Control		0	0	0	0	0	0	0	0
2 Hoe 046366 75 EW	0.105	0	0	0	52	70	100	100	100
3 Hoe 046360 + DPX M6316	0.105 + 0.015	0	0	0	20	50	94	100	100
4 Hoe 046360 + DPX M6316	0.105 + 0.023	0	0	0	47	64	91	100	100
5 Hoe 046360 + DPX M6316	0.105 + 0.030	0	0	0	10	26	57	72	72
6 Hoe 046360 + Clopyrolid	0.105 + 0.200	0	0	0	44	44	91	100	98
7 Hoe 046360	0.125	0	0	0	52	52	92	100	100
8 Hoe 046360 + DPX M6316	0.125 + 0.015	0	0	0	13	39	53	69	81
9 Hoe 046360 + DPX M6316	0.125 +'0.023	0	0	0	45	45	92	100	100
10 Hoe 046360 + DPX M6316	0.125 + 0.030	0	0	0	15	40	77	100	100
11 Hoe 046360 + Clopyrolid	0.125 + 0.200	0	0	0	29	47	89	100	100
12 DPX M6316	0.023	0	0	0	8	0	0	0	5
13 Hoe 033171 (90 EC)	0.200	0	0	0	10	50	90	100	102
14 Hoe 033171 + DPX M6316	0.200 + 0.023	0	0	0	39	44	95	100	100
15 Hoe 033171 + 16-2-6	0.200 + 25%	0	0	0	42	67	95	95	97
16 Hoe 046360 + Paclobutrazol	0.105 + 1.000	0	0	0	51	77	100	100	100
17 Hoe 046360 + 16-2-6	0.105 + 25%	0	0	0	45	80	100	100	100
18 Control		0	0	0	0	0	0	0	0

Hoe 046360 and Hoe 033171 alone or tank mixed with DPX M6316, clopyralid, paclobutrazol and liquid fertilizer gave excellent control of multi-tillered crabgrass. No injury occurred to the turf. (Dept. Environ. Biol., Univ. Guelph).

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Tolerance of two-newly seeded bentgrass and Kentucky bluegrass varieties to fenoxaprop-ethyl. Hall, J.C. and K. Christensen. Experiment location- Cambridge Research Station; Crop- Bentgrass- Penncross and Highland; K. bluegrass- Baron and Sydsport; Soil type- Sandy loam; Planting date- 870513; Plot size- 1 x 2 m; Experimental designrandomized complete block; Replicates- 4; AT APPLICATION: Dote and method- 870626-POST; Equipment- bicycle sprayer; Volume- 400 L/ha; Pressure- 200 kPa; Tips- S58002LP; Crop stage of growth- 4-7 leaf; Weed stage of growth: Hairy crabgrass (*Digitaria sanguinalis*), 1-3 tiller. Date of assessment- % of plot infested with crabgrass; crop injury; (TI) 870626, J2) 870627, (T3) 870629, J4) 870701. (T5) 870703, J6) 870706,(T7) 870710).

BENTGRASS - PENNCROSS	DOSE	DAYS AFTER TREATMENT													
		T1		T2		T3		T4		T5		T6		T7	
# TREATMENT	kg/ha	%S	I	%S	I	%S	I	%S	I	%S	I	%s	I	%S	I
1 Control		11	0	11	0	11	0	11	0	11	0	11	0	11	0
2 Hoe 046360 75 EW	0.075	11	0	11	0	11	0	1	4	1	7	0	7	0	7
3 Hoe 046360 75 EW	0.105	5	0	5	0	5	0	1	3	0	5	0	6	0	6
4 Hoe 046360 75 E4	0.250	5	0	5	0	5	0	0	5	0	7	0	7	0	7
5 Hoe 033171 90 EC	0.200	4	0	4	0	4	0	0	3	0	7	0	7	0	7
6 Hoe 033171 90 EC	0.250	5	0	5	0	5	0	0	4	0	7	0	7	0	7
7 Hoe 033171 90 EC	0.500	4	0	4	0	4	0	0	5	0	8	0	8	0	8
8 Hoe 033171 60 EW	0.200	4	0	4	0	4	0	0	2	0	5	0	5	0	5
BENTGRASS - HIGHLAND															
1 Control		13	0	13	0	13	0	13	0	11	0	11	0	11	0
2 Hoe 046360 75 EW	0.075	18	0	18	0	18	0	4	3	0	1	0	0	0	0
3 Hoe 046360 75 EW	0.105	14	0	14	0	14	0	3	3	0	1	0	0	0	0
4 Hoe 046360 75 EW	0.250	13	6	13	0	13	0	3	2	0	1	0	0	0	0
5 Hoe 033171 90 EC	0.200	10	0	10	0	10	0	1	3	0	2	0	0	0	0
6 Hoe 033171 90 EC	0.250	18	0	18	0	18	0	4	2	0	1	0	0	0	0
7 Hoe 033171 90 EC	0.500	28	0	28	0	28	0	8	3	0	1	0	0	0	0
8 Hoe 033171 60 EW	0.200	21	0	21	0	21	0	6	3	0	2	0	0	0	0
K. BLUEGRASS - BARON															
1 Control		15	0	15	0	15	0	15	0	15	0	15	0	11	0
2 Hoe 046360 75 EW	0.075	15	0	15	0	15	0	1	3	0	3	0	3	0	3
3 Hoe 046360 75 EW	0.105	15	0	15	0	15	0	0	4	0	4	0	4	0	4
4 Hoe 046360 75 E14	0.250	18	0	18	0	18	0	6	4	0	4	0	4	0	4
5 Hoe 033171 90 EC	0.200	18	0	18	0	18	0	3	5	0	5	0	5	0	5
6 Hoe 033171 96 EC	0.250	20	0	20	0	20	0	3	6	0	6	0	6	0	6
7 Hoe 033171 90 EC	0.500	15	0	15	0	15	0	1	6	0	6	0	6	0	6
8 Hoe 033171 60 EW	0.200	13	0	13	0	13	0	1	3	0	3	0	3	0	3
K. BLUEGRASS - SYDSPORT															
1 Control		40	0	40	0	40	0	40	0	40	0	40	0	40	0
2 Hoe 046360 75 EW	0.075	30	0	30	0	30	0	3	1	0	1	0	1	0	1
3 Hoe 046360 75 EW	0.105	45	0	45	0	45	0	16	1	0	1	0	1	0	1
4 Hoe 046360 75 EW	0.250	35	0	35	0	35	0	3		0	3	0	4	0	4
5 Hoe 033171 90 EC	0.200	53	0	53	0	53	0	6	0	0	0	0	0	0	0
6 Hoe 033171 90 EC	8.250	53	0	53	0	53	0	23	3	0	3	0	3	0	3
7 Hoe 033171 90 EC	0.500	46	0	46	0	46	0	10	4	8	4	0	4	0	4
8 Hoe 033171 60 EW	0.200	38	0	38	0	38	0	5	2	0	2	0	2	0	2

%S - % stand crabgrass infestation; I - injury to crop 0-10; 10 - complete kill

Crabgrass control was excellent with Hoe 046360 and Hoe 033171. Injury was moderate on both K. bluegrass varieties with Baron being more susceptible than Sydsport. Injury was moderate to severe on bentgrass, with Penncross being more susceptible than Highland. In all cases Hoe C46360 was less phytotoxic than Hoe 033171 to K. bluegrass and bentgrass. (Dept. Environ. Biol., Univ. Guelph).

Tolerance of two newly established bentgrass and Kentucky bluegrass varieties to fenoxapropethyl. Hall, J.C. and K. Christensen. Experiment location - Cambridge Research Station; CropBentgrass- Pencross and Highland; K. bluegrass- Baron and Sydsport; Soil type - Sandy loam; Planting date - 87B513; Plot size - 1 x 2 m; Experimental design - randomized complete block; Replicates - 4; AT APPLICATION: Date and method - 870806-POST; Equipment bicycle sprayer; Volume - 400 L/ha; Pressure200 kPa; Jips - SS8002LP; Crop stage of growth Established; Weed stage of growth: Hairy crabgrass,(*Digitaria sanguinalis*), 1-3 tiller; Date of assessment- % of plot infested with crabgrass;crop tolerance;(Tl) 870806, (T2) 87080, (T3) 870809, (T4) 870811. (TS) 870813, J6) 870816, J7) 870820.

BENTGRASS - PENNCROSS		Days after treatment													
	DOSE	T1		T2		T3		T4		T5		T6		T7	
I TREATMENT	kg/ha	%S	I	%S	I	%S	I	%S	I	%S	I	%S	I	%S	I
1 Control		10	0	10	0	10	0	10	0	10	0	10	0	10	0
2 Hoe 046360 EW	0.075	18	0	18	0	18	0	9	0	9	0	9	0	9	2
3 Hoe 046360 E4	0.105	24	0	24	0	26	0	13	3	13	3	13	3	11	3
4 Hoe 046360 EW	0.250	20	0	20	0	20	0	4	4	4	4	4	4	0	5
5 Hoe 033171 90 EC	0.200	23	0	23	0	23	0	4	4	4	4	4	4	3	4
6 Hoe 033171 90 EC	0.250	23	0	23	0	23	0	1	5	1	5	1	5	0	5
7 Hoe 033171 90 EC	0.500	25	0	25	0	25	0	6	5	6	5	6	5	5	6
8 Hoe 033171 60 EW	0.200	15	0	15	0	15		3	2	3	2	3	2	0	2
BENTGRASS - HIGHLAND															
1 Control		55	0	55	0	55	0	55	0	55	0	55	0	60	0
2 Hoe 046360 EW	0.075	68	0	68	0	68	0	8	1	5	2	5	2	0	2
3 Hoe 046360 EW	0.105	55	0	55	0	55	0	3	2	3	2	3	2	0	2
4 Hoe 046360 EW	0.250	73	0	73	0	73	0	8	2	8	2	8	2	0	2
5 Hoe 033171 90 EC	0.200	73	0	73	0	73	0	3	2	3	2	3	2	0	3
6 Hoe 033171 90 EC	0.250	70	0	70	0	70	0	1	2	1	3	1	3	0	3
7 Hoe 033171 90 EC	0.500	55	0	55	0	55	0	0	2	0	2	0	2	0	2
8 Hoe 033171 60 EW	6.200	35	0	35	0	35	0	0	1	0	1	0	1	0	2
K. BLUEGRASS - BARON															
1 Control		58	0	58	0	58	0	58	0	58	0	58	0	58	0
2 Hoe 046360 EW	0.075	58	0	58	0	58	0	0	0	0	0	0	0	0	0
3 Hoe 046360 EW	0.105	58	0	58	0	58	0	5	0	5	0	5	0	0	0
4 Hoe 046360 EW	0.250	38	0	38	0	38	0	3	0	3	0	3	0	0	0
5 Hoe 033171 90 EC	0.200	43	0	43	0	43	0	3	0	3	0	0	0	e	0
6 Hoe 033171 90 EC	0.250	63	0	63	0	63	0	0	0	0	0	0	0	0	0
7 Hoe 033171 90 EC	0.500	55	0	55	0	55	0	5	0	5	0	5	0	0	0
8 Hoe 033171 60 EW	0.200	48	0	48	0	48	0	15	0	15	0	15	0	0	0
K. BLUEGRASS - SYDSPORT															
1 Control		55	0	55	0	58	0	58	8	58	0	58	0	58	0
2 Hoe 046360 EW	0.075	70	0	70	0	70	0	6	0	6	0	6	0	0	0
3 Hoe 046360 EW	0.105	53	0	53	0	53	0	3	0	3	0	3	8	0	0
4 Hoe 046360 E34	0.250	78	0	78	6	78	0	0	0	0	0	0	0	0	0
5 Hoe 033171 90 EC	0.200	70	0	70	0	70	0	5	0	3	0	3	0	0	0
6 Hoe 033171 90 EC	0.250	60	0	60	0	60	0	0	0	0	0	0	0	0	0
7 Hoe 033171 90 EC	0.500	48	0	48	0	48	0	0	0	0	0	0	0	0	0
8 Hoe 033171 60 EW	6.200	38	0	38	0	38	0	5	0	0	0	0	0	0	0

%S - % crabgrass infestation; I - injury to crop 0-10; 10 - complete kill

Crabgrass control was excellent in all cases. Three months after seeding, both varieties of K. bluegrass were not injured by either Hoe 033171 or Hoe 046360. However, both bentgrass varieties were injured by the two formulations of fenoxaprop. Highland wus less susceptible than Penncross. (Dept. Environ. Biol., Univ. Guelph).

Tolerance of two newly seeded fescue and perennial ryegross varieties to fenoxaprop-ethyl. Hall, J.C. and K. Christensen. Experiment Location - Cambridge Research Station; Crop - Fescue- Victory and Banner; P. ryegrass- Palmer and Yorktown II; Soil type - Sandy loam; Planting date - 870513; Replicates4; AT APPLICATION - Date and method - 870626-POST; Equipment - bicycle sprayer; Volume - 400 L/ho; Pressure - 200 kPa; Tips - SS8002LP; Crop stage of growth - 4-7 leaf; Weed stage of growth: Hairy crabgrass (Digitaria sanquinalis). 1-3 tiller, Date of assessment - % of plot infested with crabgrass;crop tolerance;(Tl) 870626, J2) 87b627, J3) 870629, J4) 870701, (T5) 870703, J6) 870706, (W) 870710.

FESCUE - VICTORY		Days after treatment													
# TREATMENT	DOSE	T1		T2		T3		T4		T5		T6		T7	
	kg/ha	%S	I	%S	I	%S	I	%S	I	%S	I	%S	I	%S	I
1 Control		30	0	30	0	30	0	30	0	33	0	33	0	33	0
2 Hoe 046360 EW	0.075	30	8	30	0	30	6	3	0	0	0	e	0	0	0
3 Hoe 046360 EW	0.105	50	0	50	0	50	8	4	0	0	0	0	0	0	0
4 Hoe 046360 EW	0.250	48	0	48	0	48	0	4	0	8	0	0	0	0	0
5 Hoe 033171 90 EC	0.200	38	0	38	0	38	0	5	0	0	0	0	0	0	0
6 Hoe 033171 90 EC	0.250	23	0	23	0	23	8	5	0	0	0	0	0	0	0
7 Hoe 033171 90 EC	0.500	35	0	35	8	35	8	11	8	0	0	0	0	0	0
8 Hoe 033171 60 EW	0.200	48	6	48	6	48	0	0	0	0	0	0	0	0	0
FESCUE - BANNER															
1 Control		48	0	48	0	45	0	48	0	48	0	48	0	48	0
2 Hoe 046360 EW	0.075	35	0	35	0	35	8	6	0	1	0	0	0	0	0
3 Hoe 046360 EW	0.105	35	0	35	0	35	0	8	0	0	0	0	0	0	0
4 Hoe 046360 EW	0.250	43	0	43	0	43	0	4	0	0	0	0	0	0	0
5 Hoe 033171 90 EC	0.200	45	0	45	0	45	8	4	0	0	0	0	e	0	0
6 Hoe 033171 90 EC	0.250	48	0	48	0	48	0	3	0	0	0	0	0	0	0
7 Hoe 033171 90 EC	6.500	68	0	60	8	60	0	1	0	0	0	0	0	0	0
8 Hoe 033171 60 EW	0.200	45	0	45	0	45	0	6	0	8	0	0	0	0	0
P. RYEGRASS - PALMER															
1 Control		25	8	25	0	25	6	28	0	28	0	28	0	28	0
2 Hoe 046360 EW	0.075	35	0	35	0	35	8	5	8	0	0	0	0	0	0
3 Hoe 046360 EW	0.105	25	0	25	0	25	0	3	0	0	0	0	0	0	0
4 Hoe 046360 EW	8.250	33	0	33	0	33	0	4	0	0	1	8	1	0	1
5 Hoe 033171 90 EC	8.200	23	6	23	0	23	8	4	0	0	0	8	8	0	0
6 Hoe 033171 90 EC	8.250	38	0	38	0	38	8	4	6	0	2	8	2	0	2
7 Hoe 033171 90 EC	0.500	28	8	28	0	28	8	4	8	0	2	8	2	0	2
8 Hoe 633171 60 EW	0.200	35	0	35	8	35	8	5	8	0	1	0	1	0	1
P. RYEGRASS - YORKTOWN II															
1 Control		19	8	19	0	19	8	19	0	18	0	19	0	19	0
2 Hoe 846360 EW	0.075	14	0	14	0	14	0	e	0	8	0	0	0	0	0
3 Hoe 046360 EW	0.105	10	8	10	0	10	8	0	0	0	0	0	0	0	0
4 Hoe 046360 EW	0.250	13	0	13	6	13	8	8	1	0	3	0	3	0	3
5 Hoe 033171 90 EC	0.200	8	0	8	0	8	8	6	0	0	1	0	1	0	1
6 Hoe 033171 90 EC	0.250	13	0	13	0	13	0	8	1	0	2	0	2	0	2
7 Hoe 033171 90 EC	0.500	9	0	9	0	9	0	3	1	0	3	0	3	0	3
8 Hoe 033171 60 EW	8.200	18	0	18	8	18		1	0	0	1	0	1	0	1

%S - % crabgrass infestation; I - injury to crop 0-10; 10 - complete kill

Both fescue varieties were not injured by any dose of Hoe 046360 or Hoe 033171, 1.5 months after seeding. Some slight discolouration was evident on both p. ryegrass varieties with all doses of Hoe 033171 and only with the high dose of Hoe 046360. Crabgrass confrol was excellent. (Dept. Environ. Biol., Univ. Guelph).

Tolerance of two newly established fescue and perennial ryegrass varieties to fenoxaprop-ethyl. Hall, J.C. and K. Christensen. Experiment location - Cambridge Research Station; Crop - FescueVictory and Banner; P. Ryegrass- Palmer and Yorktown II; Soil type - Sandy loam; Planting date - 870513; Plot size - 1 x 2 m; Experimental design randomized complete block; Replicates - 4; AT APPLICATION: Date and method - 870806-POST; Equipment bicycle sprayer; Volume - 400 L/ha; Pressure - 200 kPa: Tips-S58002LP; Crop stage of growth - Established; Weed stage of growth - Hairy crabgrass,(*Digitaria sanguinalis*),1-3 tiller, Date of assessment -% of plot infested with crabgrass; crop tolerance;(Tl) 870806. (T2) 870807. (T3) 870809. J4) 870811, (T5) 870813. (T6) 870816, (T7) 870820.

FESCUE - VICTORY		Days after treatment													
	DOSE	T1		T2		T3		T4		T5		T6		T7	
# TREATMENT	kg/ha	%S	I	%S	I	%S	I	%S	I	%S	I	%S	I	%S	I
1 Control		78	0	78	0	78	0	78	0	78	0	78	0	78	0
2 Hoe 046360 EW	0.075	95	0	95	0	95	0	5	0	5	0	5	0	0	0
3 Hoe 046360 EW	0.105	80	0	80	0	80	0	15	0	15	0	15	0	0	0
4 Hoe-046360 EW	0.250	80	0	80	0	80	0	5	0	5	0	3	0	0	0
5 Hoe 033171 90 EC	0.200	100	0	100	0	100	0	3	0	3	0	3	0	0	0
6 Hoe 033171 90 EC	0.250	100	0	100	0	100	0	8	0	8	0	8	0	0	0
7 Hoe 033171 90 EC	0.500	90	0	90	0	90	0	3	0	3	0	3	0	0	0
8 Hoe 033171 60 EW	0.200	85	0	85	0	85	0	8	0	8	0	8	0	0	0
FESCUE - BANNER															
1 Control		160	0	100	0	100	0	100	0	100	0	100	0	100	0
2 Hoe 046360 EW	0.075	95	0	95	0	95	0	40	0	40	0	40	0	0	0
3 Hoe 046360 EW	0.105	95	0	95	0	95	0	20	0	20	0	20	0	0	0
4 Hoe 046360 EW	0.250	88	0	88	0	88	0	0	0	0	0	0	0	0	0
5 Hoe 033171 90 EC	0.200	100	0	100	0	100	0	20	0	20	0	20	0	0	0
6 Hoe 033171 90 EC	0.250	95	0'	95	0	95	0	15	0	15	0	15	0	0	0
7 Hoe 033171 90 EC	0.500	100	0	100	0	100	0	6	0	5	0	5	0	0	0
8 Hoe 033171 60 EW	0.200	35	0	35	0	35	0	0	0	0	0	0	0	0	0
P. RYEGRASS - PALMER															
1 Control		55	0	55	0	55	0	55	0	55	0	55	0	55	0
2 Hoe 046360 EW	6.075	58	0	58	0'	58	0	0	0	0	0	0	0	0	0
3 Hoe 046360 EW	0.105	53	0	53	0	53	0	0	0	0	0	0	0	0	0
4 Hoe 046360 EW	0.250	58	0	58	0	58	0	0	0	0	0	0	0	0	0
5 Hoe 033171 90 EC	0.200	60	0	60	0	60	0	e	0	0	0	0	0	0	0
6 Hoe 033171 90 EC	0.250	53	0	53	0	53	0	0	0	0	0	0	0	0	0
7 Hoe 033171 90 EC	0.500	63	0	63	0	63	0	0	0	0	0	0	0	0	0
8 Hoe 033171 60 EW	0.200	35	0	35	6	35	0	0	0	0	0	0	0	0	0
P. RYEGRASS - YORKTOWN II															
1 Control		43	0	53	0	53	0	53	0	53	0	53	0	53	0
2 Hoe 046360 EW	0.075	25	0	25	0	25	0	0	0	0	0	0	0	0	0
3 Hoe 046360 EW	0.105	20	0	20	0	20	0	0	0	0	0	0	0	0	0
4 Hoe 046360 EW	0.250	30	0	28	0	28	0	0	0	0	0	0	0	0	0
5 Hoe 033171 90 EC	0.200	23	0	23	0	23	0	0	0	0	0	0	0	0	0
6 Hoe 033171 90 EC	0.250	45	0	45	0	45	0	3	0	3	0	3	0	0	0
7 Hoe 033171 90 EC	0.500	23	0	23	0	23	6	0	0	0	0	0	0	0	0
8 Hoe 033171 60 EW	0.200	38	0	38	0	38	0	0	0	0	0	0	0	0	0

%S - % crabgrass infestation; I - injury to crop 0-10; 10 - complete kill

Three months after seeding, both varieties of fescue and perennial ryegrass were not injured by any dose of Hoe 046360 or Hoe 933171. Crabgrass control was excellent. (Dept. Environ. Biol., Univ. Guelph).

Phytotoxic effects of AC 263499 and Mon-15126, on pure stands of annual and Kentucky bluegrass. Hall, J.C. and K. Christensen. Experiment location- Cambridge Research Station; Crop- annual and Kentucky bluegrass pure stands; Soil type- Sandy loam; Planting date- September 1985; Plot size- 1 x 2 m; Experimental design- randomized complete block; Replicates- 4; AT APPLICATION: Date and method- 870529-POST; Equipment- bicycle sprayer; Volume- 700 L/ha; Pressure- 200 kPa; TipsSS8002LP; Date of assessment- % stand; (T1) 870605, (T2) 870612, (T3) 870619, (T4) 870626, (T5) 870703, (T6) 870710, (T7) 870717, (T8) 870724, (T9) 870731.

# TREATMENT	DOSE	WEEKS AFTER TREATMENT								
	kg/ha	T1	T2	T3	T4	T5	T6	T7	T8	T9
ANNUAL BLUEGRASS										
1 Control		26	26	26	26	26	26	26	26	26
2 AC 263499 + Triton X	0.10 + 0.25%	25	25	25	25	25	25	25	25	25
3 AC 263499 + Triton X	0.15 + 0.25%	21	21	21	21	21	21	21	21	21
4 AC 263499 + Triton X	0.20 + 0.25%	24	24	24	24	24	24	24	24	24
5 Mon-15126 + Agral 90	0.50 + 0.50%	19	19	19	19	19	19	19	19	19
6 Mon-15126 + Agral 90	0.75 + 0.50%	21	21	21	21	21	21	21	21	21
7 Mon-15126 + Agral 90	1.00 + 0.50%	20	20	20	20	20	20	20	20	20
8 Mon-15126 + Agral 90	1.50 + 0.50%	28	28	28	28	28	28	28	28	28
KENTUCKY BLUEGRASS										
1 Control		100	100	100	100	100	100	100	100	100
2 AC 263499 + Triton X	0.10 + 0.25%	100	100	100	100	100	100	100	100	100
3 AC 263499 + Triton X	0.15 + 0.25%	100	100	100	100	100	100	100	100	100
4 AC 263499 + Triton X	0.20 + 0.25%	100	100	100	100	100	100	100	100	100
5 Mon-15126 + Agrol 90	0.50 + 0.50%	100	100	100	100	100	100	100	100	100
6 Mon-15126 + Agrol 90	0.75 + 0.50%	100	100	100	100	100	100	100	100	100
7 Mon-15126 + Agral 90	1.00 + 0.50%	100	100	100	100	100	100	100	100	100
8 Mon-15126 + Agral 90	1.50 + 0.50%	100	100	100	100	100	100	100	100	100

Annual and Kentucky bluegrass were grown in pure stands. Neither AC 263499 nor Mon-15126 were phytotoxic to either species. Therefore, these herbicides cannot be used to selectively remove annual bluegrass from established stands of Kentucky bluegrass. (Dept. Environ . Biol . , Univ. Guelph).

Phytotoxicity of linuron to Kentucky bluegrass. Hall, J.C. and K. Christensen. Experiment location- Cambridge Research Station; Crop- Kentucky bluegrass pure stand; Soil type- Sandy loam; Plot size- 1 x 2 m; Experimental design- randomized complete block; Replicates- 4; AT APPLICATION: Date and method- 870626-POST; Equipment- bicycle sprayer; Volume- 700 L/ha; Pressure- 200 kPa; Tips- SS8002LP; Date of assessment- pre-spray rating; % Kentucky bluegrass stand; injury;(Tl) 870703, (T2) 870710, (T3) 870717, (T4) 870724, (T5) 870731, (T6) 870807.

# TREATMENT	DOSE	WEEKS AFTER TREATMENT											
	kg/ha	T1		T2		T3		T4		T5		T6	
		%S	I	%S	I	%S	I	%S	I	%S	I	%S	I
1 Control		100	0	100	0	100	0	100	0	100	0	100	0
2 Linuron	0.50	100	0	100	3	100	2	100	0	100	0	100	0
3 Linuron	0.75	100	0	100	3	100	2	100	0	100	0	100	0
4 Linuron	1.00	100	0	100	4	100	2	100	0	100	0	100	0
5 Linuron	1.25	100	0	100	5	100	4	100	1	100	0	100	0
6 Linuron	1.50	100	0	100	6	100	5	100	2	109	2	100	0
7 Linuron	2.00	100	0	100	7	100	5	100	3	100	2	100	0

Linuron - Afolon; %S - % stand; I - injury to crop; 0-10, 10- complete kill

Linuron,at a dose of 2.00 kg/ha caused yellowing and tip burn on K. bluegrass. However, within one month the bluegrass completely recovered. (Dept. Environ. Biol., Univ. Guelph).

Selective control of annual bluegrass with linuron. Hall, J.C. and K. Christensen. Experiment location- Cambridge Research Station; Cropannual bluegrass pure stand; Soil type- Sandy loam; Plot size- 1 x 2 m; Experimental design- randomized complete block; Replicates- 4; AT APPLICATION: Date and method- 870626-POST; Equipment- bicycle sprayer; Volume- 700 L/ha; Pressure- 200 kPa; Tips- SS8002LP; Date of assessment- % annual bluegrass stand; annual bluegrass injury;(Tl) 870626, (T2) 870703, (T3) 870710, (T4) 870717, (T5) 870724, (T6) 870731.

# TREATMENT	DOSE	WEEKS AFTER TREATMENT											
		T1		T2		T3		T4		TS		T6	
	kg/ha	%S	I	%S	I	%S	I	%S	I	%S	I	%S	I
1 Control	0.00	43	0	43	0	43	0	43	0	43	0	43	0
2 Linuron	0.50	55	0	53	2	53	2	53	0	53	0	53	0
3 Linuron	0.75	45	0	35	3	35	3	35	0	35	0	35	0
4 Linuron	1.00	40	0	29	4	29	4	29	1	30	0	30	0
5 Linuron	1.25	48	0	25	6	25	7	25	0	25	0	25	0
6 Linuron	1.50	45	0	4	8	4	8	4	2	4	2	4	0
7 Linuron	2.00	45	0	3	0	3	8	3	3	3	2	3	0

Linuron-Afolan; %S-% stand; I-injury to crop; 0-10, 10- complete kill

Linuron at doses above 1 Kg/ha significantly reduced the stand of annual bluegrass. Therefore, linuron can be used to remove annual bluegrass which is often regarded as a weed in turf. (Dept. Environ. Biol., Univ. Guelph).

Use of linuron for the selective control of annual bluegrass infestations in Kentucky bluegrass. Hall, J. C. and K. Christensen. Experiment location-Cambridge Research Station; Crop- Kentucky bluegrass and annual bluegrass mixed stand; Soil type- Sandy loam; Plot size- 1 x 2 m; Experimental design- randomized complete block; Replicates- 4; AT APPLICATION: Date and method- 870626-POST; Equipment bicycle sprayer; Volume- 700 L/ha; Pressure- 200 kPa; Tips- SS8002LP; Date of assessment- pre-spray rating (T1); % of plot infested with annual bluegrass; Kentucky bluegrass injury; (T1) 870626, (T2) 870703, (T3) 870710, (T4) 870717, (T5) 870724, (T6) 870731.

# TREATMENT	DOSE	WEEKS AFTER TREATMENT											
		T1		T2		T3		T4		T5		T6	
	kg/ha	%S	I	%S	I	%S	I	%S	I	%S	I	%S	I
1 Control		25	0	25	0	25	0	25	0	25	0	23	0
2 Linuron	0. 5b	20	0	20	0	20	0	20	0	20	0	14	0
3 Linuron	0.75	23	0	20	0	20	0	18	0	18	0	9	0
4 Linuron	1.00	23	0	21	0	21	0	13	0	13	0	5	0
5 Linuron	1.25	28	0	9	0	8	0	6	0	6	0	5	0
6 Linuron	1.50	23	0	6	0	5	2	4	0	4	0	4	0
7 Linuron	2.00	25	0	5	0	4	2	1	0	1	0	1	0

Linuron - Afolon; %S - % of plot infested with annual bluegrass; I - crop injury; 0-10. 10-complete kill

At doses of 1 kg/ha and higher, linuron significantly reduced the population of annual bluegrass infesting a stand of established K. bluegrass. Linuron caused no injury to K. bluegrass. Dept. Environ. Biol., Univ. Guelph).

Phytotoxicity of clethodim when applied to pure stands of Kentucky bluegrass and bentgrass. Hall, J.C. and K . Christensen. Experiment location- Cambridge Research Station; Crop; Kentucky bluegrass and bentgrass; Soil type - Sandy loam; Plot size- 1 x 2 m; Experimental design- randomized complete block; Replicates- 4; AT APPLICATION: Date and method- 870626-POST; Equipment- bicycle sprayer; Volume- 700 L/ha; Pressure- 200 kPa; Tips- SS8002LP; Date of assessment- % stand; crop injury; (T1) 870703, (T2) 870710, (T3)870717, (T4) 870724, (T5) 870731, (T6) 870807.

KENTUCKY BLUEGRASS													
# TREATMENT	DOSE	WEEKS AFTER TREATMENT											
	kg/ha	T1		T2		T3		T4		T5		T6	
		%S	I	%S	I	%S	I	%S	I	%S	I	%S	I
1 Control		100	0	100	0	100	0	100	0	100	0	100	0
2 Clethodim	0.05	100	5	100	8	100	5	100	4	100	0	100	0
3 Clethodim	0.10	100	7	100	9	100	6	100	4	100	0	100	0
4 Clethodim	0.15	100	6	100	9	100	9	100	5	100	0	100	0
5 Clethodim + Assist	0.05 + 1%	100	7	100	9	100	8	100	5	100	0	100	0
6 Clethodim + Assist	0.10 + 1%	100	6	100	a	100	8	100	5	100	0	100	0
7 Clethodim + Assist	0.15 + 1%	100	7	100	9	100	9	100	5	100	0	100	0
BENTGRASS													
1 Control		100	0	100	0	100	a	100	a	100	0	100	0
2 Clethodim	0.05	100	8	25	8	38	8	53	7	70	5	70	5
3 Clethodim	0.10	100	9	13	9	13	9	13	9	is	8	15	8
4 Clethodim	0.15	100	9	0	9	0	9	0	9	0	9	0	9
5 Clethodim + Assist	0.05 + 1%	100	9	28	9	28	8	30	7	30	7	30	7
6 Clethodim + Assist	0.10 + 1%	100	8	11	8	14	8	14	8	14	8	14	8
7 Clethodim + Assist	0.15 + 1%	100	8	0	9	0	9	a	9	0	9	0	9

%S - % stand; I - crop injury; 0-10. 10-complete kill

Clethodim caused severe injury to Kentucky bluegrass at 0.05 to 0.15 kg/ha. However, there was no stand reduction and the K. bluegrass recovered 1 month after treatment. Clethodim at 0.10 and 0.15 kg/ha reduced the bentgrass stand by more than 80%. At 0. 05 kg/ha the addition of Assist (1%) increased the efficacy of clethodim on bentgrass. These results indicate that clethodim may have potential for the selective removal of bentgrass from K. bluegrass swards. (Dept. Environ. Biol., Univ. Guelph).

Phytotoxicity of sethoxydim when applied to established Kentucky bluegrass and bentgrass. Hall, J.C. and K. Christensen. Experiment location- Cambridge Research Station; Crop- pure stands of Kentucky bluegrass and bentgrass; Soil type- Sandy loam; Plot size- 1 x 2 m; Experimental design-randomized complete block; Replicates- 4; AT APPLICATION: Date and method- 870626-POST; Equipment- bicycle sprayer; Volume- 700 L/ha; Pressure- 200 kPa; ' Tips- SS8002LP; Date of assessment- injury; % stand; (T1) 870703, (T2) 870710, (T3) 870717, (T4) 870724, (T5) 870731, (T6) 870807.

KENTUCKY BLUEGRASS

# TREATMENT	DOSE kg/ha	WEEKS AFTER TREATMENT T1		T2		T3		T4		T5		T6	
		%S	I	%S	I	%S	I	%S	I	%S	I	%S	I
1 Control		100	0	100	0	100	0	100	0	100	0	100	0
2 Sethoxydim + Assist	0.10 + 1.00%	100	3	75	6	100	4	100	4	100	1	IV	0
3 Sethoxydim + Assist	0.15 + 1.00%	100	4	75	6	100	4	100	4	100	2	100	1
4 Sethoxydim + Assist	0.20 + 1.00%	100	4	63	7	100	4	100	4	100	3	100	1
5 Sethoxydim + Assist	0.25 + 1.00	100	5	63	7	100	5	100	5	100	3	100	1
6 Sethoxydim + Assist	0.30 + 1.00%	100	3	95	4	100	3	100	3	100	1	100	0
7 Sethoxydim	0.10	100	5	70	7	100	4	100	4	100	3	100	0
8 Sethoxydim	0.15	100	4	63	8	100	4	100	4	100	1	100	0
9 Sethoxydim	0.20	100	5	63	7	100	3	100	3	100	1	100	0
10 Sethoxydim	0.25	100	5	60	8	100	4	100	4	100	2	100	1
11 Sethoxydim	0.30	100	5	53	8	100	5	100	5	100	2	100	1
12 Control		100	0	100	0	100	0	100	0	100	0	100	0

BENTGRASS

# TREATMENT	DOSE kg/ha	WEEKS AFTER TREATMENT T1		T2		T3		T4		T5		T6	
		%S	I	%S	I	%S	I	%S	I	%S	I	%S	I
1 Control		100	0	100	0	100	0	100	0	100	0	100	0
2 Sethoxydim + Assist	0.10 + 1.00%	100	5	100	7	70	7	70	2	70	2	88	1
3 Sethoxydim + Assist	0.15 + 1.00%	100	6	100	7	53	8	53	2	53	2	70	2
4 Sethoxydim + Assist	0.20 + 1.00%	100	7	100	8	13	9	13	7	13	6	39	4
5 Sethoxydim + Assist	0.25 + 1.00%	100	5	100	8	5	9	5	8	5	7	10	7
6 Sethoxydim	0.10	100	5	100	6	78	7	78	1	78	0	93	1
7 Sethoxydim	0.15	100	5	100	7	39	8	46	3	46	2	63	2
8 Sethoxydim	0.20	100	6	100	8	14	9	14	7	14	6	48	4
9 Sethoxydim	0.25	100	7	100	8	20	9	20	8	20	8	35	6
10 Sethoxydim	0.30	100	6	100	8	0	9	0	9	0	9	10	8
11 Control		100	0	100	0	100	0	100	0	100	0	100	0

%S - % stand; I - injury; 0-10, 10- complete kill

Sethoxydim at doses of 0.15 to 0.30 kg/ha significantly reduced established bentgrass. Although all doses-were phytotoxic to Kentucky bluegrass, this grass recovered 1.5 months after treatment. Sethoxydim did not reduce the density fo the K. bluegrass swards. (Dept. Environ. Biol., Univ. Guelph).

Use of sethoxydim for the selective control of bentgrass infestations in Kentucky bluegrass. Hall, J.C. and K. Christensen, Experiment location- Cambridge Research Station; Crop- Kentucky bluegrass and bentgrass mixed stand; Soil type- Sandy loam; Plot size- 1 x 2 m; Experimental design- randomized complete block; Replicates- 4; AT APPLICATION: Date and method- 870626-POST; Equipment- bicycle sprayer; Volume- 700 L/ha; Pressure- 200 kPa; Tips- SS8002LP; Date of assessment- pre-spray rating (T1); % of plot infested with bentgrass; Kentucky bluegrass injury; (T1) 870626, (T2) 870703, (T3) 870710, (T4) 870717, (T5) 870724, (T6) 870731.

# TREATMENT	DOSE	WEEKS AFTER TREATMENT											
	kg/ha	T1		T2		T3		T4		T5		T6	
		%SD	I	%SD	I	%SD	I	% SD	I	% SD	I	% SD	I
1 Control		35	0	35	0	35	0	35	0	35	0	38	0
2 Sethoxydim + Assist	0.10 + 1.00%	35	0	20	4	20	4	23	0	23	0	24	0
3 Sethoxydim + Assist	0.15 + 1.00%	35	0	3	6	3	6	4	0	4	0	6	0
4 Sethoxydim + Assist	0.20 + 1.00%	20	0	1	5	1	5	0	0	0	0	1	0
5 Sethoxydim + Assist	0.25 + 1.00%	33	1	5	5	5	5	0	0	0	0	3	0
6 Sethoxydim + Assist	0.10	33	0	4	5	4	5	10	0	10	0	13	0
7 Sethoxydim	0.15	23	0	5	5	5	5	5	0	5	0	8	0
8 Sethoxydim	0.20	20	8	3	5	3	5	1	0	1	0	5	0
9 Sethoxydim	0.25	25	0	3	5	3	5	0	0	0	0	1	0
10 Sethoxydim	0.30	36	8	3	7	3	7	0	0	0	0	0	0
11 Control		23	0	20	0	20	0	23	0	23	0	25	0

%S - % of plot infested with annual bluegrass; I - crop injury; 0-10, 10-complete kill

Sethoxydim at doses of 0.10 to 0.30 kg/ha significantly reduced bentgrass infestations in established K. bluegrass swards. Although all doses were phytotoxic to K. bluegrass, this grass recovered 1 month after treatment. Sethoxydim did not reduce the density of the K. bluegrass sward. (Dept. Environ. Biol., Univ. Guelph).

Alternatives to 2,4-D for the control of broadleaf weeds in turf - Experiment # 1. Hall, J.C. and K. Christensen. Experiment location - Guelph Regional Airport ; Soil type- loam; Plot size- 2 x 2 m; Experimental design- randomized complete block; Replicates- 4; AT APPLICATION: Date and method- 870604-POST; Equipment- bicycle sprayer; Volume- 800 L/ha; Pressure- 200 kPa; Tips- SS8002LP; Crop stage of growth- Established; Weed stage of growth: Established; Date of assessment- prespray rating (Tl)- % of plot infested with dandelion, wild strawberry, broadleaved plantain, clover and mouse-eared chickweed; post spray rating - 3 dat, 3, and 6 weeks after treatment; (T1) 870529, (T2) 870625, (T3) 870716.

# TREATMENT	DOSE	INFESTATION (% OF PLOT)														
	kg/ha	D			S			P			C			CH		
		T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
1 Control		19	9	19	21	14	21	1	1	1	13	26	25	1	0	0
2 2,4-D/MCPP/Dica*	6.0 L/ha	15	1	3	18	12	18	1	0	0	8	1	0	1	0	0
3 MCPA K-Salt	1.250	13	1	8	8	2	13	0	0	0	19	2	4	1	0	0
4 MCPA Amine	1.250	21	5	19	13	3	9	1	0	0	7	2	7	1	0	0
5 MCPA Estamine	1.250	16	6	16	21	6	7	1	0	8	8	3	7	1	0	0
6 MCPA+Dica	1.250+0.140	15	1	5	21	16	19	1	1	0	14	2	1	1	0	0
7 MCPA+Dica	1.250+0.200	19	1	2	11	3	7	1	1	0	8	1	1	1	0	0
8 MCPA+Dica	1.250+0.280	15	2	2	15	9	14	1	2	0	11	1	0	1	0	0
9 MCPA+MCPP+Dica	1.250+0.630+0. 140'	11	1	3	18	13	15	2	1	0	5	1	0	1	0	0
10 MCPA+MCPP+Dica	1.250+1.250+0.140	18	1	5	20	7	7	2	1	0	8	1	0	1	0	0
11 Clo+Tri	0.140+0.140	18	2	7	9	6	7	3	3	0	5	1	0	1	0	0
12 Clo+Tri	0.140+0.280	14	2	6	18	18	13	3	1	0	11	1	0	1	0	0
13 Clo+Tri	0.280+0.280	16	1	2	21	16	20	1	1	0	5	1	0	1	0	0
14 Clo+Tri+Dica	0.140+0.280+0.140	15	1	2	17	12	14	0	0	a	9	1	0	1	0	0
15 Tri+Dica	0.140+0.140	16	1	15	20	27	35	2	1	0	9	1	3	1	0	0
16 Tri+Dica	0.280+0.140	15	2	6	19	12	13	1	1	1	6	1	2	1	0	0
17 Clo+Dico	0.140+0.140	16	1	3	18	19	21	2	1	0	8	1	0	1	0	0
18 Clo,+Dica	0.280+0.140	16	1	3	16	16	15	1	1	0	21	1	0	1	0	0
19 Clo+Tri+Chlor	0.140+0.140+0.140	11	1	4	16	12	24	1	1	8	13	14	8	1	0	0
20 Clo+Tri+Chlor	0.140+0.280+0.140	16	1	6	9	5	11	1	1	6	19	2	0	1	0	0
21 Clo+Tri+Chlor	0.140+0.140+0.280	18	1	1	9	7	9	1	0	0	13	1	0	1	0	0
22 Clo+Tri+Chlor	0.140+0.280+0.280	18	1	2	17	10	12	1	1	0	4	1	0	1	0	0
23 Tri+Chlor	0.280+0.140	15	1	12	15	8	14	1	1	8	3	1	0	1	0	0
24 Tri+Dica+Chlor	0.140+0.140+0.280	15	1	6	9	9	15	1	1	1	14	1	1	1	0	0
25 Tri+Dica+Chlor	0.280+0.140+0.280	16	11	9	13	9	17	1	1	0	7	2	1	1	0	0
26 2,4-0/MCPP/Dica**	6.00 L/ha	18	1	1	3	1	3	1	1	0	4	1	0	1	0	0
27 Control		16	19	19	9	7	11	1	1	1	5	30	10	1	0	0

D-dandelion; S-wild strawberry; P-plantain; C-lover; CH-chickweed;
Clo-clopyralid; Tri-triclopyr; Chlor- chlorflurenol; D-dicamba; *-Killex; **-Trimex.

(Dept. Environ. Siol., Univ. Guelph)

Chlorflurenol, clopyralid, dicamba, fluroxypyr and triclopyr used alternatives to 2,4-D for the control of broadleaf weeds in turf. Hall, J.C. and K. Christensen. Experiment location- Guelph Regional Airport; Soil type- loam; Plot size- 2 x 2 m; Experimental design- randomized complete block; Replicates- 4; AT APPLICATION: Date and method 870604-Post; Equipment- bicycle sprayer; Volume- 800 L/ha; Pressure- 200 kPa; Tips- SS8002LP; Crop stage of growth- Established; Weed stage of growth: Established; Date of assessment- prespray rating (Tl)- % of plot infested with dandelion, wild strawberry, broadleaved plantain, clover and mouse-eared chickweed; post spray rating - 3 dat, 3, and 6 weeks after treatment; (T1) 870529, (T2) 870625, (T3) 870716.

# TREATMENT	DOSE kg/ha	INFESTATION														
		D			S			P			C			CH		
		T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
1 Clopyrolid (XRM 3972)	0.07	3	1	1	1	1	1	0	1	0	1	0	0	1	1	0
2 Clopyralid (XRM 3972)	0.14	7	1	1	1	1	1	1	1	0	1	0	0	1	1	1
3 Clopyrolid (XRM 3972)	0.28	3	1	1	2	1	1	1	1	0	1	1	0	1	1	0
4 Clopyralid (XRM 3972)	0.35	3	1	1	1	1	1	0	1	0	1	0	0	1	1	0
5 Fluroxypyr (EF 689)	0.07	2	1	1	1	1	1	0	1	1	1	1	0	1	0	0
6 Fluroxypyr (EF 689)	0.14	3	1	1	1	1	1	0	1	0	1	0	0	1	1	0
7 Fluroxypyr (EF 689)	0.28	4	1	1	3	1	1	0	1	0	1	0	0	1	1	1
8 Fluroxypyr (EF 689)	0.42	6	1	1	1	1	1	0	1	0	1	0	0	1	1	0
9 Chlorflurenol	0.140	8	5	2	8	9	3	1	1	8	13	7	8	1	0	0
10 Chlorflurenol	0.280	10	2	2	4	7	3	0	1	0	15	11	10	1	1	1
11 Dicamba	0.140	10	2	1	3	5	7	0	0	0	13	7	1	1	1	1
12 Dicamba	0.280	10	1	2	3	2	1	0	1	0	11	3	0	1	0	1
13 Tri (XRM 3724)	0.140	11	3	6	5	5	3	0	1	0	8	8	5	1	1	1
14 Tri (XRM1 3724)	0.280	7	6	5	6	3	2	0	0	0	3	4	5	1	1	1
15 Tri (XRM 3724)	0.380	13	4	7	3	1	2	0	1	0	8	5	7	1	1	1
16 Tri (XRM 3724)	0.500	11	3	7	4	2	1	1	1	0	13	3	1	1	1	1
17 Clo (XRM 3972) + Tri	0.070+0.380	9	4	7	4	2	2	0	0	0	4	1	0	1	1	1
18 Clo (XRM 3972) + Tri	0.14M.380	11	3	5	3	1	1	0	0	0	8	1	0	1	0	1
19 Clo (XRM 3972) + Tri	0.070+0.500	10	2	7	7	3	1	0	0	0	9	1	0	1	0	1
20 Clo (CRM 3972) + Tri	0.140+0.500	11	2	3	1	1	1	0	0	0	6	1	0	1	0	1
21 Dica + Chlor	0.140+0.140	11	3	2	3	6	8	1	1	0	7	2	0	1	0	1
22 Dica + Chlor	0.280+0.140	15	2	5	3	6	7	1	1	0	7	1	0	1	0	1
23 Dica + Chlor	0.140+0.280	9	1	2	4	7	7	0	0	6	9	1	0	1	0	0
24 Dica + Chlor	0.280+0.280	11	1	2	2	1	1	1	1	1	5	1	0	1	0	1
25 Tri + Chlor	0.140+0.140	8	2	8	5	3	2	1	1	1	8	4	5	1	1	0
26 Tri + Chlor	0.140+0.280	13	3	6	3.	2	3	1	1	0	5	7	6	1	1	1
27 Tri + Chlor	0.280+0.280	11	2	3	4	1	7	1	1	0	6	1	0	1	1	1
28 Clo + Chlor	0.140+0.140	10	3	3	6	8	7	1	1	0	5	1	0	1	0	1
29 Clo + Chlor	0.140+0.280	6	1	2	10	9	1	0	0	0	10	1	0	1	0	1
30 Tri + Dica + Chlor	0.280+0.140+0.140	8	1	2	5	3	4	1	1	1	4	1	0	1	0	0
31 Clo + Dica + Chlor	0.140+0.140+0.280	10	1	1	5	4	6	1	1	0	4	1	0	1	0	0

0-dandelion; S-wild strawberry; P-plantain; C-clover; CH-chickweed;
Clo - Clopyralid; Tri - Triclopyr; Chlor - Chlorflurenol; Dica - Dicamba

(Dept. Environ. Biol., Univ. Guelph)

Clopyralid, 2,4-DP, dicamba, MCPA, MCPP, and triclopyr used as alternatives to 2,4-D for broadleaf weed control in turf. Hall, J.C. and K. Christensen. Experiment location- Guelph Regional Airport; Soil type- loam; Plot size- 2 x: 2 m; Experimental design- randomized complete block; Replicates- 4; AT APPLICATION: Date and method- 870604-POST; Equipment- bicycle sprayer; Volume- 800 L/ha; Pressure- 200 kPa; Tips- SS8002LP; Crop stage of growth- Established; Weed stage of growth: Established; Date of assessment- prespray rating (T1) - % of plot infested with dandelion, wild strawberry, broadleaved plantain, clover and mouseeared chickweed; postspray rating - 3 dat, 3, and 6 weeks after treatment; (T1) 870529; (T2) 870625,(T3) 870716.

# TREATMENT	DOSE	INFESTATION (% OF PLOT)														
	kg/ha	D			S			P			C			CH		
		T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
1 MCPA (May&Baker)	0.63	6	1	1	3	1	1	0	0	0	1	0	0	1	1	1
2 MCPA	1.25	9	1	1		1	1	0	0	0	1	0	1	1	1	1'
3 MCPP 0 (May&Baker)	0.63	8	1	1	1	1	1	0	0	0	1	0	0	1	1	1
4 MCPP 0	1.25	4	1	1	2	1	1	0	0	0	1	0	0	1	1	1
5 2,4-DP (Moy&Baker)	0.63	7	1	1	3	1	1	0	0	0	1	0	0	1	1	1
6 2,4-DP	1.25	5	1	1	3	1	1	0	0	0	1	0	0	1	1	1
7 2,4-DP+MCPP D	1.25+0.63	5	2	1	6	2	1	0	0	0	1	0	0	1	1	1
8 MCPA+MCPP D	1.25+0.63	7	1	1	3	1	1	0	0	0	1	0	0	1	1	0
9 MCPA+MCPP D	1.25+1.25	4	1	1	4	1	1	0	0	0	1	0	0	1	1	1
10 MCPA+2,4-DP	0.63+1.25	7	1	1	1	1	1	0	0	0	1	0	0	1	1	0
11 MCPA+2,4-DP	1.25+0.63	6	1	1	2	1	1	0	0	0	1	1	0	1	1	1
12 MCPA+2,4-DP	1.25+1.25	8	1	1	2	1	1	0	0	0	1	0	0	1	1	0
13 MCPA+2,4-DP+MCPP D	0.63+0.63+0.63	5	1	1	3	1	1	0	0	0	1	0	0	1	1	0
14 MCPA+2,4-DP+MCPP D	1.25+1.25+0.63	3	1	1	3	1	1	0	0	0	1	0	0	1	1	1
15 2.4-DP/MCPA (premix)	5.00 L/ha	8	2	1	3	2	1	0	0	0	1	1	0	1	1	0
16 2,4-DP/MCPA (premix)	7.50 L/ha	6	2	1	2	1	1	0	0	0	1	0	0	1	1	0
17 2,4-DP/MCPA (premix)	10.00 L/ha	5	1	1	3	1	0	0	0	0	1	0	0	1	1	0
18 Clo+Tri+Dica	0.175+0.280+0.052	5	1	1	8	1	1	1	0	0	4	0	0	1	0	1
19 Clo+Tri+Dica	0.263+0.420+0.079	5	1	1	3	1	1	1	1	0	2	0	0	1	0	0
20 Clo+Tri+Dica	0.350+0.560+0.015	6	1	1	3	1	1	0	0	0	3	0	0	1	0	1
21 Clo+Tri+Dica+Chlor	0.175+0.28+0.052+0.14	5	1	1	8	1	1	1	1	0	3	0	0	1	0	1
22 Clo+Tri+Dica+Chlor	0.263+0.42+0.079+0.14	5	1	1	7	2	1	1	1	0	1	0	0	1	1	1
23 Clo+Tri+Dica+Chlor	0.350+0.56+0.105+0.14	6	1	1	4	1	1	0	0	0	1	0	0	1	0	1
24 Clo+Tri+Dica+Chlor	0.140+0.140+0.14+0.14	5	1	1	5	1	1	1	0	0	4	0	0	1	0	1
25 Clo+Tri+Dica	0.140+0.140+0.140	5	1	1	7	2	1	1	1	1	2	0	0	1	0	1
26 Clo+Dica+Chlor	0.140+0.140+0.140	5	1	1	3	1	1	1	0	1	5	0	0	1	1	1
27 Tri+Dica+Chlor	0.140+0.140+0.140	5	1	1	7	1	1	1	0	0	2	0	0	1	1	1
28 Amber	0.015	5	1	1	7	1	1	1	0	0	2	0	0	1	1	1
29 Amber+Dicamba	0.015+0.140	5	1	1	3	1	1	0	0	0	2	0	0	1	1	1

D-dandelion; S-wild strawberry; P-plantain; C-clover; CH-chickweed;
Clo-Clopyralid; Tri-Triclopyr; Chlor-Chlorflurenol; Dica-Dicamba

(Dept. Environ. Biol., Univ. Guelph).

Alternatives to 2,4-D for the control of broadleaf weeds in turf-Experiment # 2. Hall, J.C. and K. Christensen. Experiment location-Guelph Regional Airport; Soil type-loam; Plot size- 2 x 2 m; Experimental design-randomized complete block; Replicates- 4; AT APPLICATION: Date and method- 870604-POST; Equipment- bicycle sprayer; Volume- 800 L/ha; Pressure- 200 kPa; Tips- S38002LP; Crop stage of growth-Established; Weed stage of growth: Established; Date of assessment- prespray rating (T1) - % of plot infested with dandelion, wild strawberry, broadleaved plantain. clover and mouse-eared chickweed; postspray rating - 3 dat. 3. and 6 weeks after treatment; (T1) 870529; (T2) 870625. (T3) 870716.

# TREATMENT	DOSE	INFESTATION (% OF PLOT)														
	ml/100m^2	D			S			P			C			CH		
		T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
1 2.4-D/MCPP/Dica*	60.00	5	1	1	4	1	1	0	0	0	2	0	0	1	0	0
2 2.4-D/MCPP/Dica**	60.00	5	1	1	2	1	1	0	1	0	1	0	0	1	0	0
3 Int-86061	60.00	6	1	1	3	1	1	1	1	0	2	0	0	1	0	0
4 Int-86062	60.00	3	1	1	3	1	1	0	0	0	1	0	0	1	1	0
5 Int-86063	60.00	6	1	1	1	1	0	0	0	0	1	0	0	1	1	1
6 Int-86064	60.00	7	1	1	4	1	1	0	0	0	1	0	0	1	0	0
7 Int-86065	60.00	8	1	1	3	1	1	0	0	0	1	0	0	1	0	1
8 Int-86066	60.00	6	1	1	1	1	1	1	0	0	1	0	0	1	0	1
9 Int-87067	60A0	6	2	1	4	1	1	1	1	1	1	0	0	1	0	0
10 Int-87068	60.00	3	1	1	3	1	1	0	1	0	1	0	0	1	1	0
11 Int-87069	60.00	5	1	1	3	1	1	1	0	1	1	0	0	1	0	1
12 Int-87070	60.00	6	1	1	4	1	1	1	0	1	1	0	0	1	1	0
13 Int-87-check	60.00	6	1	1	2	1	1	1	1	0	1	0	0	1	1	0

D-dandelion; S-wild strawberry; P-plantain; C-clover; CH-chickweed;
*-Trimex; --Killex

Granular herbicides used as alternatives to 2,4-D in turf. Hall, J.C. and K. Christensen. Experiment location- Guelph Regional Airport; Soil type loam; Plot size 2 x 2 m; Experimental design randomized complete block; Replicates 4; AT APPLICATION: Date and method- 870620-POST; Equipment- Scotts fertilizer spreader; Crop stage of growth- Established; Weed stage of growth: Established; Date of assessment- prespray rating (T1) - % of plot infested with dandelion, wild strawberry. broadleaved plantain, clover and mouse-eared chickweed; postspray rating - 3 dat. 3, and 6 weeks after treatment; (T1) 870620; (T2) 870711. (T3) 870801.

# TREATMENT.	DOSE kg/ha	SPREADER SETTINGS	INFESTATION (% OF PLOT)														
			D			S			P			C			CH		
			T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
1 S-1092	1.50	6	23	15	1	1	1	0	1	1	1	7	3	0	3	3	1
2 S-2150	1.50	6 1/8	20	12	1	0	1	1	0	1	1	12	10	1	1	1	1
3 S-2149	1.20	4 1/2	20	14	1	1	1	1	1	1	0	7	4	0	1	1	1
4 S-1858	1.20	4 3/4	23	14	1	1	1	1	2	3	0	10	5	0	1	1	1

D-dandelion; S-wild strawberry; P-plantain; C-clover; Ch-chickweed;

(Dept. Environ. Biol.. Univ. Guelph)

Effect of plant growth regulators on Kentucky bluegrass. Hall, J.C. and K. Christensen. Experiment location- Cambridge Research Station; Crop- Kentucky bluegrass pure stand; Soil type- Sandy loam; Planting date- 1986; Plot size- 1 x 2 m; Experimental design- randomized complete block; Replicates- 4; AT APPLICATION: Date and method- 870527-POST; Equipment- bicycle sprayer: Volume- 700 L/ha; Pressure- 200 kPa; Tips- SS8002LP; Date of assessment- % stand per plot, % seedheads per plot. colour, height (mm); (T1) 870610, J2) 870708, (T3) 870805.

TREATMENT	DOSE	T1				T2				T3			
	kg/ha	%SD	%SH	CR	HT	%SD	%SH	CR	HT	%SD	%SH	CR	HT
1 Control		100	90	0	112	100	3	0	121	100	0	0	130
2 Maleic hydrazide	3.50	100	75	3	61	68	3	5	71	68	0	5	97
3 Maleic hydrazide	7.00	100	60	3	51	58	0	5	91	53	0	5	129
4 Amidichlor	2.50	100	73	2	57	100	0	1	87	100	0	25	141
5 Amidichlor	2.75	100	68	2	61	80	0	3	77	75	0	2	66
6 Amidichlor	3.00	100	63	4	53	93	0	2	79	90	0	2	99
7 EPTC EC	2.00	100	70	1	88	100	0	0	123	100	0	0	104
8 EPTC EC	4.00	83	55	3	61	93	0	0	140	93	0	3	102
9 Chlorflurenol	0.25	88	73	2	119	100	0	0	149	100	0	1	107
10 Chlorflurenol	0.50	95	80	1	111	100	0	0	142	100	0	0	111
11 Paclobutrazol	0.50	100	78	0	45	75	5	2	72	75	0	0	137
12 Paclobutrazol	1.00	100	85	0	41	53	0	5	55	53	0	8	81
13 Paclobutrazol	1.50	100	90	0	38	45	0	0	44	45	0	0	90
14 Paclobutrazol on fertilizer	0.25	100	90	0	123	50	0	0	91	75	0	0	111
15 Paclobutrazol on fertilizer	0.50	100	90	0	120	50	0	0	79	50	0	0	118
16 Paclobutrazol on fertilizer	1.00	100	90	0	108	45	0	0	93	45	0	0	102
17 Paclobutrazol on fertilizer	1.50	100	85	0	63	78	0	0	52	78	0	0	111
18 Paclobutrazol on fertilizer*	0.32/0.32	100	95	0	59	65	0	3	53	65	0	0	103
19 Paclobutrazol on fertilizer*	0.48/0.48	100	90	0	56	88	0	2	63	88	0	1	107
20 XE-1019	0.14	100	75	0	50	23	0	0	67	38	0	0	64
21 XE-1019	0.21	95	58	10	44	10	0	3	52	20	0	3	120
22 XE-1019	0.28	100	68	0	42	43	0	2	51	28	0	1	71
23 Paclobutrazol + EPTC EC	1.00 + 2.00	90	53	4	35	40	0	7	61	18	0	8	82
24 Paclobutrazol + EPTC EC	1.00 + 4.00	85	60	6	30	45	0	9	53	13	0	10	65
25 Paclobutrazol + EPTC EC	1.50 + 2.00	98	60	5	34	33	0	9	50	10	0	10	54
26 Paclobutrazol +EPTC EC	1.50 + 4.00	95	58	5	28	53	0	9	65	9	0	10	58
27 Paclobutrazol+maleic hydrazide	1.00 + 3.50	100	53	4	50	60	0	6	41	25	0	8	107
28 Paclobutrazol+maleic hydrazide	1.00 + 7.00	95	58	5	31	25	0	16	37	25	0	8	53
29 Poclobutrazol+maleic hydrazide	1.50 + 3.50	88	63	4	31	5	0	10	42	0	0	10	63
30 Paclobutrazol+maleic hydrazide	1.50 + 7.00	95	35	5	29	0	0	10	35	0	0	10	64
31 XE-1019 + EPTC EC	0.14 + 2.00	90	50	4	34	48	0	8	60	20	0	8	66
32 XE-1019 + EPTC EC	0.14 + 4.00	90	45	6	33	33	0	8	74	28	0	8	82
33)CE-1019 + EPIC EC	0.21 + 2.00	100	75	4	62	55	0	7	68	35	0	8	69
34 XE-1019 + EPTC EC	0.21 + 4.00	95	68	4	32	13	0	9	47	10	0	10	76
35 Paclobutrazol + Chlorflurenol	1.00 + 0.25	93	68	4	37	35	0	9	49	20	0	10	73
36 Paclobutrazol + Chlorflurenol	1.00 + 0.50	85	55	4	36	20	0	10	70	20	0	10	69
37 Paclobutrazol + Chlorflurenol	1.50 + 0.25	78	53	4	35	30	0	8	53	23	0	9	75
38 Paclobutrazol + Chlorflurenol	1.50 + 0.25	73	45	4	34	45	0	8	69	30	0	8	82
39 XE-1019 + Chlorflurenol	0.14 + 0.25	95	63	3	42	48	0	9	79	30	0	9	77
40 XE-1019 + Chlorflurenol	0.14 + 0.50	98	75	2	49	83	0	7	102	70	0	6	80
41 XE-1019 + Chlorflurenol	0.21 + 0.25	100	78	2	36	58	0	8	65	45	0	8	82
42 XE-1019 + Chlorflurenol	0.21 + 0.50	78	70	3	49	48	0	6	91	48	0	6	86
43 Control		100	100	0	112	100	18	0	121	100	0	0	130

*TGR; %SD-% stand per plot; %SH-% seedhead per plot; CR-colour (0-10; 0=green, 5-yellow. 10-brown);HT-height (mm)

(Dept. Environ. Biol., Univ. Guelph)

Effect of plant growth regulators on annual bluegrass. Hall. J.C. and K. Christensen. Experiment location- Cambridge Research Station; Crop- Annual bluegrass pure stand; Soil type- Sandy loam; Planting date 1986; Plot size- 1 x 2 m; Experimental design- randomized complete block; Replicates- 4; AT APPLICATION: Date and method- 870527-POST; Equipment- bicycle sprayer; Volume- 700 L/ha; Pressure- 200 kPa: Tips- SS8002LP; Date of assessment- % stand per plot, % seedheads per plot, colour, height; (T1) 870610. (T2) 870708, (T3) 870805.

# TREATMENT	DOSE	T1				T2				T3			
	kg/ha	%SD	%SH	CR	HT	%SD	%SH	CR	HT	%SD	%SH	CR	HT
1 Control		100	90	0	112	100	3	0	121	100	0	0	130
2 Maleic hydrazide	3.50	100	75	3	61	68	3	5	71	68	0	5	97
3 Maleic hydrazide	7.00	100	60	3	51	58	0	5	91	53	0	5	129
4 Amidichlor	2.50	100	73	2	57	100	0	1	87	100	0	25	141
5 Amidichlor	2.75	100	68	2	61	80	0	3	77	75	0	2	66
6 Amidichlor	3.00	100	63	4	53	93	0	2	79	90	0	2	99
7 EPTC EC	2.00	100	70	1	88	100	0	0	123	100	0	0	104
8 EPTC EC	4.00	83	55	3	61	93	0	0	140	93	0	3	102
9 Chlorflurenol	0.25	88	73	2	119	100	0	0	149	100	0	1	107
10 Chlorflurenol	0.50	95	80	1	111	100	0	0	142	100	0	0	111
11 Paclobutrazol	0.50	100	78	0	45	75	5	2	72	75	0	0	137
12 Paclobutrazol	1.00	100	85	0	41	53	0	5	55	53	0	8	81
13 Paclobutrazol	1.50	100	90	0	38	45	0	0	44	45	0	0	90
14 Paclobutrazol on fertilizer	0.25	100	90	0	123	50	0	0	91	75	0	0	111
15 Paclobutrazol on fertilizer	0.50	100	90	0	120	50	0	0	79	50	0	0	118
16 Paclobutrazol on fertilizer	1.00	100	90	0	108	45	0	0	93	45	0	0	102
17 Paclobutrazol on fertilizer	1.50	100	85	0	63	78	0	0	52	78	0	0	111
18 Paclobutrazol on fertilizer*	0.32/0.32	100	95	0	59	65	0	3	53	65	0	0	103
19 Paclobutrazol on fertilizer*	0.48/0.48	100	90	0	56	88	0	2	63	88	0	1	107
20 XE-1019	0.14	100	75	0	50	23	0	0	67	38	0	0	64
21 XE-1019	0.21	95	58	10	44	10	0	3	52	20	0	3	120
22 XE-1019	0.28	100	68	0	42	43	0	2	51	28	0	1	71
23 Paclobutrazol + EPTC EC	1.00 + 2.00	90	53	4	35	40	0	7	61	18	0	8	82
24 Paclobutrazol + EPTC EC	1.00 + 4.00	85	60	6	30	45	0	9	53	13	0	10	65
25 Paclobutrazol + EPTC EC	1.50 + 2.00	98	60	5	34	33	0	9	50	10	0	10	54
26 Paclobutrazol +EPTC EC	1.50 + 4.00	95	58	5	28	53	0	9	65	9	0	10	58
27 Paclobutrazol+maleic hydrazide	1.00 + 3.50	100	53	4	50	60	0	6	41	25	0	8	107
28 Paclobutrazol+maleic hydrazide	1.00 + 7.00	95	58	5	31	25	0	16	37	25	0	8	53
29 Poclobutrazol+maleic hydrazide	1.50 + 3.50	88	63	4	31	5	0	10	42	0	0	10	63
30 Paclobutrazol+maleic hydrazide	1.50 + 7.00	95	35	5	29	0	0	10	35	0	0	10	64
31 XE-1019 + EPTC EC	0.14 + 2.00	90	50	4	34	48	0	8	60	20	0	8	66
32 XE-1019 + EPTC EC	0.14 + 4.00	90	45	6	33	33	0	8	74	28	0	8	82
33)CE-1019 + EPIC EC	0.21 + 2.00	100	75	4	62	55	0	7	68	35	0	8	69
34 XE-1019 + EPTC EC	0.21 + 4.00	95	68	4	32	13	0	9	47	10	0	10	76
35 Paclobutrazol + Chlorflurenol	1.00 + 0.25	93	68	4	37	35	0	9	49	20	0	10	73
36 Paclobutrazol + Chlorflurenol	1.00 + 0.50	85	55	4	36	20	0	10	70	20	0	10	69
37 Paclobutrazol + Chlorflurenol	1.50 + 0.25	78	53	4	35	30	0	8	53	23	0	9	75
38 Paclobutrazol + Chlorflurenol	1.50 + 0.25	73	45	4	34	45	0	8	69	30	0	8	82
39 XE-1019 + Chlorflurenol	0.14 + 0.25	95	63	3	42	48	0	9	79	30	0	9	77
40 XE-1019 + Chlorflurenol	0.14 + 0.50	98	75	2	49	83	0	7	102	70	0	6	80
41 XE-1019 + Chlorflurenol	0.21 + 0.25	100	78	2	36	58	0	8	65	45	0	8	82
42 XE-1019 + Chlorflurenol	0.21 + 0.50	78	70	3	49	48	0	6	91	48	0	6	86
43 Control		100	100	0	112	100	18	0	121	100	0	0	130

*TGR; %SD-% stand per plot; %SH-% seedhead per plot; CR-colour (0-10; 0=green, 5-yellow. 10-brown);HT-height (mm)

(Dept. Environ. Biol., Univ. Guelph)

Effect of plant growth regulators on bentgrass. Hall, J.C. and K. Christensen. Experiment locitionCambridge Research Station; Crop- Bentgrass pure stand; Soil type- Sandy loam; Planting date- 1986; Plot size-
1 x 2 m; Experimental design- randomized complete block; Replicates- 4; AT APPLICATION: Date and method-870527-POST; Equipment- bicycle sprayer; Volume- 700 L/ha; Pressure- 200 kPa; Tips- SS8002LP: Date at assessment- % stand per plot, % seedheads per plot, colour. height (mm); (Tl) 870G10, (T2) 870708, J3) 870805.

# TREATMENT	DOSE	T1				T2				T3			
	kg/ha	%SD	%SH	CR	HT	%SD	%SH	CR	HT	%SD	%SH	CR	HT
1 Control		100	0	0	22	100	25	0	48	100	0	0	97
2 Maleic hydrazide	3.50	100	0	3	16	100	3	1	46	100	0	0	85
3 Maleic hydrazide	7.00	100	0	3	13	95	0	0	43	100	0	0	82
4 Amidichlor	2.50	100	0	3	14	100	10	1	44	100	0	0	73
5 Amidichlor	2.75	100	0	3	13	100	13	1	40	100	0	0	75
6 Amidichlor	3.00	100	0	3	16	100	11	1	40	100	0	0	73
7 EPTC EC	2.00	100	0	1	18	100	15	0	51	100	0	0	93
8 EPTC EC	4.00	100	0	3	14	100	21	1	52	100	0	0	86
9 Chlorflurenol	0.25	100	0	4	21	100	16	0	51	100	0	0	81
10 Chlorflurenol	0.50	100	0	4	24	100	8	0	60	100	0	0	88
ll Paclobutrazol	0.50	100	0	1	16	100	18	0	48	100	0	0	90
12 Paclobutrazol	1.00	100	0	2	12	100	20	2	30	100	0	0	59
13 Paclobutrazol	1.50	100	0	2	13	100	16	0	29	100	0	0	73
14 Paclobutrazol on fertilizer	0.25	100	0	0	22	100	18	0	62	100	0	0	91
15 Paclobutrazol on fertilizer	0.50	100	0	0	25	100	16	0	53	100	0	0	80
16 Paclobutrazol on fertilizer	1.00	100	0	0	25	100	10	0	65	100	0	0	96
17 Paclobutrazol on fertilizer	1.50	100	0	0	20	100	15	1	47	100	0	0	84
18 Paclobutrazol on fertilizer (TGR)	0.32/0.32	100	0	0	18	100	13	1	48	100	0	0	97
19 Paclobutrazol on fertilizer (TGR)	0.48/0.48	100	0	0	20	100	9	0	54	100	0	0	104
20 XE-1019	0.14	100	0	0	20	100	11	0	56	100	0	0	87
21 XE-1019	0.21	100	0	0	18	100	20	0	45	100	0	0	77
22 XE-1019	0.28	100	0	2	12	100	15	3	27	100	0	0	49
23, Paclobutrazol + EPTC EC	1.00 + 2.00	100	0	4	11	100	6	2	37	100	0	0	70
24 Paclobutrazol + EPTC EC	1.00 + 4.00	100	0	4	10	100	1	1	30	100	0	0	68
25 Paclobutrazol + EPTC EC	1.50 + 2.00	100	0	4	11	100	10	2	26	100	0	0	61
26 Paclobutrazol + EPTC EC	1.50 + 4.00	100	0	4	10	100	1	2	27	100	0	0	47
27 Paclobutrazol + Malefic hydrazide	1.00 + 3.50	100	0	4	11	100	0	2	36	100	0	0	61
28 Paclobutrazol + Malefic hydrazide	1.00 + 7.00	100	0	4	11	90	0	3	35	100	0	2	73
29 Paclobutrazol + Malefic hydrazide	1.50 + 3.50	100	0	4	12	95	6	2	28	100	0	0	63
30 Paclobutrazol + Malefic hydrazide	1.50 + 7:00	100	0	4	13	80	0	1	29	100	0	0	62
31 XE-1019 + EPTC EC	0.14 + 2.00	100	0	4	12	100	8	1	29	100	0	0	5
32 XE-1019 + EPTC EC	0.14 + 4.00	100	0	3	11	100	3	2	26	100	0	0	59
33 XE-1019 + EPIC EC	0.21 + 2.00	100	0	4	10	100	9	1	32	100	0	0	57
34 XE-1019 + EPTC EC	0.21 + 4.00	100	0	4	10	100	1	3	27	100-	0	0	46
35 Paclobutrazol + Chlorflurenol	1.00 + 0.25	100	0	2	16	100	14	0	41	100	0	0	82
36 Paclobutrazol + Chlorflurenol	1.00 + 0.50	100	0	2	14	100	4	2	34	100	0	0	64
37 Paclobutrazol + Chlorflurenol	1.50 + 0.25	100	0	3	15	100	3	2	26	100	0	0	57
38 Paclobutrazol + Chlorflurenol	1.50 + 0.50	100	0	3	13	100	4	2	24	100	0	0	58
39 XE-1019 + Chiorflurenol	0.14 + 0.25	100	0	2	16	100	10	1	29	100	0	0	57
40 XE-1019 + Chlorflurenol	0.14 + 0.50	100	0	0	18	100	5	2	37	100	0	0	61
41 XE-1019 + Chlorflurenol	0.21 + 0.25	100	0	0	21	100	9	2	41	100	0	0	75
42 XE-1019 + Chlorflurenol	0.21 + 0.50	100	8	1	14	100	11	2	27	100	0	0	58
43 Control		100	0	0	22	100	35	0	50	100	3	0	97

%SD- % stand per plot; %SH- % seedheads per plot; CR- colour (0-10; 0-green, 5-yellow. 10-brown); HT- height *(mm)*

(Dept. Environ. Biol., Univ. Guelph)

DISLODGABLE RESIDUES OF 2,4-D ON TURF

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In Ontario, 2,4-D has been extensively used for broad-leaved weed control in turfgrass areas such as parks, golf courses, homelawns and schoolyards. Recently however, public concern regarding the potential risk of human exposure through contact with the turf surface has lead to the restricted or discontinued use of 2,4-D in many weed control programs. Field and laboratory studies were conducted to determine the persistence, distribution and dislodgability of 2,4-D on turfgrass (Thompson et al., 1984).

The studies reported here are an extension of those earlier investigations and were designed to determine the effect of formulation and sunlight on the longevity and dislodgability of the phenoxy herbicide in the field. Included in the analysis are the residues of mecoprop and dicamba, two herbicides commonly found with 2,4-D in homelawn mixtures.

METHODS

Field plots were established at the University of Guelph, Cambridge Research Station on an established stand of Kentucky Blue/Annual Blue (*Poa pratensis/Poa annua*). Plots were scuffled across with bag and cheesecloth covered boots, anT the samples returned to the laboratory for extraction in acetone. Sampling times were 0, 1, 2, 3, 4, and 9 days, and the rate of application was 1.0 kg a.i./ha.

Sunlight vs. Shade

To determine the effect of sunlight on the persistence, distribution and dislodgability of 2,4-D, cores of turfgrass (12.7 cm diam X 2 cm depth) were cut from an established stand of Kentucky Blue/Annual Blue. A frame was constructed and covered with dark screening to provide shade for half of the pots and the other half were left exposed to natural sunlight. All the pots were protected from rain. Sampling times were 0, 1, 2, 3, 4, 5, 9, and 14 days. Various extraction procedures were used to determine the dislodgable, potentially dislodgable, bound and unavailable residues.

RESULTS

Liquid vs. Granular Formulations of 2,4-D + Mecoprop + Dicamba

In this study, dislodgable residues at Day 0 were higher for all three herbicides formulated together and applied as a liquid than when the three herbicides were applied as a granular. However, at Day 1, dislodgable residues from the granular application were not lower than from the spray. From that point on residues from both types of treatments showed similar rates of disappearance to less than 2.0% at Day 4 and less than 0.2% at Day 9.

Dislodgable residues of 2,4-D, mecoprop and dicamba - liquid

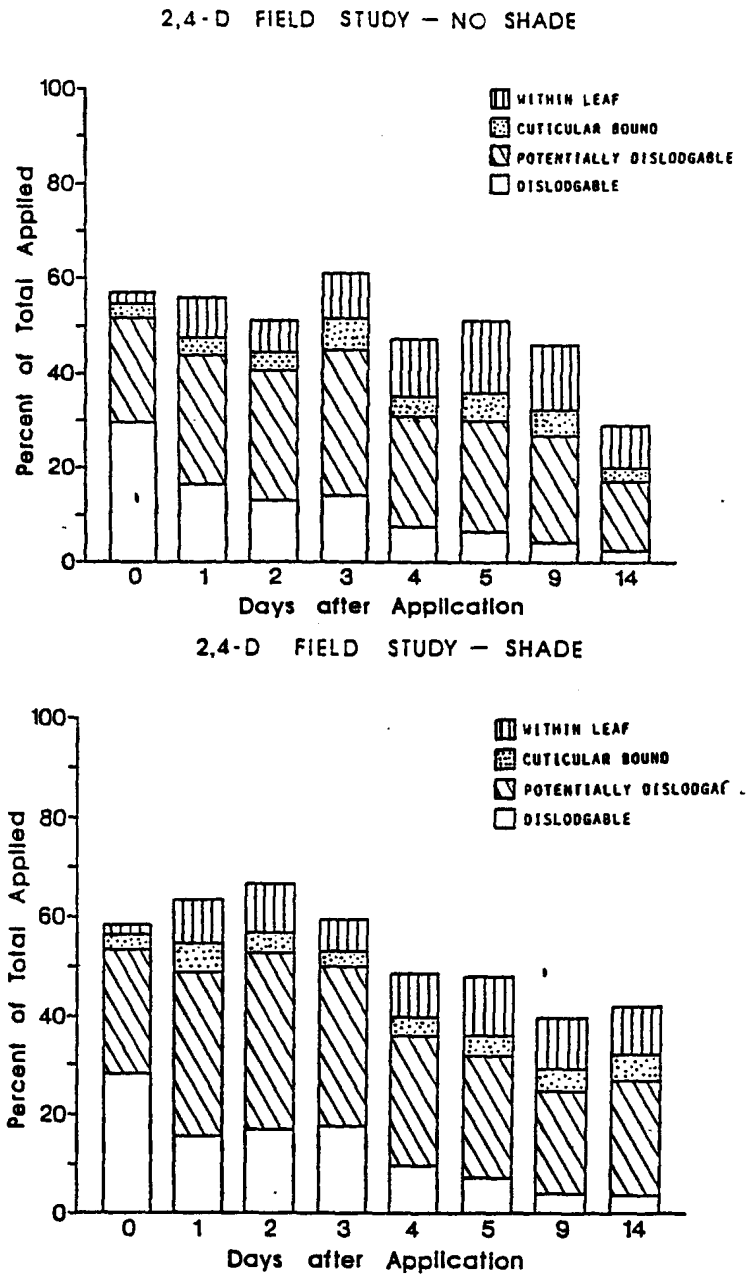
	% of total chemical applied		
Day	2,4-D	mecoprop	dicamba
0	7.8	7.5	1.2
1	4.4	3.0	0.6
2	1.3	0.6	0.2
3	1.5	0.4	0.1
4	1.3	0.3	0.06
9	0.01	0.005	0.01

Dislodgable residues of 2,4-D, mecoprop and dicamba - granular

	% of total chemical applied		
Day	2,4-D	mecoprop	dicamba
0	2.4	2.7	0.4
1	5.9	5.2	1.1
2	2.3	1.4	0.3
3	1.1	0.6	0.05
4	0.4	0.2	0.02
9	0.2	0.01	0.04

Sunlight vs. Shade

The dislodgable fraction of 2,4-D showed a rapid decline over the 14 days for both shaded and nonshaded turf. The potentially dislodgable fraction in both shaded and nonshaded treatments showed a general increase to Day 3 and then a decrease with the nonshaded turf having less at Day 14. The cuticle bound residue increased with time but was variable. The residues in the blades increased substantially to Day 5 and then decreased as a result of metabolism or movement to underground portions of the plant. Total residues recoverable were fairly high throughout the experiment but lower in the nonshaded turf at Day 14.



Data from the formulation experiment established that dislodgable residues of mecoprop and dicamba behave in a similar manner and show similar rates of disappearance as those observed for 2,4-D. 2,4-D was slightly more persistent on turf under shaded conditions outdoors than on turf in full sunlight. However, the effect of shade was not sufficient to explain the very rapid disappearance of dislodgable residues in outdoor experiments versus the earlier laboratory studies.

LATERAL MOVEMENT OF 2,4-D FROM GRASSY INCLINES

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The herbicide 2,4-D [(2,4-dichlorophenoxy)acetic acid] is recommended for the control of broadleaved weeds in parks, golf courses, and lawns, as well as along roadsides in the heavily populated areas throughout southern Ontario (Thompson et al. 1984). In many use-situations this compound is applied to grassy inclines adjacent to drainage ditches, slews, and ponds. Because of the high levels of annual rainfall and use of irrigation waters on golf courses and home lawns there is a need to establish whether these herbicides will move laterally in runoff water. There is substantial evidence to indicate that the phenoxy alkanoic acid herbicides can be readily washed from agricultural soils, to eventually contaminate ground and surface waters (Barnett et al. 1967, Bovey et al. 1974, Frank & Sirons 1980, Merkle & Bovey 1974, Que Hee & Sutherland 1981, Trichell et al. 1968, Wauchope & Savage 1977). However, little information exists on the lateral movement of the phenoxy alkanoic acid herbicides from grassy inclines with surface water into drainage systems. This fact coupled with the current public concern about the health risks and impact on non-target sites Thompson et al. 1984) of the phenoxy alkanoic acid herbicides made it imperative that studies be conducted to determine the environmental fate of these compounds in surface runoff water.

METHODS

Plant Material

Turfgrass strips (88 cm length X 26 cm width X 2.5 cm depth) were cut from a two year old sward of Kentucky bluegrass (*Poa pratensis*) and placed in plastic flats (88 cm length X 26 cm depth X 6 cm depth) containing a peat: soil: vermiculite mixture (1:1:1). The turf was allowed to re-establish for 3 months in a controlled environment growth room maintained at 25/18°C day/night period. The light source provided a photosynthetic electron flux of approximately 550 $\mu E\ m^{-2}\ s^{-1}$. Relative humidity was maintained at 65- 70%. Trimming and subirrigation were performed as required. Fertiliser (20:20:20 N:P:K; 3 g/l) was used to subirrigate the turf once every week.

After 3 months, some of the flats containing turfgrass were moved outside and allowed to adjust to the environmental conditions for 3 weeks. The turfgrass was watered and fertilised as described above. The outdoor environment resembled typical summer conditions in southern Ontario, with an average day/night temperature of 28/20°C, a 16 h photoperiod, and a relative humidity of 70- 80%. Prior to rainfall, the flats were covered with a clear sheet of plastic which was removed immediately after the rainfall ceased.

Herbicide Application and Collection of Runoff Water

A commercial formulation of 2,4-D amine (470 g a.e./l) was applied at a dose of 1 kg a.e./ha using a motorized hood sprayer equipped with a flat-fan nozzle (8002E) and calibrated to deliver 195 1/ha at 276 Kpa.

Immediately following herbicide application, four replicated treated flats were randomly assigned sampling times of 0, 1, 2, 3, 5, 6, and 10 days after treatment for the indoor experiments. Outdoor experiments included sampling times of 0 h, 6 h, 12 h, 1, 2, 3, 7, 11, and 14 days after treatment. Herbicide residues were estimated by placing the flats in an apparatus designed to incline the turf at a 28° angle from a horizontal plane. Exactly 5 l of distilled water was sprayed uniformly on the surface of the sod and the effluent that ran off the surface of the turf was collected in a stainless steel vessel.

Herbicide Extraction

The runoff water was transferred to a glass bottle, shaken for one minute, and its total volume determined. A 500 ml aliquot of the effluent water was filtered through a glass fibre filter (11 cm diam; Whatmen 934-AH) and acidified with 2 ml of H_2SO_4 (37 N). The aqueous solution was extracted twice with 150 and 100 ml, respectively, of ethyl acetate. The ethyl acetate fractions were combined, dried by passing over anhydrous sodium sulphate, and collected in a boiling flask containing methanol (2 ml). Rotary evaporation was used to remove the ethyl acetate, and the methanolic concentrate was then transferred to a sample tube. The boiling flask was rinsed with methanol (2 X 5 ml) to ensure that all herbicide residue was removed.

Preparation of Derivatives and Sample Clean-up

All sample extracts containing 2,4-D in methanol were converted to derivatives using a boron trifluoride/ methanol reagent (140 mg/g; BDH Chemical, Toronto, Ontario). The reaction was performed with sample tubes tightly sealed and partially immersed in a water bath (90°C) for 15 min. The efficiency of the methylating process was 95%.

Clean-up of the derivatised samples involved partitioning of the reaction products from distilled water (25 ml) into petroleum ether (3 X 5 ml). The ether fractions were combined, dried with anhydrous sodium sulphate, reduced to a volume of 6 ml under a stream of nitrogen gas at 50°C, and brought to a final volume of 10 ml with iso-octane.

Chromatography

Quantification of the methyl ester of 2,4-D was performed using a gasliquid chromatograph equipped with an electron- capture detector and a glass column (2 m length X 0.6 cm outside diam) packed with 5% OV-17 on a solid support of Gas Chrom Q (80-100 mesh). The conditions employed were: carrier gas, oxygen-free nitrogen at 43 ml/min; temperatures, injector 2000C, column 1800C, detector 3000C. Chromatographic peak areas were integrated electronically and compared with reference standards to obtain the mass of the herbicide. Results were corrected for esterification and extraction efficiencies which previously had been determined in replicated tests using samples fortified with analytical standards.

Statistical Analysis

All experiments were of a randomized design with four replicates per treatment. All experiments were conducted twice. Data from growth room and outdoor experiments were subjected to a one-way analysis of variance to determine the statistical significance of the reduction in herbicide residues

over time. A protected LSD test was used to evaluate the differences between means.

RESULTS

When effluent water was collected immediately after the application of the herbicide, 91.3% of the applied 2,4-D was present in the runoff water collected from turfgrass grown under controlled environment conditions (see Table 1). This level is equivalent to 11.4 mg per flat, and represents a residue concentration of 3.23 mg per litre of runoff water. The total applied herbicide was a calculated number (12.5 mg) based on the spray that theoretically should have been intercepted by the surface of the turfgrass contained in a flat. Within 1 day after application, the total quantity of 2,4-D collected in the runoff water was reduced to 8.1 mg which is equivalent to 64.6% of the total dose applied to a flat. There were two further decreases to 6.3 and 4.0 mg per flat by day 6 and 10, respectively. These levels are equivalent to 50.0 and 31.9% of the total applied dose, respectively. When compared to the quantity of 2,4-D recovered per flat at time 0, there was a 30, 55, and 65% decrease in recovery 1, 6, and 10 days after treatment, respectively. Because of the difference in the total amount of runoff water collected at each time, the statistical trends were not exactly the same when a comparison was made between the data expressed on mg per litre and on a mg per flat basis. Within I day after herbicide application, 2.30 mg per litre of 2,4-D was recovered and decreased to 1.93 and 1.43 mg per litre, respectively, 5 and 10 days after this application. When compared to the concentration of 2,4-D collected at time 0, there was a 29, 43, and 55% decrease 1, 6, and 10 days after treatment, respectively.

Table 1. Residues of 2,4-D recovered in effluent water collected after runoff from the surface of *Poa pratensis* sod grown under controlled environment conditions[a].

Time after application (days)	Residue recovered in runoff water		
	mg/l[b]	total recovery (mg/flat)[c]	% of dose applied[d]
0	3.23 (0-29)a	11.4 (0.5) a	91.3 (3.9) a
1	2.30 (0.29) b	8.1 (1.0) b	64.6 (7.9) b
2	2.30 (0.39) b	6.9 (1.8) bc	54.9 (14.9) bc
3	2.05 (0.19) bc	5.6 (1 3) c	44.4 (10.6) c
5	1.93 (0.30) c	6.8 (1.4) bc	54.7 (11.1) bc
6	1-85 0.25) c	6.3 (0.5) c	50.0 (4.0) c
10	1.45 (0.13) d	4.0 (1.1) d	31.9 (8.8) d
$LSD_{0.05}$	0.36	1.6	11.9

[a] Means in a column are followed by the standard deviation value in parenthesis. Means followed by the same letter(s) are not significantly different at the 5% value according to a protected LSD range test.

[b] 2,4-D recovery expressed as mg/l of surface runoff water.

[c] Quantity of 2,4-D present in the total volume of runoff water collected from a flat.

[d] Quantity of 2,4-D recovered in the runoff water when expressed as a percentage of the theoretical- dose (12.5 mg) applied to each flat of turf.

In the outdoor experiments, there was a significant effect due to time, no matter how the data were expressed (see Table 2). At time 0, 70.9% of the applied 2,4-D was present in the runoff water. This level is equivalent to 8.7 mg per flat and represents a residue concentration of 2.33 mg per litre of runoff water collected. Within half a day after treatment, there was a significant decrease in recovery to 7.7 mg per flat which is equivalent to 57.2% of the total dose applied per flat. There were two further decreases to 3.9 and 2.0 mg per flat by day 2 and 11, respectively. These levels are equivalent to 31.5 and 12.2% of the total applied dose, respectively. When compared to the quantity of 2,4-D recovered per flat at time 0, there was a 20, 55, and 83% decrease 0.5, 2, and 11 days after treatment, respectively. Because of the difference in total amount of runoff water collected after each time interval, the statistical trends were not exactly the same when a comparison was made between the data expressed on a mg per litre and a mg per flat basis. Within half a day after herbicide application, 1.90 mg of 2,4-D per flat was recovered and this level decreased to 1.25, 0.90, and 0.50, respectively, 2, 7, and 11 days after application. When compared to the concentration of herbicide in the runoff water collected at time 0, there was a 19, 47, 62, and 79% decrease 0.5, 2, 7, and 11 days after treatment, respectively.

Table 2. Residues of 2,4-D recovered in effluent water collected after runoff from the surface of *Poa pratensis* sod grown under outdoor environmental conditions[a].

Time after application (days)	Residue recovered in runoff water		
	mg/l[b]	total recovery (mg/flat)[c]	% of dose applied[d]
0	2.33 (0.17) a	8.7 (1.6)a	70.9 (12.2)a
0.25	1.95 (0-24) b	7.7 (1.4)ab	61.7 (10.8)ab
0.5	1.90 (0.29) bc	7.2 (1.1)bc	57.2 (9.3)bc
1	1.68 (0.50) c	5.9 (0.1)c	47.5 (1.7)c
2	1.25 (0. 17) d	3.9 (1.1)d	31.5 (9.1)d
3	1.05 (0. 13) de	3.1 (0.3)de	24.9 (2.5)d
7	0.90 (0.08) e	3.1 (0.7)de	24.5 (5.9)d
11	0.50 (0. 16) f	2.0 (0.6)ef	12.2 (8.5)e
14	0.38 (0.05) f	1.2 (0.3)f	9.8 (2.2)e
$LSD_{0.05}$	0.24	1.4	11.4

[a] Means in a column are followed by the standard deviation value in parenthesis. Means followed by the same letter(s) are not significantly different at the 5% value according to a protected LSD range test.

[b] 2,4-D recovery expressed as mg/1 of surface runoff water.

[c] Quantity of 2,4-D present in the total volume of runoff water collected from a flat.

[d] Quantity of 2,4-D recovered in the runoff water when expressed as a percentage of the theoretical dose (12.5 mg) applied to each flat of turf.

DISCUSSION

When a comparison was made between the data from the indoor and outdoor experiments, there was a significant difference in the amount of 2,4-D present in the runoff water (see Tables 1 and 2). At time 0, significantly more 2,4-D was removed by the runoff water in the indoor than in the outdoor experiment. Furthermore, approximately 17, 23, and 20% more of the applied 2,4-D was recovered per flat under indoor conditions, 1, 2, and 3 days after application, respectively. Ten days after treatment, 327o of the applied herbicide was present in the runoff water obtained from flats grown under controlled environment conditions, whereas in the outdoor experiments only 12.2% of the applied dose was recovered in the runoff water 11 days after treatment. However, comparison between the data from the indoor and outdoor experiments indicates that the rate of decrease in the 2,4-D residues found in the runoff water was not different over the duration of either experiment.

In another experiment conducted under controlled environment conditions, the turfgrass was lightly misted with 1 1 of water 72 h after application of 2,4-D. Runoff water was collected from the surface of the sod 24 h after misting (96 h after herbicide application). When the results from this experiment were compared with those results from previous indoor experiments, significantly less 2,4-D was recovered in the runoff water from turfgrass that received a mist treatment. For example, in the misting experiment 2.0 + 0.7 mg of 2,4-D per flat was recovered % h after herbicide application, whereas when the turfgrass received no misting treatment 6.8 + 1.4 mg of 2,4-D per flat was recovered 120 h after 2,4-D application. These results are equivalent to 0.68 + 0.09 and 1.93 + 0.29 mg of 2,4-D per litre of runoff water recovered from turfgrass which had and had not been misted, respectively. Thompson et al. (1984) found less than 0.01% of the applied 2,4-D was dislodgable by wiping the sod with cheese-cloth one day after application if the turf received 18 mm of rainfall 1 h after spraying. Conversely, it took 7 days for the herbicide to dissipate to the same level when the turf received no rain. Taken together our results and those of Thompson et al. indicate that a light irrigation to incorporate 2,4-D 2 to 3 days after herbicide application may reduce the amount of 2,4-D that may be removed in subsequent runoff events.

Under controlled environment conditions it has been shown that 8% of the applied 2,4-D could be removed by wiping the turf with cheese-cloth 9 days after treatment (Thompson et al. 1984). However, in the same study it was found that 55% of the applied 2,4-D was still present on the surface of turf leaves 9 days after treatment. These results may explain why we recovered approximately 32% of the applied 2,4-D in the runoff water collected from sod grown indoors.

In our outdoor experiments, considerably less 2,4-D was recovered in the runoff water than in runoff water from indoor experiments. Thompson et al. (1984) found a similar relationship between the ratio of disappearance of dislodgable residues in outdoor versus indoor experiments. They postulated that the faster disappearance of 2,4-D in outdoor studies may have been due to greater rates of photodecomposition. However, recent outdoor studies with shaded versus unshaded field plots did not show a large difference in 2,4-D degradation.

In conclusion, these studies establish that runoff water can dislodge up to 10% of the 2,4-D two weeks after application to sod grown under outdoor conditions. Therefore, the magnitude of the 2,4-D residue potentially available in runoff water is a significant environmental concern for at least a few weeks after the herbicide is applied.

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EVALUATION OF SNOW MOLD SUPPRESSION POTENTIAL AMONG ISOLATES OF *TYPHULA PHACORRHIZA*

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Experiments conducted over the past four years have confirmed that isolates of *Typhula phacorrhiza* can be used to suppress the development of gray snow mo d-on creeping Bentgrass. An application rate of 200 g/m2 of grain inoculum of *T. phacorrhiza* provided > 85% disease suppression. Increasing the application rate from 50 to 400 g/ significantly reduced the time required for the turfgrass to recover to < 3% disease, but it did not significantly enhance initial disease suppression. In an attempt to lower the application rate required for effective control of gray snow mold, a study was initiated to select isolates of *T. phacorrhiza* that are more suppressive than the isolates used in previous studies.

METHODS

Thirty-five isolates of *T. phacorrhiza* (#3-37, see Table 1) were obtained from sclerotia recovered m corn ris in April, 1986. The disease suppression potential of the 35 new isolates, standard isolates of *T. phacorrhiza* (TO11 and TO16), and a fungicide (PCNB) were evaluated in a 19-x 4 m sward of creeping bentgrass cv. Penncross with a history of severe infection by *T. ishikariensis*.

Plots (0.5 x 0.5 m) were treated at a rate of 100 g/m^2 of grain infested with the isolates or treated with PCNB at 30 kg a.i./ha on 29 November 1986. Plots adjacent to each treatment area were left untreated to serve as controls. The RCBD had four replications.

Following 116 days of snow cover, the Horsfall-Barratt rating system was used to estimate disease intensity (% necrotic foliar per plot) at weekly intervals from 30 March to 01 June 1987.

RESULTS

Suppression of gray snow mold with isolates of *T. phacorrhiza* ranged from 0 to 88% (Table 2). Standard isolates of *T. phacorrhiza* (T011 and T016) had disease suppression values of 47 and 67%, -respectively. Seven of the new isolates had values = 80%. Twenty-three isolates resulted in disease suppression that was not significantly different from the suppression provided by PCNB.

Recovery of turfgrass to < 3% disease required 2.5 to 8 weeks after the initial disease rating on 30 March 1987 (Table 2). Plots treated with standard isolates of *T. phacorrhiza* (TO11 and T016) recovered in 5.2 and 3.5 weeks, respectively. Plots treated with eight of new isolates, and T016, recovered in < 4 weeks. Plots treated with PCNB recovered in less than one week, a value significantly lower than for any isolate tested.

Table 1. Source (type of corn debris) and location of isolates of *Typhula phacorrhiza* used as potential biocontrol agents for gray snow mold on creeping bentgrass.

Isolate	Corn Debris	Location (Ontario)
1 (TO11)		
2 (TO16)		
3	cob	Cambridge
4	stalk	Douglas
5	ear husk	Port Albert
6	ear husk	Osborne Corners
7	ear husk	Elfrida
8	ear husk	Arkell
9	leaf sheath	Brisbane
10	stalk	Sandhill
11	leaf sheath	Listowel
12	ear husk	Listowel
13	leaf	Cainsville
14	stalk	Elora
15	ear husk	Elora
16	leaf sheath	Strongville
17	stalk	Osborne Corners
18	stalk	Elora
19	leaf sheath	Cambridge
20	stalk	Elora
21	ear husk	Osborne Corners
22	ear husk	Terra Cotta
23	stalk	Port Hope
24	stalk	Norval
25	stalk	Brucedale
26	ear husk	Norval
27	leaf sheath	Elmvale
28	ear husk	Ospringe
29	ear husk	Mono Road
30	leaf sheath	Onondaga
31	stalk	Erin
32	stalk	Milton
33	ear husk	Brucedale
34	leaf sheath	Fowlers Corners
35	ear husk	Cambridge
36	stalk	Middleport
37	ear husk	Hornby

Table 2. Suppression of gray snow mold and weeks of turf recovery in plots of creeping bentgrass infested with isolates of *Typhula phacorrhiza*.

Isolate[1]	Disease Suppression (%)[2]	Recovery (weeks)[3]
1 (T011)	47 b	5.2 c
2 (T016)	67 c	3.5 b
3	80 c	3.0 b
4	4 a	7.2 c
5	81 c	4.8 c
6	65 c	5.0 c
7	81 c	3.5 b
8	73 c	5.0 c
9	21 a	7.5 c
10	0 a	6.8 c
11	88 c	2.5 b
12	48 b	6.0 c
13	40 b	6.2 c
14	76 c	3.8 b
15	8 a	8.0 c
16	69 c	5.5 c
17	16 a	7.0 c
18	7 a	7.2 c
19	69 c	5.5 c
20	69 c	6.0 c
21	76 c	3.5 b
22	82 c	3.2 b
23	39 b	6.2 c
24	83 c	3.5 b
25	53 c	4.5 b
26	71 c	4.8 c
27	69 c	3.8 b
28	60 c	5.2 c
29	44 b	6.0 c
30	83 c	4.8 c
31	77 c	4.0 b
32	58 c	6.2 c
33	6 a	7.0 c
34	46 b	6.2 c
35	38 b	5.8 c
36	70 c	5.0 c
37	66 c	5.5 c
PCNB	95 c	0.5 a

[1] Isolates of *T. phacorrhiza* applied as grain inoculum at 100 g/m^2 on 29 November 19W.

[2] Mean of four values calculated as a percentage of disease in adjacent, untreated plot in each block recorded on 30 March 1987.

[3] Mean of four values recorded as number of weeks for turfgrass to recover (< 3% disease) from initial disease rating on 30 March 1987. Values followed by same letter are not significantly different at P=0.05 according to cluster analysis.

CONCLUSIONS

1. Isolates of *T. phacorrhiza* differ significantly in their potential to suppress gray snow mold.
2. Debris type or location had no obvious influence on disease suppressiveness of isolates of *T. phacorrhiza*.
3. Isolates 3, 7, 11, 22, and 24 of *T. phacorrhiza* had disease suppression values > 80% and required < 4 weeks to recover.-

INFLUENCE OF LIQUID FORMULATIONS OF NITROGEN ON EPIDEMICS OF DOLLARSPOT DISEASE IN A MIXED-STAND OF CREEPING BENTGRASS AND ANNUAL BLUEGRASS

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The following study was initiated to determine if liquid sources of nitrogen could be utilized to provide acceptable control of dollarspot in a turfgrass environment similar to a golf course fairway. The disease suppression effects of five soluble sources of nitrogen were monitored over a period of two months on a mixed-stand of creeping bentgrass and annual bluegrass.

METHODS

Liquid treatments of ammonium chloride, ammonium sulfate, urea, ammonium nitrate, or potassium nitrate were applied to a mixed-stand of creeping bentgrass (80%) and annual bluegrass (20%) at rates of 2.5, 4.9 and 7.5 kg N/ha (2.2, 4.4 and 6.7 lbs N/acre) at 10-day intervals from 1 July to 28 August. The turfgrass was maintained at a 6 mm cutting height. The experimental design consisted of a randomized complete block with five replications. Fifteen treatments were included in each block. Each treatment plot measured 1 x 2 m. The turfgrass was inoculated with autoclaved rye grain infested with *Sclerotinia homeocarpa* on 18 June. Nitrogen treatments were applied in 7 1 of water per 100 m^2 with a wheel mounted compressed air boom sprayer at 138 kPa. Disease intensity was estimated at 2 day intervals, beginning 1 July using the Horsfall-Barratt rating scale. The influence of each treatment on epidemics of dollarspot was monitored by plotting disease intensity against time. Treatments were compared by evaluating the effect of each treatment on the area under a disease progress curve (AUDPC), and on the frequency of exceeding a disease threshold of 2.3%.

RESULTS

Dollarspot was suppressed by all sources of nitrogen tested. However, significant negative correlations between AUDPC and concentration of nitrogen were found only for ammonium chloride, ammonium sulfate and potassium nitrate (Table 1).

Table 1. Linear regression of area under disease progress curves for dollarspot epidemics versus concentration of liquid formulations of nitrogen applied to creeping bentgrass. 1986.

Treatment[x]	Regression coefficient	r^2
Ammonium chloride	-0.357*	0.39
Ammonium sulfate	-0.348**	0.50
Urea	-0.085	0.05
Ammonium nitrate	-0.118	0.10
Potassium nitrate	-0.347*	0.31

[x] Nitrogen sources applied at 2.5, 4.9 and 7.5 kg N/ha at 10-day intervals from 1 July to 31 August

*Slope significantly different from 0 at P=0.05

**Slope significantly different from 0 at P=0.01

Applications of ammonium chloride or ammonium sulfate at 7.5 kg N/ha (6.7 lbs. N/acre) at intervals of 10 days resulted in AUDPC's that were significantly (P=0.05) lower than the AUDPC's recorded in plots treated with urea, ammonium nitrate or potassium nitrate at equivalent rates of nitrogen (Table 2). During the course of the 59-day epidemic, the frequency at which a disease threshold of 2.3% was exceeded was significantly (P=0.05) lower in plots treated with ammonium chloride, ammonium sulfate or urea than in plots treated with ammonium nitrate or potassium nitrate.

Table 2. The effect of liquid formulations of nitrogen on epidemics of dollarspot disease. 1986.

Treatment	Rate (kg N/ha)[x]	AUDPC[y]	Frequency at which disease threshold was exceeded (%)[z]
Ammonium chloride	7.5	1.6 a*	3.8 a*
Ammonium sulfate	7.5	1.9 a	17.8 a
Urea	7.5	2. 5 b	17.8 a
Ammonium nitrate	7.5	2. 5 b	32.4 b
Potassium nitrate	7.5	2.6 b	32.4 b

[x] Applied at 10-day intervals from 1 July to 28 August

[y] AUDPC = Area Under the Disease Progress Curve

[z] Disease threshold = 2.3%

*Within a column, values followed by the some letter are not significantly different at P = 0.05 according to cluster analysis

No significant correlations were obtained when disease intensity (measured immediately prior to collection of foliar clippings) was regressed against total foliar nitrogen or when AUDPC was regressed against total foliar nitrogen.

CONCLUSIONS

1. Under southern Ontario conditions, applications of ammonium chloride or ammonium sulfate at 7.5 kg N/ha (6.7 lbs N/acre) at intervals of 10 days can provide acceptable control of dollarspot in mixed-stands of creeping bentgrass and annual bluegrass maintained under conditions similar to golf course fairways.

2. Suppression of dollarspot provided by ammonium chloride or ammonium sulfate is not related to the concentrations of total nitrogen in turfgrass plants.

BIOLOGICAL CONTROL OF DOLLARSPOT DISEASE OF CREEPING BENTGRASS (*Agrostis palustris*)

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Several mycelial fungi and one bacterium were tested for their ability to reduce epidemics of dollarspot on creeping bentgrass both in a greenhouse and on a putting green. In the field, disease progress was monitored during a one month period to assess the effects of antagonistinfested topdressings.

METHODS

Organisms isolated from turf were cultured on a sand-cornmeal mixture (2:1 v/v) or on mixed grain and applied.to turf as topdressings. Percentage of area diseased in experimental plots was visually estimated using the Horsfall-Barratt scale.

Greenhouse experiments: Creeping bentgrass was grown from seed in a fine vermiculite and cut at a height of 10 mm. Prior to inoculation turf was nutrient stressed. When two months old, turf was topdressed with 2 mm of *Sclerotinia homeocarpa* infested sand-cornmeal followed by 2 mm of sand-cornmeal colonized by a potential antagonist. Relative humidity was kept near 100% from 2100 to 0900 hrs and daily misting ensured that leaf-wetness periods exceeded 12 hrs. Daily temperature maxima varied from 30 to 35°C; minima from 20 to 24°C. Disease intensity was rated daily until disease ceased to increase 7 to 10 days after inoculation. A randomized complete block design with five replications was used. Means of areas under disease progress curves (audpc) were separated using analysis of variance and cluster analysis.

Field experiments: Topdressing treatments were applied to plots measuring 40 cm by 40 cm on a soil-based creeping bentgrass sward maintained according to prescriptions for golf course putting greens. Treatment plots were separated by untreated plots such that for each treatment plot there were four adjacent untreated check plots. All plots were separated by 10 cm borders. Treatments were completely randomized with six replications. The turfgrass was inoculated with sand-cornmeal infested with *Sclerotinia homeocarpa* on Aug. 5. All plots were given Horsfall-Barratt ratings every other day f rom the time disease was first apparent until Sept. 16 or 17. For each treatment, epidemic reduction percentages (epird) were calculated as follows:

$$\text{epird} = 100 - \frac{100\ (\text{audpc(treatment plot)})}{\text{mean (audpc (neighbouring untreated plots))}}$$

Treatments were compared by applying a Newman-Keuls-type multiple range test to mean ranks of epird. Infested sand-cornmeal topdressing were applied weekly from June 5 thru Sept. 11 at a rate of 0.4 l/m^2 (0.05 yd^3/1000 ft^2). In a separate experiment topdressings of infested grain (ground) were applied on Aug 23, Aug. 31, and Sept 10 at a rate of 160 g/m^2, (approx. 0.05 yd^3/1000 ft^2).

RESULTS

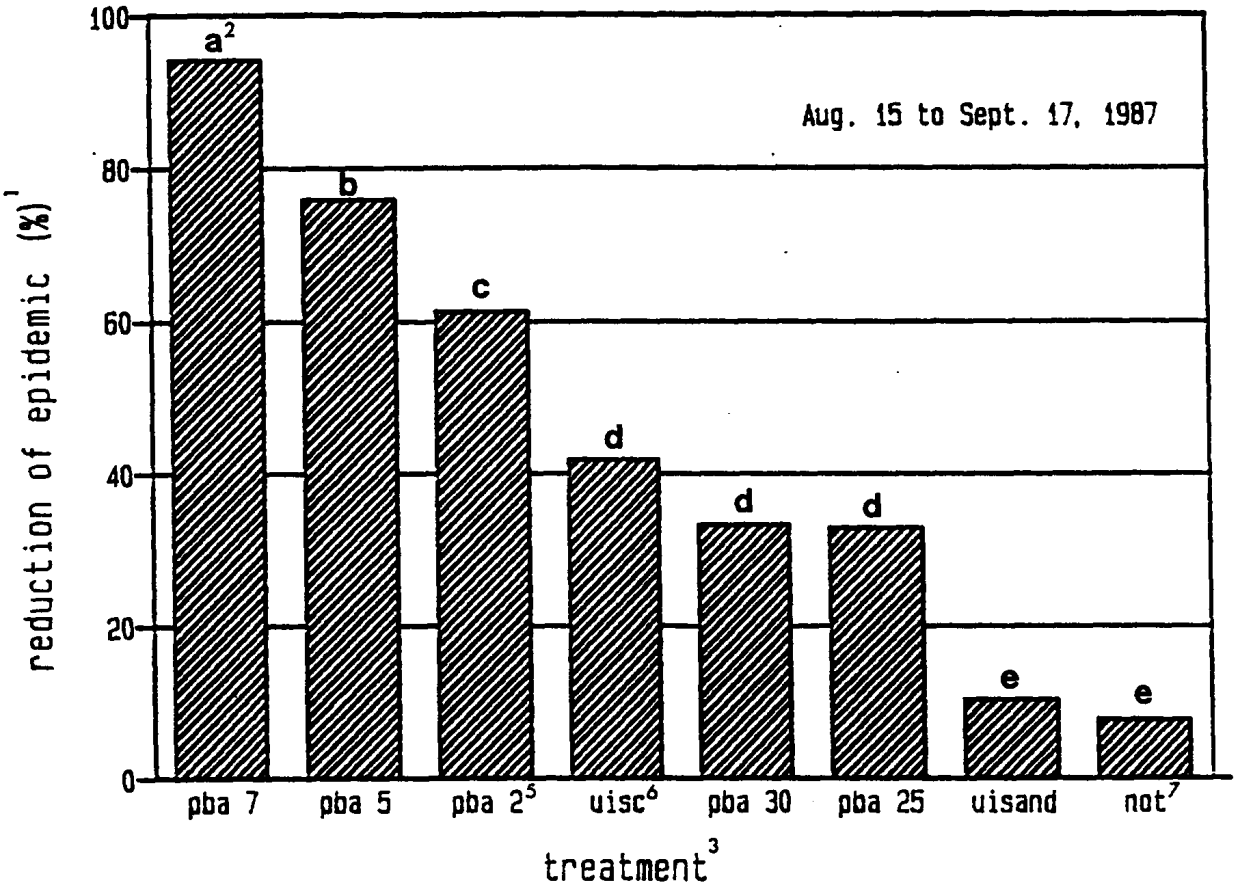
Seven of twenty-seven potential biocontrol agents (pba) tested in the greenhouse gave audpc values significantly (a=.05) lower than the uninfested sand treatment. The audpc for uninfested sand-cornmeal was greater than that for the pathogen alone. Epidemic reduction (100(1 - audpc (treatment) audpc (pathogen only))) ranged from 87% to -21%. Nine pba that showed a wide range of effectiveness in the greenhouse were tested in field experiments. Seven of these were more effective than uninfested topdressings in reducing epidemics in the field (Figures 1 and 2). Isolate pba 7 reduced field epidemics of dollarspot by 94% (Figure 1). Potential biocontrol agent 21 and pba 46 reduced field epidemics by 60% yet increased disease in the greenhouse (Figure 3). Nevertheless, field and greenhouse results were significantly correlated.

CONCLUSIONS

1. Fungal isolate pba 7 has the potential to provide excellent biological control of dollarspot on creeping bentgrass greens when applied in a topdressing formulation.

2. Evaluating the ability of potential biocontrol agents to reduce epidemics caused by *Sclerotinia homeocarpa* in the greenhouse is a valuable means of selecting isolates for field tests.

Figure 1. Reduction of dollarspot epidemic in the field using infested sand-cornmeal topdressings.



1 100 (1 - audpc (treatment plot) audpc (untreated plots)) where audpc = area under disease progress curve

2 Mean ranks of treatments labelled with the same letter do not differ significantly (a =.05) according to a Newman-Keuls –type multiple range test

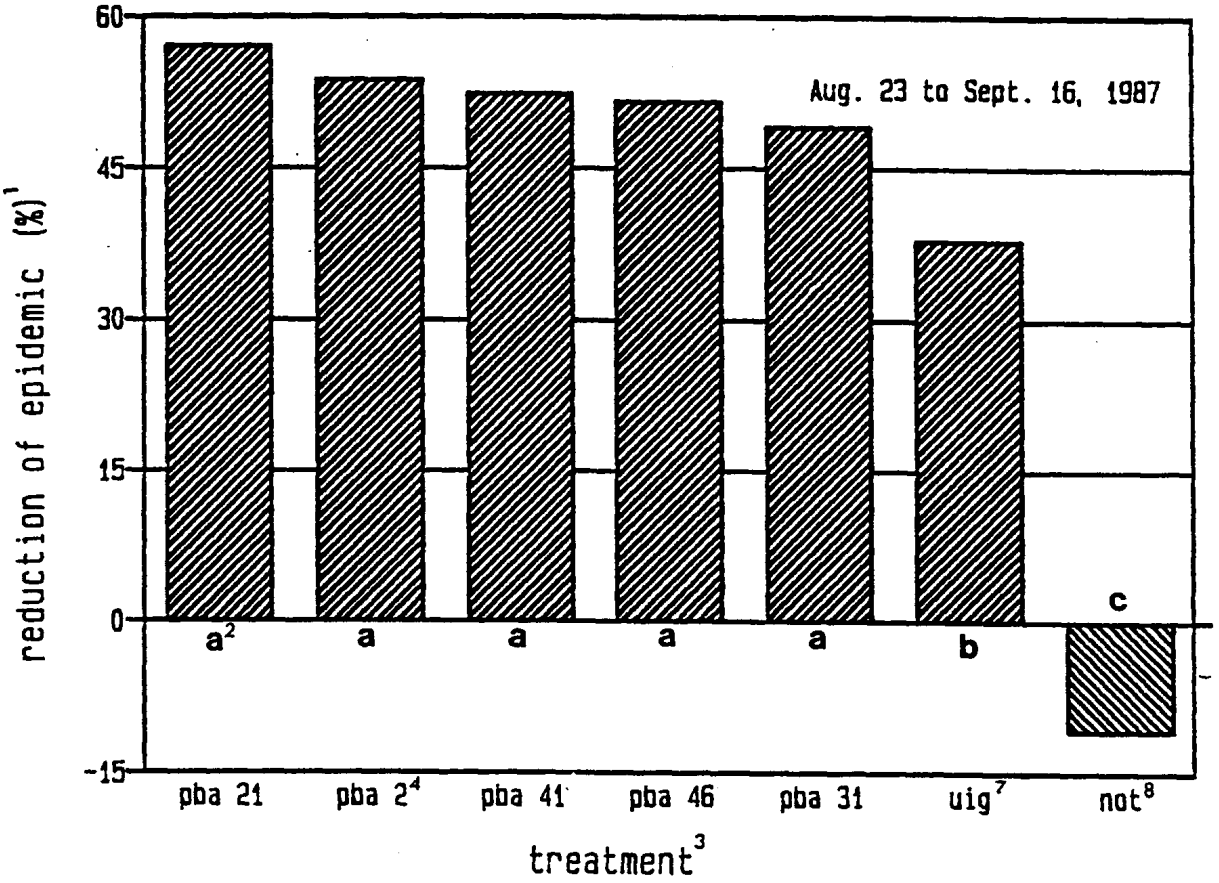
3 Infested topdressings applied weekly from June 5 to Sept. 11 at a rate of 0.4 $1/m^2$, (0.05 $yd^3/1000\ ft^2$)

5 A bacterium

6 Uninfested (autoclaved) sand-cornmeal

7 Untreated

Figure 2. Reduction of dollarspot epidemic in the field using infested grain topdressings.



1 100 (1 - audpc (treatment plot) audpc(untreated plots)) where audpc = area under disease progress curve

2 Mean ranks of treatments labelled with the same letter do not differ significantly (a =.05) according to a Newman-Keuls-type multiple range test

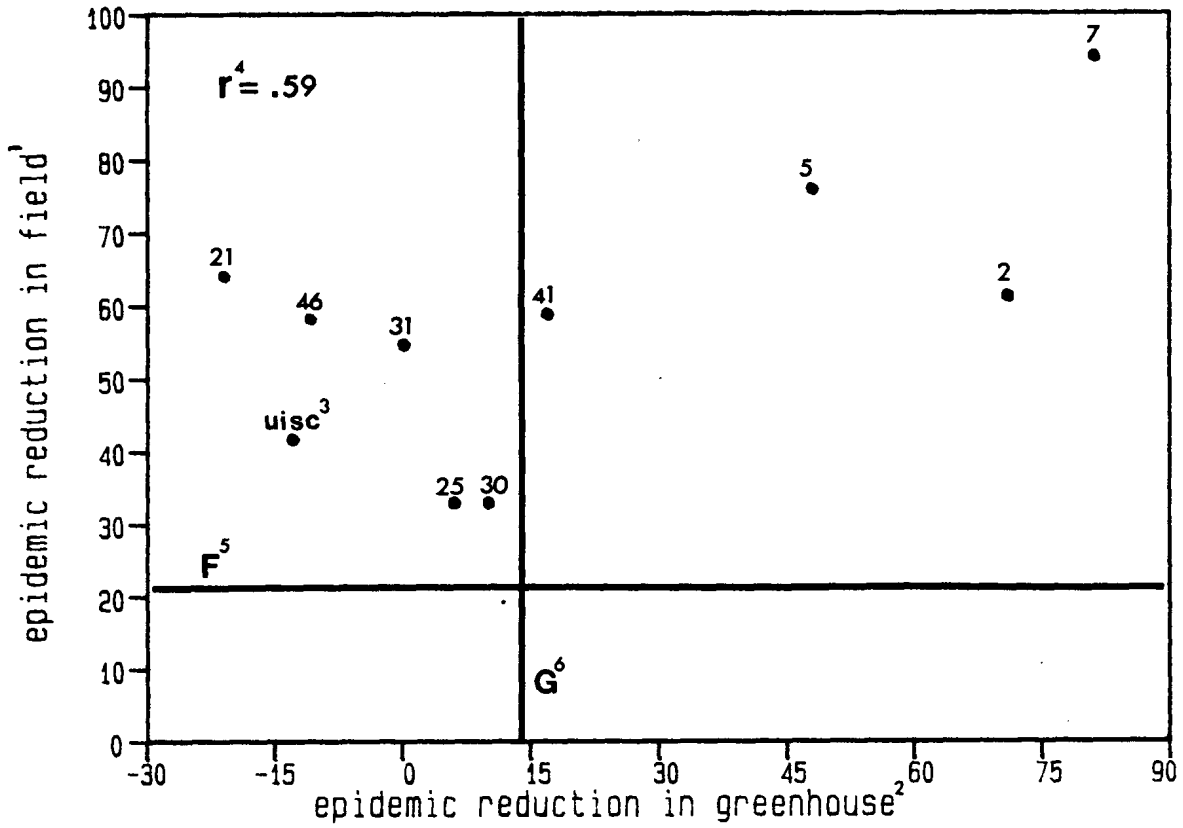
3 Infested topdressings applied Aug. 23, Aug. 31 and Sept. 10 at a rate of 160 g/m^2 (approx 0.05 $yd^3/1000\ ft^2$)

4 A bacterium

7 Uninfested (autoclaved) grain

8 Untreated

Figure 3. Correlation of epidemic reduction in greenhouse and field.



1 100 (1 - audpc (treatment plot) audpc (untreated plots)) where audpc = area under disease progress curve

2 100 (1 - audpc (treatment) audpc (untreated; ie, pathogen only))

3 Uninfested sand-cornmeal

4 Linear correlation coefficient; one-tailed prob. value = .025

5 Potential biocontrol agents above line F significantly reduced field epidemics compared to untreated plots (a =.05)

6 Potential biocontrol agents to the right of line G significantly reduced epidemics in the greenhouse compared to untreated units (a =.05)

N.B. Points are labelled with a potential biocontrol agent number: 7 = pba 7; 2 = a bacterium; 41 = pba 41; 46 = a binucleate Rhizoctonia; others are unidentified

Studies on storage products in stromata of *Sclerotinia homoeocarpa*: Light and electron microscopy and SDS-PAGE of developmental proteins

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Despite its importance as a causal agent of dollar of turfgrasses, *Sclerotinia homoeocarpa* Bennett is rather poorly known biologically. That it is not truly a member of the genus *Sclerotinia* has been known for some time (Jackson, 1974). Nevertheless, no satisfactory generic accommodation has been proposed and it is unclear whether what has been called S. homoeocarpa is one species or two, belonging in one genus or two (Kohn, 1979). Also, little is known about the histology of infection in the host plant.

Using light microscopy (LM) with histochemical staining and transmission electron microscopy (TEM) we examined two isolates of *S. homoeocarpa* as part of a larger comparative study of representatives of 14 of the 28 genera in the Sclerotiniaceae. Our objective was to develop new taxonomic characters based on somatic parts of the life cycle; to characterize each species and develop a framework for a classification based upon hyphal and/or stromatal and sclerotial features.

That a major developmental protein is present in sclerotia of *Sclerotinia sclerotiorum* and several other species in the Sclerotiniaceae as well as some Basidiomycetes has been well established (Russo et 21., 1982; Insell et al., 1985). We have established that development-specific proteins are also present in stromata of *S. homoeocarpa* and a species of *Lambertella*.

Comparison of soluble proteins appears to be a useful technique in comparing isolates of *S. homoeocarpa*-and will be helpful in determining whether we are dealing with one, two, or more species.

RESEARCH PROCEDURE

All isolates of *S. homoeocarpa* were isolated from *Agrostis palustris*. LMK 8, LMK 9, LMK 10, LMK 11 and LMK 78 were isolated either in Pennsylvania or in Cambridge, Ontario and were acquired from L. Burpee, Dept. of Environ. Biol., Univ. Guelph as S84, S38, S037, S001, and S9, respectively; LMK 37 was acquired from the American Type Culture Collection as ATCC 56039 (submitted to ATCC by A. R. Deitweiler).

Microscopy and Histochemistry:

Isolates LMK 8 and LMK 10 were grown for 6 wk on DIFCO Potato Dextrose Agar (PDA) in the dark at ambient temperature. At least 3 portions of stroma were sampled from two different transfers of each isolate. Samples were cut into pieces in a 0.07 potassium phosphate buffer pH 6.8, then fixed overnight in 4% glutaraldehyde in buffer.

For electron microscopy, after fixation samples were washed in buffer 4 times at 20 min intervals, followed by post-fixation in 1% osmium tetroxide in buffer for 2 h, then washed 4 times in distilled water at 20 min intervals. Samples were dehydrated in a graded series of acetone before adding resin. Spurr's low viscosity resin was added in drop-wise fashion over two days until the volume of resin equalled the volume of acetone. The samples were gently shaken in the resin-acetone mixture

for three days, then the acetone was allowed to evaporate. Tissues were placed in freshly prepared Spurr's resin and allowed to sit overnight at room temperature before polymerization at 60°C for 12 to 24 h. Sold sections were stained with uranyl acetate followed by lead citrate prior to examination.

For light microscopy, both samples embedded in Spurr's resin (as previously described) and in glycol methacrylate (GMA) were examined. Samples were prepared for embedding in GMA, after the same fixation and washing procedure as for Spurr's resin. Samples were then dehydrated over several days in two changes each of the following: methyl cellusolve, 100% ethanol, 100% n-propanol, 100% n-butanol. Samples were then placed in a 50:50 mixture of 100% n-butanol and GMA for 7 da, followed by 14 da in pure GMA. Samples were then placed in fresh GMA and polymerized for 3 h under UV lights in a chamber flushed with high purity nitrogen. For both Spurr's resin-, and GMA-embedded samples, sections 0.5 to 1.5 µm thick were allowed to dry onto slides coated with a thin layer of gelatin prior to staining.

For histochemistry, sections were stained by the following methods. Lipid determination was with Sudan Black B (Bronner, 1973). Fresh stromata were sectioned on a freezing microtome in 50% aq mucilage which, upon drying, affixed the sections on a microscope slide. A lipid extraction in 1:1 methanol and chloroform for 20 min prior to staining was used as a control. Polysaccharide determination was with periodic acid-Schiff's reagent (PAS) (Feder and O'Brien, 1966) and sections embedded in GMA. Omitting the periodic acid step in the staining procedure

was the control (Gahan, 1984). A digestion in amylase (human saliva) for 2 h was used to remove glycogen as another control prior to staining. Protein determination was with Amido Black 10B (Fisher, 1968) or Acid Fuchsin (Kohn and Grenville, in ms.) and sections embedded in GMA. A 2 h protein digestion in papain or pepsin was used prior to staining as a control. We also found counterstaining, first with Amido Black, then with PAS, to be a useful technique. Melanin determination was with Toluidine Blue 0 in Benzoate buffer at pH 4.4 (Sidman *et al*., 1961) or Vanillin (Ling-Lee *et al*., 1977). Both stains were used with sections embedded in GMA.

Protein Extraction:

Protein was extracted from six isolates as listed previously. Cultures were grown in standing liquid culture in potato dextrose liquid medium (PDM) whith was PDA prepared without agar and on a defined liquid medium (Newstead *et al*., 1985), in the dark at ambient temperature. Mycelium was harvested by filtration after 2 wk. Stromata were allowed to develop for 5 wk before they were harvested with forceps. Protein was immediately extracted from mycelia but stromata were first surface sterilized in 2% (v/v) sodium hypochlorite for 5-10 min and allowed to dry at room temperature for one week prior to protein extraction. Protein extraction combined and modified (Novak & Kohn, in ms.) the methods of Newsted *et al*. (1985) and Russo & Van Etten (1985). Total protein was determined by the method of Lowry (1951). Proteins were stored at -20°C.

Electrophoretic Analysis:

One-dimensional SDS-polyacrylamide gel electrophoresis (SDS-PAGE) was carried out using the methods and buffers of Laemmeli (1970). Samples of 20 µl were loaded into gel slots along with low molecular weight standards (Biorad) without boiling. Electrophoresis was carried out at room temperature for 6 h at constant voltage (120-150 volts). Gels were stained in 0.125% (w/v) brilliant blue R-250, 50% methanol, and 10% acetic acid for 12 h, then destained. Molecular weights of proteins were determined graphically before the gels were dried down.

RESULTS

Macroscopically, *S. homoeocarpa* produces sheet-like stromata first on the upper surface of the solid medium and ultimately on any plane in or on the medium, often resulting in concentric stromatic zones when viewed through the underside of the petri dish.

Microscopically, *S. homoeocarpa* produces a 1-celled rind of brick-shaped to globose cells, 1.5-2.5(-4.5) µm in diam, with only the outermost walls on the stromatal surface thickened and heavily melanized. Stromata on the surface of the medium have a cortical zone beneath the rind, distinguished by some gelatinous matrix between cells which contains melanin granules; inner stromata lack a distinguishable cortical zone. The inner zone, the medulla, is composed of loosely arranged, widely spaced, thin-walled hyphae, 1-3 µm wide. No gelatinous matrix was observed to bind medullary cells together.

While LM with histochemical staining showed the rind cells to be devoid of storage products other than some diffusely organized

protein, TEM revealed rind cells to contain storage vacuoles, one or two nuclei, single or stacked ER and several mitochondria. Medullary cells showed a fascinating level of cellular organization confirmed by both LM with histochemical staining and TEM. Most medullary cells contained a central cluster of mitochondria surrounded by a ring of ER, with protein and lipid bodies interspersed around the periphery of the cytoplasm. Polysaccharides were observed mainly in cell walls; not much carbohydrate appeared to be stored as glycogen in the cytoplasm. Cytoplasm in rind, cortical, and medullary cells did stain diffusely for protein, however, in addition to the protein bodies observed in medullary cells.

Two development-specific proteins were observed in one-dimensional SDS-PAGE of total protein of stromata of six isolates of *S. homoeocarpa*; a major protein of 36.5 and a minor protein of 15 kda (when 50-75 µg/µl of protein was loaded in gel slots, rather than 0.5-1.0 µg/µl) were present. In isolates LMK 10, LMK 37, and LMK 78 an additional band of 34.5 kda was observed from stromatal extractions.

CONCLUSIONS

1) Anatomically, the stroma of *S. homoeocarpa* is of the substratal stromatal type produced by such genera as *Lanzia*, *Rutstroemia* (= *Poculum*), and *Lambertella*, and is quite different from the sclerotial type produced by *Sclerotinia*.
2) Based an LM with histochemistry and TEM, the storage potential in *S. homoeocarpa* is in the medullary hyphae; rind cells

are alive (with cytoplasm and organelles) and protected by a thickened melanized outer wall, but have fewer storage vacuoles.

3) The high level of cellular organization in medullary cells suggests that they are capable of rapid growth. We did not observe this kind of organization in any other genus that we examined in the Sclerotiniaceae. *S. homoeocarpa* appears to have diverged from other substratal stromatal species in an adaptation for rapid and abundant mycelial growth.

4) Protein is the major cytoplasmic storage product in stromata of *S. homoeocarpa*; it is mainly sequestered in protein bodies in medullary cells.

5) Development-specifc proteins have been identified in stromata of *S. homoeocarpa* and in another substratal stromatal genus, *Lambertella*. In one-dimensional SDS-PAGE, two bands were observed in extracts from all six of the isolates examined; a third band was observed from 3 isolates. The molecular weight of the larger, major protein (36.5 kda) was in the range expected for members of the Sclerotiniaceae (31-36 kda).

Continuing projects in our laboratory include: a) LM, histochemical and TEM studies of lesions produced by, and stromata of *S. homoeocarpa* as they develop in the field over the season..

With the cooperation of L.L. Burpee, we have been working with a plot of Kentucky Bluegrass inoculated with LMK 8. b) Immunological studies with the development-specific proteins from stromata and sclerotia of members of the Sclerotiniaceae including *S. homoeocarpa*. c) Taxonomic studies, including in vitro production of the sexual state and electrophoretic comparisons of proteins to discover the correct generic accommodation for *S. homoeocarpa*.

We are seeking isolates of *S. homoeocarpa* from as wide a range of hosts and localities as possible. Please contact L. M. Kohn who will arrange for necessary importation permits.

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CHEMICAL CONTROL OF DOLLARSPOT ON CREEPING BENTGRASS

L.L. Burpee and L.G. Goulty

Department of Environmental Biology

The following study was designed as an evaluation of several registered and unregistered fungicides for control of dollarspot disease of creeping bentgrass.

METHODS

Treatment were applied to a 10-year-old sward of creeping bentgrass. The turfgrass was maintained at a 5 mm cutting height. Cultural practices were similar to those used in maintenance of golf course putting greens in Ontario. The experimental design consisted of a randomized complete block design with four replicates. Twenty-one treatments and an untreated control were included in each block. Each treatment plot measured 1 x 2 m. The turfgrass was inoculated with autoclaved rye grain infested with an isolate of Sclerotinia homeocarpa on 4 July. Fungicides were applied at 7, 14, or 21 d intervals, beginning 7 July, in 7 1 of water per 100 m^2 with a wheel mounted compressed air boom sprayer at 138 kPa. Disease intensity was estimated at 7 d intervals, beginning 14 July, using the Horsfall-Barratt rating scale.

RESULTS

All treatments, except Moncut applied at 5 and 10 g a.i./100 m^2, provided significant control of dollarspot (Table 1).

Table 1. Influence of fungicides on dollarspot disease of creeping bentgrass. 1987.

TREATMENT	RATE (g a.i./100 m^2)	APPLICATION INTERVAL (DAYS)	PERCENT DISEASE	DURATION OF CONTROL (DAYS)
DACONIL	24.0	7	0.0*	7
DACONIL	48.0	7	0.0*	7
ROVRAL GREEN	15.0	14	2.3*	7-14
ROVRAL 50WP	15.0	14	2.3*	7-14
NUSTAR	2.0	14	0.0*	14
NUSTAR	4.0	14	0.0*	14
NUSTAR	6.0	14	0.0*	14
MONCUT	5.0	14	54.7	0
MONCUT	10.0	14	56.3	0
MONCUT.	15.0	14	35.0*	0
ANVIL	0.5	14	5.9*	7-14
ANVIL	1.0	14	0.6*	7-14
ANVIL	1.5	14	0.0*	14
ANVIL	2.0	14	0.6*	7-14
DACONIL	24.0	14	11.1*	7
DACONIL	48.0	14	2.3*	7-14
ACR 3675	1.0	21	6.4*	14-21
ACR 3675	2.0	21	3.5*	14-21
ACR 3675	4.0	21	1 .8*	14-21
ROVRAL GREEN	23.0	21	9.4*	14-21
ROVRAL 50WP	23.0	21	4.7*	14-21
UNTREATED CONTROL			56.3	0

* significantly different from control at P = 0.05

CHEMICAL CONTROL OF PINK SNOW AND GREY SNOW MOLD ON CREEPING BENTGRASS

L. L. Burpee and L.G. Goulty

Department of Environmental Biology

The following study was designed to evaluate the potential of several experimental fungicides to suppress pink and grey snow mold on creeping bentgrass. Scotts LDP (quintozene) applied at 300 g a.i./100 m2 was used as a standard.

METHODS

Treatments were applied to a 10-year-old sward of creeping bentgrass. Cultural practices were similar to those used in-maintenance of golf course putting greens in Ontario. The experimental design consisted of a randomized complete block design with four replicates. Each treatment plot measured 1 x 2 m. Wettable powder and flowable formulations were applied in 7 1 of water per 100 m^2 with a wheel-mounted compressed air boom sprayer at 138 kPa. A scotts drop spreader was used to apply SCOTTS LAWN DISEASE PREVENTER. Treatments were applied on 28 November 1986. Turfgrass was inoculated with antoclaved rye grain infested with *Microdochium nivale* and *Typhula iskikariensis* on 29 November. Disease intensity was estimated on 30 March 1987. Location: Cambridge, Ontario.

RESULTS

All treatments provided significant control of grey snow mold. All treatments, except Bayleton at 15 and 30 g a.i./100 m^2 and Moncut at 5 and 10 g a.i./100 m^2, provided significant control of pink snow mold. A disease suppression > 95% is considered acceptable for fine turf.

Table 1. Suppression of grey and pink snow mold by fungicides on creeping bentgrass. 1987.

TREATMENT	RATE (g a.i./100 m2)	Disease Suppression (%)	
		Grey Snow Mold	Pink Snow Mold
BANNER	15	97.3*	87.7*
BANNER	30	99.0*	94.5*
BANNER	60	100.0*	98.8*
BANNER	120	100.0*	100.00*
ANVIL	20	99.0*	95.8*
ANVIL	30	99.0*	95.1*
ROVRAL GREEN	60	97.3	98.8*
ROVRAL GREEN	120	99.0*	96.3*
XE 779	20	98.0*	87.2*
XE 779	30	100.0*	82.7*
UBI 2382	450	98.0*	61.8*
SCOTTS LDP	300	99.0*	100.0*
BAYLETON	15	68.2*	30.4
BAYLETON	30	94.2*	34.8
BAYLETON	60	91 .5*	61.5*
BAYLETON	120	98.0*	73.6*
MONCUT	5	58.2*	32.9
MONCUT	10	92.3*	39.2
UNTREATED CONTROL		0.0	0.0

+Product/100 m^2

*Significantly different from control at P = 0.05. Values that are underlined depict acceptable control (.1 95% disease suppression) of both grey and pink snow mold

EVALUATIONS OF PERENNIAL RYEGRASS CULTIVARS

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Department of Horticultural Science

Perennial ryegrass cultivars established in 1984 at the Cambridge Research Station continue to be evaluated.

RESEARCH PROCEDURE

Seventeen cultivars of perennial ryegrass were seeded (2 kg /100 m^2) in 1 x 40 m plots on 1 August, 1984 at the Cambridge Research Station. Plots were randomized and replicated. Evaluations in 1987 included color, general appearance, leaf shredding from mowing, and annual bluegrass invasion.

RESULTS

Significant differences are apparent among the cultivars in color, general appearance, leaf shredding, and annual bluegrass infestation (Tables 1 and 2). The order of rank of cultivars in general appearance is approximately the same as in previous evaluations of the same plots.

Table 1. Evaluations of perennial ryegrass cultivars.

Cultivar	Color[z]	Cultivar	General appearance[y]
Ranger	9.0 a	Yorktown II	9.1 a
Prelude	8.9 ab	Palmer	8.8 ab
Palmer	8.8 ab	Ranger	8.7 abc
Yorktown II	8.6 abc	Prelude	8.2 abcd
Hunter	8.5 abcd	Fiesta	8.0 bcd
Blazer	8.5 abcd	Barry	7.9 bcd
Barry	8.5 abcd	Blazer	7.9 bcd
Gambit	8.4 abcd	Diplomat	7.8 bcd
Fiesta	8.2 abcde	Cowboy	7.6 cde
Cowboy	8.1 bcdef	Arno	7.5 de
Omega	7.9 cdef	Omega	7.5 de
Diplomat	7.8 cdef	Manhattan	7.3 de
Bison	7.6 def	Hunter	6.7 ef
Norlea	7.5 ef	Ensilo	5.8 fg
Arno	7.3 f	Norlea	5.7 g
Manhattan	7.3 f	Bison	4.8 gh
Ensilo	5.3 g	Gambit	4.8 gh

[z]Visual evaluation: scale 0 to 10, 10 = darkest green, b = acceptable color. Mean value for 4 dates (23-07, 29-07, 30-09, 14-10).

[y]Visual evaluation: scale 0 to 10, 10 = best, 5 acceptable. Mean value for 6 dates (2-06, 23-07, 17-08, 9-09, 30-09, 14-10).

Table 2. Evaluations of perennial ryegrass cultivars.

Cultivar	Leaf shredding[z]	Cultivar	*Poa annua* infestation[y]
Prelude	1.5 c	Yorktown II	16.4 d
Blazer	1.8 bc	Arno	16.9 d
Fiesta	1.8 bc	Hunter	17.4 d
Omega	2.0 bc	Ranger	17.6 d
Diplomat	2.0 bc	Palmer	17.6 d
Norlea	2.0 bc	Barry	20.3 d
Manhattan	2.0 bc	Manhattan	23.9 cd
Palmer	2.2 bc	Diplomat	24.2 cd
Yorktown II	2.3 bc	Cowboy	24.5 cd
Gambit	2.3 bc	Prelude	25.0 cd
Cowboy	2.3 bc	Fiesta	25.0 cd
Ranger	2.5 bc	Blazer	27.5 cd
Hunter	2.5 bc	Omega	28.0 cd
Barry	2.5 bc	Ensilo	34.9 bc
Bison	2.8 b	Bison	45.6 a
Arno	2.8 b	Gambit	47.2 a
Ensilo	5.0 a	Norlea	49.7 a

[z]Visual evaluation: scale 0 to 5, 0 = no shredding, 5 = worst. Mean value for 2 dates (23-07, 30-07).

[y]Visual evaluation: percent infestation. Mean value for 2 dates (2-06, 12-06).

EVALUATIONS OF FESCUE CULTIVARS

J. L. Eggens, N. E. McCollum, and K. Carey

Department of Horticultural Science

Fineleaf and tall fescue cultivars established in 1986 at the Cambridge Research Station continue to be evaluated.

RESEARCH PROCEDURE

Nine chewings fescue, three hard fescue, three creeping red fescue, and seven tall fescue cultivars were seeded in 1 x 32 m plots on 15 May, 1986 at the Cambridge Research Station. Plots were randomized and replicated. Evaluations in 1987 included color and general appearance.

RESULTS

There were significant differences among the cultivars, both for color and for general appearance (Tables 1 and 2). Ta11 fescue cultivars tended to rank high in general appearance because of their density and uniformity, but low in color.

Table 1. Evaluations of fescue cultivars: general appearance.

Cultivar	Type[z]	General appearance[y]
Mustang	t	8.5 ab
Rebel II	t	8.1 abc
Epsom	c	7.9 bc
Rebel	t	7.8 bcd
Atlanta	c	7.6 bcde
Scarlet	c	7.4 bcde
Victory	c	7.4 bcde
Peremid	t	7.2 cdef
Center	c	7.1 cdef
Jamestown	c	7.1 cdef
Wilma	c	6.9 cdefg
Clemfine	t	6.6 defgh
Banner	c	6.4 efghi
Luster	c	0.1 fghij
Kentucky 31	t	6.1 fghij
BiIjart	h	5.7 ghij
Spartan	h	5.7 hij
Scaldis	h	5.5 hij
Common Creeper	r	5.2 ij
Azay		5.2 ij
Fortress	r	5.1 i

[y]Visual evaluation: scale 0 to 10, 10 = best, 5 acceptable. Mean value for 5 dates (10-08, 17-08, 9-09, 30-09, 14-10).

[z]Types: t = tall fescue, c = chewings fescue, r = creeping red fescue, h = hard fescue.

Table 2 Evaluations of fescue cultivars: color

Cu1tivar	Type[z]	Color[y]
Scaldis	h	10.0 a
Spartan	h	10.0 a
Wilma	c	9.2 ab
Jamestown	c	9.2 ab
Biljart	h	9.0 bc
Luster	c	9.0 bc
Banner	c	8.9 bcd
Scarlet	c	8.8 bcd
Fortress	r	8.7 bcde
Victory	c	8.7 bcde
Peremid	t	8.5 bcde
Center	c	8.3 bcdef
Azay		8.2 cdef
Atlanta	c	8.0 def
Common Creeper	r	7.8 efg
Rebel II	t	7.5 fgh
Mustang	t	7.5 fgh
Rebel	t	7.0 ghi
Epsom	c	6.8 i
Kentucky 31	t	6.5 i
Clemfine	t	6.5 i

[y]Visual evaluation: scale 0 to 10, 10 = darkest green, 5 = acceptable color Mean value for 2 dates (30-09, 14-10)

[z]Types: t = tall fescue, C = Chewings fescue, r = creeping red fescue, h = hard fescue

EVALUATIONS OF KENTUCKY BLUEGRASS CULTIVARS

J. L. Eggens, N. E. McCollum, and K. Carey

Department of Horticultural Science

Kentucky bluegrass cultivars established in 1987 at the Cambridge Research Station continue to be evaluated.

RESEARCH PROCEDURE

Twenty Kentucky bluegrass cultivars were seeded in 1 x 32 m plots on 10 June, 1986 at the Cambridge Research Station. Plots were randomized and replicated. Evaluations in 1987 included color and general appearance.

RESULTS

There were significant differences among the cultivars, both for general appearance and for color (Table 1)

Table 1. Evaluations of Kentucky bluegrass cultivars.

Cultivar	General appearance[z]	Cultivar	Color[y]
Barblue	8.5 a	Midnight	9.8 a
Ram I	8.3 a	Alpine	9.0 ab
Midnight	8.3 a	Nugget	8.8 ab
Baron	8.2 a	Ram 1	8.8 ab
America	8.0 ab	Majestic	8.7 abc
Sydsport	8.0 ab	Nassau	8.5 abc
Nallo	8.0 ab	Baron	8.5 abc
Banff	8.0 ab	Haga	8.2 bcd
Haga	8.0 ab	America	8.2 bcd
Cheri	8.0 ab	Gnome	8.0 bcd
Touchdown	7.8 abc	Cheri	8.0 bcd
Julia	7.8 abc	Barb1ue	8.0 bcd
Nugget	7.8 abc	Fylking	7.7 bcde
Gnome	7.7 abc	Julia	7.7 bcde
Bronco	7.7 abc	Nallo	7.7 bcde
Fylkiny	7.5 abc	Sydsport	7.7 bcde
A-34	7.5 abc	Touchdown	7.3 cde
Alpine	7.0 bc	Banff	7.0 de
Nassau	7.0 bc	A-34	6.8 de
Majestic	6.8 c	Bronco	6.3 e

[y]Visual evaluation: scale 0 to 10, 10 = darkest green, 5 = acceptable color. Mean value for 3 dates (9-09, 30-09, 14-10)

[z]Visual evaluation: scale 0 to 10, 10 =. best, 5 acceptable. Mean value for 3 dates (14-08, 9-09, 30-09).

RESULTS FROM 1987 INDUSTRY INFORMATION SURVEY

Annette Anderson, Turf Extension Specialist, OMAF

An information survey was distributed to golf courses, lawn care operators, sod growers, sports turf managers, students and others involved in turf management. The purpose of the survey was to obtain feedback from the commercial turf industry on areas concerning pesticides, pest problems, fertility and management practices. Participants were asked to rate these topics according to their relative interest or priority. Approximately 650 surveys were distributed producing a 30% response rate. The following table summarizes the results of the survey.

1987 INFORMATION SURVEY

Topic	Not Important	Somewhat Important	Moderately Important	Important	Very Important
PESTICIDES					
Safety	3.60%	8.76%	17.0%	21.13%	49.58%
Application	3.63	3.63	19.69	35.75	37.3
Calibration	4.23	8.47	21.69	20.10	45.50
Training	2.63	8.42	13.10	29.47	46.32
DISEASE, INSECT, WEED & OTHER PESTS					
Weed I.D.	5.85.	7.98	27.13	23.40	36.70
Weed Life Cycles	6.29	8.00	26.86	25.71	33.14
Insect I.D.	3.19	5.85	21.81	23.94	45.21
Insect Life Cycles	3.86	4.41	17.13	24.86	49.72
Disease I.D.	2.12	5.82	12.70	22.75	56.61
Disease Life Cycles	5.05	3.37	15.73	21.90	53.90

SOIL FERTILITY					
Soil Physical Properties	3.10	9.74	35.38	35.38	16.41
Soil & Tissue Testing & Interpreting Results	2.75	14.84	34.60	29.12	24.17
Fertilizers	8.51	15.95	32.44	27.66	14.89
pH, Lime & Sulfur	6.30	10.60	35.10	27.66	20.21
Fertilizer Appl. & developing a fertility program	5.88	3.74	22.46	32.62	35.29
Micronutrients	4.60	10.92	41.95	31.03	11.49
Calibration & Calculations	5.35	11.23	28.34	29.94	25.13
TURF MANAGEMENT					
Turfyrass species & varieties	1.75	3.50	22.22	39.77	32.75
Drainage	2.23	10.06	31.28	35.20	21.23
Water, Irrigation, Weather	3.39	7.90	32.76	35.03	20.90
Sands & Rootzones	6.11	9.44	35.00	30.00	19.44
Wetting Agents	12.77	17.22	36.11	18.88	15.00
Irrigation/ Water Quality	4.79	15.55	32.33	29.94	17.37
Equipment	10.64	10.11	30.32	28.72	20.21

Overseeding	3.87	6.07	24.86	39.23	25.97
Seeding/ Sodding	4.02	6.90	32.18	33.90	22.99
Aeration/ Coring	4.62	5.78	23.70	41.04	24.86
Landscaping	7.43	5.71	16.57	34.26	36.00

General Comments

By looking at the percentages in the "very important" category, some general comments can be made on areas where information is of highest concern.

Topics pertaining to Pesticides and Pest problems received significant ranking. Within these categories Pesticide Safety (49.58%) and Disease Identification and Life Cycles (55.25 avg/) were identified as notable topics.

Under Soil Fertility, Fertilizer Application/Developing Fertilizer Programs ranked the highest with (35.29%). Interpreting Soil and Tissue Test Results and Calculations and Calibrations were tabulated at 24.71% and 25.13% respectively.

Percentage distribution within the cultural management category was evenly rated by the group, with the majority of respondents rating this area as moderately to very important.

Some areas within this category that stand out include Turfgrass Species and Varieties (32.75%), Overseeding (25.97%), and Aeration/Coring (24.86%). Landscaping/Ornamentals rated the highest, with 36%.

Information and trends noted in this survey will serve as a guideline for extension information in the future.

1987 TURFGRASS EXTENSION REPORT

Annette Anderson, Turf Extension Specialist, OMAF

1987 was the first year extension services were made available to the turf9rass industry by the Ontario Ministry of Agriculture and Food.

What exactly does a Turfgrass Extension Specialist do? This was a very frequent question this season! My function is to provide information and advice on the production and management of turfgrass to those persons in Ontario involved in the golf course industry, lawn care industry, sod producers, municipal parks and recreation departments, cemeteries and others in the commercial turf industry.

Relaying information to the industry is achieved through individual consultations, newsletters, magazine articles, field days, meetings and conferences. Working closely with industry associations such as the Ontario Turf Research Foundation, the Canadian Golf Superintendent's Association, Nursery Sod Growers Association, Landscape Ontario and The Sports Turf Association assists in keeping up to date with industry activities and areas where extension efforts may be needed.

Cooperation with research personnel in Ontario and elsewhere contributes to being aware of the trials being conducted and possible practical applications of this research for the hands-on turf manager. In turn extension information may provide researchers with insight into problems encountered by turf managers and possible areas where future research may be needed.

There are several diagnostic and analytical services available through OMAF to assist turf managers. I can assist with interpretations of these results as required.

SERVICE	LOCATION
1. Soil Testing o no charge for basic test (N, P. K, Mg, pH); optional tests available o Fee for home and garden samples	AGRI-FOOD LABS Unit 1 503 Imperial Road Guelph, Ontario N1H 6T9 (519) 837 -1600
2. Foliar (Tissue) Testing o fee based on elements tested	AGRI-FOOD LABS
3. Water Testing o fee based on elements tested	AGRI-FOOD LABS
4. Pesticide Residue Testing o e.g. atrazine residues	Provincial Pesticide Laboratory Agricultural Lab Services OMAF Building 43, McGilvray St. c/o University of Guelph Guelph, Ontario N1G 2WI (519) 824-4120 ext. 4825
5. Pest Diagnostic Clinic o fee o disease diagnosis o weed/insect/grass I.D.	University of Guelph Ont. Agriculture College Dept. of Environmental Biology Pest Diagnostic & Advisory Clinic Guelph, Ontario N1G 2W1 (519) 824-4120 ext. 2700
6. Sand Analysis (particle size) o fee	University of Guelph Dept. of Land Resource Science Guelph, Ontario N1G 2W1 (519) 824-4120 ext. 2494

Problems encountered by turf managers in 1937 were mainly caused by unusual weather conditions throughout the entire season.

Winter injury including ice damage and variable snow mold control occurred on many courses. Renovation in the spring was complicated by poor overseeding conditions and a shortage of bentgrass seed.

Weed control was a big concern for the lawn care industry. Poor spraying conditions and drought in the spring, resulted in reduced broadleaf weed control. Crabgrass control was a tremendous problem mainly due to timing of application and warm weather conditions that reduced the residual of the control products.

Sod growers experienced poor germination conditions in mid-summer resulting in uneven seedings and above average annual weed problems.

Insect problems were significant this year with grub type insects and chinch bug topping the list. Detection and control was difficult due to drought conditions and insect life cycles being approximately 2 weeks ahead of a normal year's development, making timing complicated.